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Tilling the Soil

FOR

Profit and Pleasure

.. BY ..

Successful Southern Tillers

A Compendium of Agricultural Science and Practice
on Field, Orchard, and Garden Crops, Spraying,
Soils, the Feeding and Diseases of Farm
Animals, Dairy Farming and Poultry
in the Southern States.

.. By ..

JAMES CLYDE ADAMS, S. B.

Illustrated.

The Austell Publishing Co., Atlanta, Ga.

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1908

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PREFACE

We have no apologies to offer for bringing out this book. Having been raised on the farm; lived in several of the Southern States, and traveled in all of them, we believe that we are in a position to know the wants and needs of the farmers.

The South is the Garden Spot of America. If men will only develop her resources, they need not fear what the rest of the world may do. Primarily the South is an agricultural section. Other industries are important and necessary, but they should not, neither can they take the place of agriculture. The world must have the grains and cereals, cotton and wool, silk and tea, fruits and vegetables, horses and mules. The South can produce these articles cheaper than any other section. But to produce them a revolution must take place in her methods of Cultivation. Agriculture, the oldest of the arts, has not kept pace with the other arts and industries. There are many reasons why Agriculture is so far behind. The principal reason why there has not been more progress in our own section is ignorance. The farmers have been uneducated. They have relied on brawn instead of brain. Up to this time there has never been issued, as we know of, a strictly Southern agricultural book. The country is not crowded with books on this line as on others. Some agricultural books have been sold in the South, but they were written by Northern men, published by Northern houses, and have not been adapted to our needs. These books are all right for the sections they were written for, but they will not do here. The sale of these books, no doubt accounts for the idea so prevalent that books will not help the farmer. We are not so foolish as to believe that you can take a book, and just by reading it make an excellent crop of corn, wheat or cotton, but we do believe, and our experience backs us up in the belief, that there are many valuable suggestions in books that will be of incalculable benefit to the farmer. What is true of farming is true of other professions. The physician, whom you call into your home cannot rely on his medical books altogether, but he must use common sense and judgment. Just so with the farmer. He cannot farm by book methods alone, but by using the suggestions as given in books that are suited to his country, with good common sense, he can have better success than without the book.

It has been our aim to have the book practical. We have selected practical men to write and revise the different departments with the idea of giving to the farmer a work that he can read and understand. Every department of the book has been edited and revised by men who live in the South, and who know our conditions and needs.

We are under obligations to many men throughout the South who have given us encouragement in our efforts to bring out this book. The work could not be as great a success as it is without their aid. Especially are we under obligations to each of the editors and to those who furnish us many of the illustrations.

J. C. ADAMS.

To the men of the South who have borne the heat and
burden of many days and summers without
receiving their just reward, this book is

DEDICATED

With a prayer that it may aid the Southern Farmer in
receiving the just recompense for his efforts.

PUBLISHER'S PREFACE

It may be of interest to the readers of this book to know something of the methods used in producing it. The Editor of the book, Mr. Adams, was born and reared upon a Southern farm. He knows from experience what it is to labor on the farm. He has traveled in every Southern State among the farmers. He is a graduate of Emory College. While in college he made a special study of the sciences. All of this qualified him for the work of gathering together the material for a Great Southern Farm Book. He secured back files, and subscribed to the leading Southern farm papers. He also secured books covering every topic possible, even securing some books from across the Atlantic Ocean. From this matter he compiled, what he thought, an excellent farm book. (With the exception of the Horse Department, Floral Department, And The Use of Improved Farm Machinery, which were written by their respective authors as they now stand.) However, in order to produce the very best book possible, he secured for each department an editor especially gifted in his particular line. to revise the department, thereby bringing out the very best book possible.

Many people do not get the full value of a book because they do not know what it contains. Read your book; know what it contains; make it your companion. When you cannot find what you want, consult the Index in the back of the book. The Index was made to use.

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You can't beat this
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BOOK I.
FARM DEPARTMENT.

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AGRICULTURE AS A SCIENCE.

Science is what man knows about God's laws. There are no accidents in the physical universe. Everything moves according to some law. This is true in every department of nature. There are laws governing the growth of plants, and these laws are invariable. Some of them most of us are unacquainted with, but these laws exist just the same. The earth or soil was created and adapted to germinate seed when certain conditions are fulfilled and if these conditions are not fulfilled there will be no germination of seed. There are a class of farmers who do not believe that agriculture is a science; they believe that all that is necessary to make a successful farmer is manual labor; but if these people would stop to think for a moment they would see the fallacy of their position. There are three principal conditions necessary for the germination of seed; the presence of heat, moisture and air. Unless these conditions are present the seed will not germinate. Let us look at the matter a little. If you plant seeds in cold soil, they will not germinate. Every farmer and gardener knows that if he plants seeds in the Spring when the ground is cold, they will be slow to germinate and may not come up at all. Of course some seeds require more heat to cause them to sprout than others, and some few will sprout in cold weather, but these are exceptions. Again, if you will take seeds and plant them in a soil that has been thoroughly dried out by heating, and do not let it become moist, they will not come up. Seed also require air. If you place some seed on a wet piece of blotting paper, in a bottle, leaving the stopper of the bottle out; and in another bottle place some in the same way, but place the stopper in, you will note the effect of air upon germination. In the one that is stopped up there is some air and the experiment will not be entirely complete; but the comparison is sufficient to show that air is necessary for seed to germinate. And so it is in all departments of agriculture, there are certain laws which govern the growth of plants and these laws must be complied with.

If farmers understood the laws governing the feeding of plants, they would avoid many mistakes in buying their fertilizers. The successful farmer will study the needs of his plants. A simple corn plant is

very much like the human body in many respects. Just as there are laws governing the human body, so there are laws governing the simplest plant that grows. The plant breathes, takes in food and water, and reproduces itself very much like human beings. There are male plants and female plants just as there are male beings and female beings. You must know the laws governing these plants in order to be successful in the highest sense of the word.

And may we not suggest just here that the farmer who raises the greatest number of bales of cotton or the greatest number of bushels of corn is not necessarily the most successful farmer. To be a successful farmer, you must be able to enjoy your work, and above all things see the beauty of nature. You must also be able to show the largest margin of profit.

The question has often been asked, How can the farm boys be kept on the farm? We believe that question will be answered when farmers are able to show to their children some of the beauties of the farm life, some of the attractions, and some of the sweet, pure thoughts that the study of nature inspires. There is no more fascinating study anywhere than the laws governing the growth of plants, and yet how many children are ignorant of all of these laws. They are taught to study everything that will lead them away from the farm towards the city and factory. The farm need not fear results. If the beauties of God's laws, as expressed in the laws governing the growth of plants, are taught to the child, as well as some of the attractions of machinery and electricity, and the counting room, the farm will not suffer.

Our farmers should also be able to show their boys that there is money to be made on the farm and that it offers an opportunity for intelligent efforts equal if not superior to any other calling. The aim of this department is to show to the people some few of these simple laws, and to suggest to them the advisability of studying these principles. Most of the education in the rural schools is away from the farm, instead of towards it. People have gone mad in their pursuit of higher education, while what we really need is wider education. We need to know more

about the laws governing nature. It is well enough to know something concerning the writings of Caesar, Cicero, Ovid, Xenophon, and many other ancient writers; but it is far more important to know something concerning the laws that govern the plants which are growing around us every day.

There are two great divisions of matter; dead matter, and living matter. We might define dead matter as that which cannot move or change its form. For instance, you see a grain of sand. You may look at it every day for a year, or two years for that matter, and it will be just the same as before. You may change it, but it in itself can not change or move. Living matter is that which can move or change its form. Fig. 1 shows some yeast plants as they appear under a microscope. There are the little plants that are in ordinary loaf bread, or light bread, which causes it to rise. These plants are so small that you can not see them with the ordinary eye. But they are in the bread, and if it was not for them, you could have no light bread. Each one of these little plants is made up of a little closed sac, containing a thick liquid jelly, and we call this jelly matter, protoplasm. Now if we look at this yeast plant un-

Fig. 1.—Yeast plants, magnified.

der the microscope, we find that it changes. Little swellings grow upon it, like knots on a potato, and these swellings finally fall off. The part that falls off is another yeast plant. In other words, this little plant that you can not see with the unaided eye has grown into two plants. But in order for it to do so, certain laws and conditions had to be complied with. In other words, for this plant to grow into two plants it had to have food, air, moisture or water, and heat. Unless it had had plenty of each of these, it would have never grown into two plants. A horse will not live without corn or some other kind of food, and neither will a plant live without food. That is, it is necessary to use barnyard manure and commercial

fertilizers under plants. In other words, when you put guano, or fertilizers under corn, wheat or cotton, you are simply feeding that corn, wheat or cotton, just the same as you would be when you feed the horse, hay or oats. Many of the plants that are raised on the farm are fed to animals in order that the animal may live. We, as human beings, are high animals; in fact, the highest class of beings, and take a great many different things to supply our needs and make us comfortable. To make the plant comfortable so that it will thrive it is just as necessary to supply its needs as it is our own.

Soil is the home of plants in which they live and from which they take their food. But what is soil? Soil is the top of the earth, or that part which has become fine and in which plants will grow. Soil has no fixed depth or fertility. In other words, soil is the rocks that have rotted or been decomposed by the elements and varies very greatly in different places. In one place it is sandy, and in another we have a clay soil. The soil and subsoil are very much alike. That part of the soil that is somewhat loose and dark colored we call top soil; and that which is not so loose and lighter in color, the subsoil; but there is no fixed definite line between soil and subsoil. The subsoil begins where the soil leaves off, no matter where that may be.

As is explained in the fertilizer department, plants require three principal foods; nitrogen, phosphoric acid, and potash. These three elements are in all soils to a greater or less extent. But in order that this plant food be of any service it must be in a state in which it can be dissolved in water; for unless this is the case the plants can not use it, as they take up all their food in a liquid form. There are large amounts of potash in some solids that can not be dissolved in water, also nitrogen and phosphoric acid which are in indissoluble forms. These minerals that can not be dissolved in water are of no service whatever to the plants. They will in time come to the point where they will be soluble in water, but until that time, they are of no service whatever. Thorough tillage and the adding of vegetable matter to the soil will hasten and help make them available, as will also the growing of different crops, some of which have the faculty of appropriating the crude forms of plant food. When such crops die on the land and are turned under they return this plant food in a more avail-

able form which other crops utilize. The soil on hill-sides is not so fertile as a rule as the more level portion of the earth's surface, for the loose parts of the earth have been to some extent washed away. In low places we find exactly the opposite to be true, the loose earth has accumulated here and the soil is deeper and more fertile. It is frequently true that the soil in bottoms is several feet deep, while the soil on a hill is less than six inches. The soil or top soil is made from the subsoil, and will be just as deep as you plow. For instance, if you plow six inches deep, the soil will be six inches. Under this six inches, there may be just as good soil, but it is of little use to the farmer in growing crops for it is hard and the roots of the plants can not penetrate it. When you plow only four or six inches deep, year after year, the tramping of the horse in the bottom of the furrow finally forms a hard pan or clay land, and the land will not drain well. It then becomes necessary to use a subsoil plow to break this hard pan and when this is done the land will be much more productive. As a rule, it is better to deepen the soil gradually by plowing an inch or so deeper every year as you are able to add the necessary vegetable matter to keep it in good mechanical condition. If you plow too deeply all at once, the succeeding crop is likely to be smaller than the one before it.

Now there are many different kinds of soil. We often hear of sandy soils, but still never ask ourselves in what sandy soil consists. A sandy soil is one in which sand predominates. It contains about 70 per cent. sand. Clay soils have about 70 per cent. clay. In between these two soils, we have what is called loams. There are two kinds of loams; sandy loams, and clay loams. A sandy loam is one containing 60 per cent. sand, and a clay loam is one containing 60 per cent. clay. But what is the difference between sand and clay? Sand is the name that is given coarse grains or particles, while clay is the name given to fine grains or particles. Soils are composed of minerals, such as aluminum, quartz, iron, feldspar, potash, lime, phosphoric acid, magnesia, soda and many others. Humus is also a prominent element in soils. Humus is decayed vegetable or carbonaceous matter, and is not a mineral. Many soils are sandy on top, and have a stiff clay below. These soils can be easily improved, but if the soil has no clay underneath or if the subsoil is pipe clay, it is very difficult

to improve it. These facts should be borne in mind when buying a piece of land.

We have already suggested that the soil furnishes the plant with food; but it also serves another purpose, it supports the plant, holding it up against the wind. For this purpose the soil must furnish a good root bed, for it is by the roots that the plants are held in the correct position, and in many cases the roots penetrate deep down in the ground. So you can readily see that the soil must be porous in order to fully accomplish its mission. This is another very strong argument in favor of deep breaking of your land. We have had a great deal to say about deep plowing, breaking the land 9 to 12 inches deep; but you must remember that this applies only to clay land and land having a clay subsoil. On the sandy poorer soils near the coast the best results will be obtained by shallow plowing.

Another very important function of the soil is to hold the water for the plant. The soil not only takes in water, but it must dissolve and hold in solution the food that is consumed by the plant. When we consider that nearly three-fourths of all vegetation is water, we at once realize the importance of the water question, and the necessity of putting it in ideal condition. In this connection it might be well to consider what constitutes an ideal condition of the soil. In the first place; it should be deep, so it will act as a reservoir for holding water. At the same time it must be well drained, so that surplus water will pass off. The soil receives its water at irregular intervals, and it must be able to hold the water in order to supply the need of the crops. We have already learned that plants must have air, therefore the soil should be porous, for the air can only get to the roots of the plants through the pores in the soil. The rootlets of plants will not grow in clods, and the plant food contained in clods is useless. Therefore, all clods should be crushed and the soil made fine, so that the plant roots will have access to every portion. Unless the land is well drained the surplus water will exclude the air and nitrification or the conversion of decaying vegetable matter into available plant food will stop, and the plant will turn yellow and cease to grow. Consequently the land should be well drained. Lastly, it should be well filled with decaying vegetable matter, for this not only supplies plant food, but helps to make the soil warm and

porous, making a comfortable home for the plant. In decomposing, vegetable matter generates a great deal of carbonic acid gas and this gas acts on the soil setting free phosphoric acid and potash which before was locked up and unavailable. A piece of new land when freshly cleaned of stumps and roots, especially hammock and hard wood lands, is an ideal condition and the farmer should try to bring his soil into a similar state, and keep it so.

THE SOIL AND WATER.

All have seen a kerosene lamp burning, and many of us have asked the question why it is that the oil rises in the wick as fast as it is burned out? We are tempted to believe at first, that it is something special in the wick that attracts the oil upwards. And still we have no answer for that question. If we try an ordinary piece of blotting paper we find that ink rises in it just as oil does in the lamp wicks. But will a liquid rise in other materials, as well as lamp wicks, and blotting paper? Have these two substances any special property that causes a liquid to rise in them? If we take ordinary soil or earth and fill a bottle with it, we will find that this earth makes an excellent wick, and that oil rises as rapidly through the pores or little holes in the earth as it does in the lamp wick. As to why this liquid rises through the pores we cannot tell, it is what is known as capillary attraction. But what has this to do with agriculture? Simply this; the water in the soil rises through the pores of the soil as the oil in the lamp wick rises through the pores of the lamp wick and supplies the plant. If this law of capillary attraction were not true, there would be no vegetation practically, for as soon as the root used up the water right around it, it would be unable to secure more water, and the plant would die of thirst. During dry weather the moisture will rise from the subsoil into the surface soil and supply water to the plant if the land is in the right condition. If the soil is left rough and lumpy, especially if these lumps are at the bottom of the furrow, or if a great deal of trash is turned under in the spring without being worked up, they will tend to break the capillary attraction and prevent the soil water from rising. Then, if the surface is kept broken to prevent evaporation the soil will remain moist.

HOW PLANTS FEED.

We have explained that water in the ground has minerals in it, and when the plant takes in this water it takes in the mineral matter also, but here are other foods that must be taken in as well. We cannot see the air, and it would seem strange that a part of the plant comes from the air, but it is true, nevertheless. The air contains a gas called carbonic acid, mixed with it. This gas is made of two substances, carbon and oxygen. We have all seen carbon in the form of charcoal and ordinary soot in the chimney, it also composes a large part of the woody substance of plants. The other element in carbonic acid is not so familiar to the ordinary man, and it is oxygen. Where we have charcoal the carbon combines with the oxygen from the air and goes off in smoke as carbonic acid gas. When wood or plants decay, this is a slow burning and is called oxidation, as the carbon combines with oxygen and goes off in the air. Plants breathe through their leaves and in so doing they absorb the carbonic acid once more and it is reconverted into wood fibre. This carbonic acid enters the leaves of the plant through small openings, and after it goes in the leaves it enters the cells, and comes in contact with a substance called chlorophyll. If the sun is shining a part of the carbonic acid and water which is in the cells is decomposed (by decomposed we mean separated into the different parts that make it up.) Some of this carbon unites with other substances and forms an altogether different substance. This new substance is called starch. Now most of us are familiar with starch. Starch is made in the green part of plants. It is mostly in the leaves of the plants. This starch, together with the minerals that are taken in by the roots, serves as food for the protoplasm of the plant, being converted into fibre and in some plants, such as sugar cane, into the sweet juice which we make into syrup and sugar.

HOW PLANTS GROW.

By looking at the illustration Fig. 2 you will see an ordinary plant of Indian Corn. You will observe two small tiny shoots growing from this plant. One of these shoots grows upward and the other downward. This is always true. It is according to law that the one grows up, while the other grows down. The one

that grows upward is called the stem, while the one whose tendency is downward is the root. As noted, you can always depend upon the root tending downward, no matter in what position you turn the seed. If you reverse the seed, and turn the root so that it will point upward and the stem downward, the root and stem will change, the root still growing down-

the plant; which means that the plant must starve. To take away the food of the plant by destroying the leaves, is just about the same as taking away the food of a man. We cannot work without food, and just so the plant cannot work without food, for the roots cannot grow and absorb as much water and other elements from the soil in consequence.

Fig. 2.—Plantlet of Indian corn.

ward, and the stem upward. This law cannot be changed. You will notice on the main roots there are smaller roots, and upon these smaller roots there are still smaller roots. These smallest roots are called root hairs, and they take up the water and plant food that the plant uses. All water that is used by plants comes through these very tiny root hairs. Some of these are so small that you cannot see them with the naked eye.

The stem, that part which grows above the ground, bears the leaves, flowers, fruit, and seed. In many plants it supports the leaves above the ground, but in some plants it is weak, and has to grow upon some other support, like the grape vine. It is necessary that the leaves be exposed to the light, and this the plant does. The leaves do not grow out from the stem at haphazard places, but they come at regular intervals. The more we study plants, and their habits the more we are convinced that there is a definite law controlling plants, and that this law is never violated. Light can pass through the leaves, as you will see if you place a finger behind the leaf. In the leaves is the chlorophyll that causes it to appear green. These leaves are very necessary, for we have already learned that it is in the leaves that the starch is manufactured. If the insects eat the leaves or if they are picked off or broken off they cannot prepare food for

HOW TO KEEP THE LAND FERTILE.

Suppose we dissolve a spoonful of salt in a glass of water, and then take out a spoonful of this water. Of course we take a part of the salt in solution. There is not as much salt left in the glass as there was before. But suppose we keep on taking out this water, spoonful after spoonful. Let us look at the water for a minute. Have we removed any salt? Look as hard as you may, and you cannot see a single grain of salt. But suppose we taste it. We find that it has salt in it, so when we take out all the water we have also taken out all of the salt. Just so it is with farming. The water absorbs, or dissolves the mineral matter, such as nitrogen, phosphoric acid, and potash, and the plant takes in this water through the root hairs and if it keeps on taking up this mineral matter after a while there will be none left unless it is replaced by some other means. But some farmers believe that they ought to be able to take away from the land every year, and never replace anything. After a while the land has nothing to give, and as a result we have what is called poor land. A man is called poor when he has not enough to properly feed his family, and the land is called poor when it has not enough plant food in it to properly feed the plants growing upon it. We have already shown the fact that plants need food, and we have told you what the principal foods are that plants require. Another way that soil is worn out or becomes poor in the South is by washing. Where land is not properly drained or terraced the rains cause water to flow over it, and this takes the plant food out of it. Washing has ruined many farms throughout the South. It would not be so bad if it was necessary, but it is not necessary. Whenever land is washed away it is on account of some one's carelessness, or inattention. Many farmers have land that does not wash, nor do they use terraces. They prevent the washing in their method of cultivation. They take for their motto

"Plow deep and on a level,
And in peace and plenty revel."

Plow deep enough to break the hard-pan. By doing this the water will soak in, and there will not be so much to run off. This not only prevents the land from washing, but it also stores the water for use in a drouth. But the thing under consideration is the washing of land. Unless the hard-pan is broken so that the water can soak in, it must run off. Each square yard of land will hold all the water that falls upon it, provided none gets on it from any other source. But for the water to remain where it falls and not run here and there, the land must be broken deep. And you will note that the little rhyme says something concerning level plowing. Many farmers make the mistake of not plowing level. You cannot do this by guess work. It will be necessary for you to take a spirit level and lay off guide rows to plow by. Those guide rows should be for every three feet of perpendicular fall. They should be run on an exact level, so that there will be as near no fall as possible. The thing you want to do is to keep the water just where it falls. If your furrows run down hill, the water will follow, and your land will wash. If the farmer will break the hard-pan and plow his land on a level, he will not have to use great high banks called levels.

After you keep your land from washing, and losing valuable plant food, the next thing to be done is to replace the plant food that is removed by the plants. This can be done with barnyard manure, wood ashes and commercial fertilizers. Land, after a time, unless the soil is exceedingly deep, will become unproductive unless you fertilize it. The best way to fertilize land, is by the use of stable or barnyard manure. And as is suggested in the Fertilizer Department, this is a point where a great many farmers lose out. They fail to take care of the manure, and must buy commercial fertilizers to take their place. In using commercial fertilizers you fail to secure one element that is needed, which is supplied in manure, and that is humus, or decayed vegetable matter. Land will not produce without this vegetable matter. The wise farmer will not permit the land to be burned off, as is so often practiced. You may lay it down as a safe rule never to allow anything to be burned on the farm that will rot, and if anything will burn it will rot, therefore do not burn anything. Cornstalks are a little trouble to plow under, but they are worth a great deal more plowed under than they are burned. The vegetable matter cannot be classed as a plant

food, but it is none the less important. The grass may be rank and hard to plow under, but it is better to go to extra hard labor and plow it under than it is to burn it off. The land needs all the humus that it can get. If the wagons and stock have nothing else they can do, it will pay to haul leaves and pine straw on the land to help supply vegetable matter, for whenever the vegetable matter in the soil becomes exhausted the land becomes dead and unproductive. Such a soil may contain a large amount of plant food, but in the absence of vegetable matter this plant food reverts into insoluble forms which the plants cannot take up, so that very often a soil will appear to be worn out when in reality it is not, and all that is necessary is a new supply of vegetable matter to make it again productive. Wood ashes, if they have not become wet, contain potash, and some phosphoric acid, but no nitrogen; and are quite valuable as soil improvers. By taking advantage of these small matters, we can do much to improve our land.

ROTATION OF CROPS.

With most crops and on most soils the rotation of crops is desirable. Rotation refers to the order in which crops are made to follow each other in different years, so that in order to rotate crops you must have more than one crop. Where rotation is not practiced the same crop is planted year after year on the same land, certain elements in the soil are used up and the land becomes unproductive unless large amounts of fertilizers are used. It also encourages insect enemies. If potatoes are made to follow potatoes year after year the ground soon becomes infested with a disease so that only scabby potatoes will be reproduced, the potato bugs will also become more and more abundant each year. If clover is made to follow clover year after year the land soon becomes "clover sick" and fails to produce good crops, and the same is sometimes true of cowpeas. Land that continually grows grain soon becomes foul with weeds. You must also remember that some plants are shallow feeders, and where these are continually planted on land they leave a great deal of unused food below, which cannot be used until you introduce a deeper feeding crop.

Deep rooted crops such as alfalfa and cow peas will pump up potash and phosphoric acid from the subsoil for the benefit of other surface rooted crops to

follow. The change of crops also adds more vegetable matter and helps to keep the land from washing and blowing away, as is the case where continuous clean culture is practiced with a crop like cotton. With a proper rotation in connection with improved methods of tillage the soil will steadily improve year after year. We cannot lay down a system of rotation which will apply throughout the South, for so many crops can be planted, that you could not secure a system that would suit every one. The Louisiana Station recommends the following system of Rotation. Corn, the first year; oats followed by cow peas the second year, and cotton the third year. Some one has recommended the following principles which should guide you in your system of rotation:

"1. Have at least one leguminous crop in the rotation. 2. Have at least one cultivated crop. 3. Rotate shallow rooting crops with deep rooting crops. 4. In the South and on leachy soils plan to have a growing crop on the land all the time. 5. Avoid bare summer following. 6. Do not rotate small cereals with small cereals. 7. Plan the rotation so as to have the same amount of forage each year. 8. Keep stock on the farm. 9. Unless it be thoroughly rotted, apply the barnyard manure thus made, to the rank growing crop in the rotation like corn."

Try rotating your crops for a few years, and see how your land will improve, and how much money you will make by so doing.

THE PREPARATION OF LAND.

Some one has said that thorough preparation is half the cultivation. This is certainly true. You may put it down that the man who expects to break his land, and get it in shape after the crop is planted, will not raise much of a crop. If your land is prepared as it should be it will make a pretty fair crop regardless of seasons. If possible in preparing your land, break it up with a two-horse plow. Now, we realize that there are many farmers who have but one horse or mule, but it should be an easy matter to exchange work with your neighbor who is in the same condition you are, and prepare your land. If you have more than two horses or mules, so much the better. The more you use the better will be your preparation. Many farmers in the South find it to their advantage to use four and five horses to a plow in breaking their land. This plowing is the most im-

portant part of preparation and it should be done thoroughly so that every inch of the ground is broken, and not run over leaving ridges unbroken to be covered up. Try to use a plow which will pulverize the soil as much as possible while breaking it. After plowing harrow well with straight tooth harrow, and drag with planks or log drag. Where an extra fine seed bed is desired follow with disc or cutaway and drag again. This will put land in fine condition for almost any crop. Remember that the better the land is prepared the better will be the production from that land. Last, but not least, never plow land too wet. It should be dry enough to crumble and not be sticky when cracked in the hand, before your plow is started.

LARGE OR SMALL SEEDS.

Every perfect seed contains a plantlet. This plantlet is very small. The rest of the seed is filled with food for the plant until the root and stem become sufficiently developed to furnish food for it. It naturally follows that the larger the seed, the more food for the plantlet it contains; and as a general rule it is much better to plant the larger seed. In this connection, the size of the seed determines to a large extent how deep they should be covered. It has been stated that seed should be planted to a depth corresponding to twice the diameter of the seed, and while this will hold good with some seed, it can not be observed in all cases. The smaller the seed the more shallow it should be planted, and seed which force themselves up,—the seed forming the first leaves such as beans,—should be planted more shallow than those which send up a shoot, such as corn. Small seed like clover cannot push up through as much dirt, and overcome as much resistance as larger seed, and should always be planted very shallow. As a rule it is advisable to plant seed more shallow early in the spring than it is later in the season, when the weather is warmer and the land contains less moisture. Gardeners who grow radishes and lettuce find by sifting the seed and planting only the largest ones, that their crops mature much more evenly, than when they plant the seed without sifting them; also that the crops mature a great deal earlier. It is sometimes possible to grow an extra crop in the winter in this way. The success of any crop depends largely upon the seed that it is important that they are the

very best procurable. Many farmers pass their grain through a fanning mill, to take out the smaller and shrunken grains. It is also best to reject the small grains of corn on the end of the cob. More attention should be given generally to the selection and saving of seed on the farm, as the labor and thought so directed will pay better than in almost any other way.

FIRMING THE SOIL ABOUT SEED NECESSARY.

If you will take some ordinary moist soil (not wet) and place it in a jar, and plant some bean seed in it loosely, and in another jar plant some more beans, packing the soil well over the seed, and then set both jars away in a warm room, you will find that the seeds from the one in which the dirt is packed will come up quicker than in the other jar. You can try this for yourself, but what causes the difference? In the first place, the seed absorb water faster from the soil when it is pressed closely about them, and seed cannot germinate until it takes up all the water it can hold, and therefore it will germinate quicker when the soil is packed close about it. A very successful gardener once wrote: "As an experiment, I sowed twelve rows of sweet corn and twelve rows of beets, treading in (that is, walked over the rows, placing the heel of one foot at the toe of the other, so that all parts of the row would become packed) after sowing, every alternate row of each. In both cases those trodden in came up in four days, while those unfirmed remained twelve days before starting, and would not then have germinated had not rain followed." It is quite important, especially in dry weather, to use a roller over the land just after grain is planted, and the practice of tramping in garden seed in dry weather is an excellent one. Grain sowing machines and corn planters often have a little iron roller attached to them to press the soil over the seed, which helps greatly in obtaining a start. In planting very small seed it is frequently the practice not to cover them at all, but to place a board over them, and to walk on this board in order to bring the seed in very close contact with the soil. The pressing of the soil also brings the moisture to the surface and in a measure prevents evaporation. When a seed first starts to germinate it must secure its water from right around it, for it has no long roots

to go down in the earth and secure this water. It will, therefore, be observed how necessary it is that proper conditions be secured in order to obtain the best results.

PARTS OF THE FLOWER.

We enjoy looking at flowers, for they are beautiful. But forgetting their beauty, let us look at them a moment from the standpoint of usefulness. If we had no flowers we would have no fruit, neither would we

Fig. 3.—Sections of Cherry Blossom showing parts of a Flower.

have many varieties of grain and vegetables; for the flowers are necessary to their production. The flower is made up of the sepals, petals, stamens and pistils. The sepals taken together constitute the calyx, the petals taken together constitute the corolla. Fig. 3. By reference to this illustration you will see the different parts of the flowers. This is a section of a cherry blossom. At the base we find a green part marked C in the figure which we call the calyx. As noted above the calyx is made up of sepals. The part cor. in the illustration shows the corolla, and as stated the corolla is made up of the petals. The petals, as a rule are the part that gives the beauty to the flower. Inside of the corolla will be found some long slender organs, which are marked S., and these are called stamens. Now the stamen is one of the most important parts of the flower. Very often is it the case that they are unnoticed but that only shows how often we fail to observe the important things of life. The stamen produces pollen, which is the male part of the flower. Inside of the stamens is the pistil, which is the female part of the flower. These small pollen grains which are on the stamens must be carried to the bottom of the pistil. This process of carrying pollen from the stamen to the ovule of the pistil is called pollination. Insects and bees aid

in the carrying of this pollen grain from the stamen to the ovule. If these pollen are not carried from the stamen to the pistil there will be no seed produced. This is as true in corn as it is with the flowers of the yard. If the pollen which is in the tassel of corn is not blown to the ear below, there will be no corn produced. The pollen does not have to come

Fig. 4.—Strawberry Blossoms, A is perfect flower, B imperfect flower.

from the same flower, but a flower of the same kind. But all flowers are not perfect, that is, that have not all these parts. By reference to the illustration, Fig. 4, you will see an example of a perfect flower, (by perfect flower we mean one that has both pistils and

stamen,) and also an imperfect flower. You will notice that the Fig. A. contains both stamens (S) and pistils (P). This is what is called a perfect flower. By noticing flower B you will note that it is imperfect, or it only has pistils. Now the flower A will produce fruit of itself, but the flower B. cannot produce fruit unless the pollen come from some other perfect flower of a similar kind. It is quite important to know if a flower is perfect, for there are varieties of strawberries with imperfect flowers. It is also true with ordinary Indian corn, melons, squashes, cucumbers, and pumpkins.

If the pollen of one flower is carried to the ovules of another flower we have what is called cross-fertilization, and if the resulting seed be planted a new variety is the result. This is the reason pop corn and Indian corn mix when planted anywhere near each other. By crossing certain plants with others of like kind, and carefully collecting the seed that are produced, new and improved varieties are obtained. And yet some people claim that there are no laws governing agriculture.

FIELD CROPS.

ALFALFA OR LUCERNE.

Alfalfa is one of the best forage crops for the South. It is only recently that it has come to be grown to any great extent, but people are realizing more and more its value. It is a plant similar to clover, has a single tap root which runs down from 8 to 12 feet, and sometimes as far as 40 feet. It is a leguminous plant and is well adapted to the South.

As much as four cuttings of a ton each can be made in a season, which makes it quite a valuable forage plant. It has a distinctive advantage over clover, especially to dairymen; as it can be cut at least one month earlier in the spring, and this is an important feature. Another advantage of alfalfa is that as soon as cut it springs into growth immediately, while it takes clover some time to commence growing again. After the first cutting, another crop will be produced in six to eight weeks. Clover as a rule will die out after two or three years, while alfalfa will last from eight to ten years, and sometimes longer. It is now being grown more or less in every Southern State.

Some soils that were not considered fertile have been made to produce alfalfa very bountifully. In the States of Kentucky, Tennessee, Mississippi, Arkansas, Alabama and Georgia there is a wide stretch of soils derived from the Mississippi or subcarboniferous formations, that are not considered fertile. The characteristics of these soils is the presence of angular cherty gravel, and at some places an underclay which is stiff and chocolate in color. At other places this underclay is whitish or yellowish in color and so porous that it will not retain well the fertilizer placed upon it. Both of these soils produce alfalfa abundantly, and are quite valuable to use in that way. These soils were once considered worthless because they would not produce the cereals as did the rich limestone lands around them.

Alfalfa will do best planted in a rich sandy loam with a good subsoil. Like most leguminous crops it needs lime and thrives best where lime is abundant in the soil. It is quite important that the land have a good subsoil, and that it be well drained. Alfalfa

Fig. 5.—Alfalfa or Lucerne, showing the roots of the plant.

will not live more than a year in cold heavy clays and wet lands. One reason why more farmers have not succeeded with alfalfa is because that they did not thoroughly prepare their land for it. It should be sown on land where a hoed crop was grown the year before, which was well manured. It can either be planted in the fall or spring. If you plant in the fall, it should be sown in September, and if you plant in the spring, March or April perhaps is the best time to sow. See to it that your land is free from weeds, and then break your land very deep, fertilize well and work down fine before planting. Sow from 20 to 25 pounds seed per acre. If you use drill from 15 to 20 pounds of seeds to the acre is sufficient. If you are sowing for a hay meadow, and most farmers will, sow the larger amount of seed. If you desire to raise it from the seed, the smaller amount is better.

Some lands do not produce alfalfa because there is no bacteria in the soil. As stated above, alfalfa is a leguminous crop, and it is necessary to have the bacteria in the soil in order to make a success with it. These bacteria have the power of gathering the nitrogen from the air, and making it available so the roots can take it up. Every farmer who is a close observer has noticed the little nodules or tubercles on the roots of alfalfa or pea vines. These tubercles are nests of bacteria. The Government has taken this matter in hand, and farmers can, by applying to the Agricultural Department at Washington, D. C., obtain packages of these bacteria germs. There are three packages that go together. No. 2 contains dry cotton with bacteria, and Nos. 1. and 3 contain food for the bacteria. The following directions for the use of these different packages are given:

"Put one gallon of water, preferably rain water, in a clean tub or bucket and add No. 1 of the enclosed package of salts. Stir occasionally until all is dissolved. Carefully open package No. 2 and drop the enclosed cotton into the solution. Cover the tub with a paper to protect from dust. Set aside in a warm place for 24 hours. Do not heat the solution or you will kill the bacteria—it should never be warmer than blood heat. After 24 hours add the contents of package No. 3. Within 20 hours more the solution will have a cloudy appearance and is ready to use.

"To inoculate seeds, take just enough of the solution to thoroughly moisten them. Stir thoroughly so that all the seeds are touched by the solution. Spread

out the seeds in a shady place until they are perfectly dry and plant just as you would untreated seed. If bad weather should prevent planting at once, the inoculated seed, if thoroughly dried, may be kept without deterioration for several weeks. The dry cultures as sent from the laboratory will keep for several months. Do not prepare the liquid culture more than two or three days previous to the time when the seed are to be treated, as the solution once made up must usually be used at the end of 48 hours.

"To inoculate soil, take enough dry earth so that the solution will merely moisten it. Mix thoroughly so that all the particles of soil are moistened. Thoroughly mix this earth with four or five times as much, say half a wagon-load. Spread this inoculated soil thinly and evenly over the prepared ground, exactly as if spreading fertilizer. The inoculated soil should be harrowed in immediately. Either of the above methods may be used, as may be most convenient."

This bacteria is now put up in a commercial form and sold by most seedsmen.

The effect of inoculation is very great. The experiments made by the Department at Washington, D. C., shows an increase from three to twenty fold. Many old worn-out fields are worn-out simply because their supply of nitrogen and organic matter has been exhausted. The principle of inoculation which will enable them to grow leguminous plants and restore the nitrogen, will work wonders in the South. Perhaps better results can be had in the South to sow in drills from sixteen inches to two feet apart, and keep it worked out the first year, as the crab grass will interfere considerably before it gets started.

Alfalfa as a soil improver is very valuable. The following will give you some idea of its value as a fertilizer:

"The value of alfalfa harvested from one-half acre of land for five years was about \$50.00 more than the cost of producing it.

"The value of potatoes and grain from an adjoining half acre for five years was about \$44.00 more than the cost of producing at local prices.

"When the alfalfa land was plowed and planted to wheat it produced \$8.00 to \$12.00 more value in wheat per acre than the land which had grown potatoes and grain before.

"When alfalfa land was plowed and planted to oats it produced \$16.00 worth of grain more than land which had grown potatoes and grain before.

"When alfalfa land was plowed and planted to potatoes it gave \$16.00 worth more of potatoes per acre than was obtained from land which had grown potatoes and grain before.

"By growing alfalfa the above increase of yields and values were produced with absolutely no cost for fertilizing the ground."

Alfalfa is cut for hay just as the first flowers are coming into bloom. At this time it is more tender and contains the most digestible protein. It should be cut in the forenoon and allowed to cure until the leaves are well wilted. Then raked into windrows, and allowed to cure. It can be then removed to the stack or barn. Alfalfa should be handled just as little as possible, as the leaves, which are the most valuable part of the plant, crumble off. It can be cut from three to four times. However, it should not be cut too late in the season, as it hurts it more than cutting early. If you do not make a good crop the first year do not be discouraged, it frequently takes from one to two and frequently three years to get it started, but when you once get it started you should have no more trouble with it. You will find it advantageous to cut the first crop a little early, when there are just a few blooms to be seen.

Alfalfa will not stand heavy pasturing, and cattle and sheep are liable to bloat if pastured on young alfalfa, or when allowed to eat it while the dew is on it; but horses and hogs never have any trouble with it.

BARLEY.

Barley is grown in the United States for two purposes: feeding and malting. It will grow all right in the Southern States, but for some cause has never received a great deal of attention here.

It will grow on rather light dry soil, containing a good deal of lime and in a soil resting on a naturally drained subsoil. Heavier yields of grain and straw are produced on fertile clays, and clay loams. The malting barley used by the brewers brings the better price.

The land for barley should be plowed fairly deep and well pulverized. Land that produced some hoed

crop which was well manured will be a good place to grow it. In the South where it is grown mostly for pasturing and feeding, it should be sown in September and on fertile soils as late as the last of October. If barley is grown for feeding purposes it is best to fertilize it with stable manure or a fertilizer that contains plenty of nitrogen and phosphoric acid. A top dressing of nitrate of soda in the spring will be very beneficial. If it is grown for the purpose of malting potash should be used quite largely as a fertilizer.

It should be harvested when the grain is ripe, but do not wait until it is too ripe. The value of barley used for malting purposes is dependent upon the color of the grain.

Barley as a stock food is excellent. It has about the same food value as corn or wheat, and has a greater food value than oats or bran. It is not so good for fattening purposes as some other grains, but for growing animals it stands at the head of all grains. Barley hay does not have such a high feeding value, but it is excellent for cutting and feeding green to cattle.

Fig. 6.—Beggar Weed.

BEGGAR WEED.

The Beggar Weed is a leguminous plant, and grows from three to eight feet high. It is used for

a forage plant, and soil renovator. The United States Department of Agriculture says, in comparing it with alfalfa, velvet beans, soy beans and cow peas: "It is perhaps the best of these for the lighter, sandy soils, including the hammock and pine lands of Florida, and the sandy pine lands along the Gulf Coast." From five to six pounds of clean seed are sown per acre, but if sown for hay it will perhaps be better to sow say, from eight to ten pounds of clean seed. It should be sown when the ground is warm and moist. If it is sown early, two cuttings may be had. It should be cut for hay, when the first flowers appear. Its yield is from three to five tons of hay per acre and the hay is said to be nearly as good as red clover. It can be sown in the corn at the last plowing and furnish a good pasture the rest of the season.

BROOM CORN.

Broom corn is a variety of sorghum. It is grown for the fine stems composing its head, which are used in manufacturing brooms and such articles. Broom corn can be grown on any soil which will produce corn or sorghum. It resists drouth much better than corn, although frequent rains in the early stages of its growth induce a vigorous plant. Weeds greatly interfere with the cultivation of young broom corn, and care should be observed to plant where the land has been kept clean the year previous. Sandy or gravelly soils produce good broom corn, but they must be thoroughly drained.

It should be planted about the same time as other corn. Some plant it in drills, and others prefer to plant it in hills. It will require about three quarts of seed per acre, provided the seed are of good quality. In planting do not be in too great a hurry, for it will do all right if planted about the same time that cotton is planted. In no case should planting occur until the soil is warm. Success with broom corn like most other plants, is dependent largely upon the thorough preparation of the land. If the ground is well plowed two or three times before the corn is planted, say at intervals of ten to fifteen days, it will prove quite valuable to the growth of the crop. It should be planted in rows about three or four feet wide. The more fertile the land the thicker it may be planted. About four plants to the foot is the right distance, or thickness. If you intend to hoe it out, you can plant it in hills about twelve or fifteen inches

apart, and leave from five to six stalks in the hill. The seed should be covered about one inch deep. You should use about the same fertilizer that you would use for ordinary corn. Harvesting is done in August, September, and October, at the season when there is little rain, as rain is very detrimental to the selling qualities of the crop. Rain causes the bush to turn red, and it loses its bright green color after being cut. When the seed is in the dough stage

Fig. 7.—Dwarf Broom Corn.

is the proper time for harvesting. It is best to cure it under a shed, but care must be observed that it be not placed in too thick layers, as it will spoil. It is a good plan to cut in the morning and allow it to cure all day, and put under shed in the afternoon. The seed are then thrashed from the bush, and after the bush is cured so that it breaks easily, it is baled for the market. A good yield of broom corn is from 600 to 700 pounds per acre, and it brings from \$70.00 to \$80.00 per ton when baled.

CASTOR BEAN.

The castor bean is grown to some extent in the Southern States as a field crop, and from it castor oil is made. A fertile, well drained loam soil is best suited to the crop. However, any soil that will pro-

duce corn or wheat will produce castor beans. The ground should be thoroughly broken, and harrowed. Rows laid off from four to five feet wide each way is about the proper distance. It is a good idea to leave a wide place every sixth row to allow a wagon to be driven along when gathering the beans. Six or eight beans should be placed in a hill, and when danger from the cut worm has past, they should be thinned out, leaving one plant in a hill. The proper time for planting is from the first to the middle of April. To aid the seeds in germinating, hot water, a little below the boiling point, should be poured over them, and allow them to soak in this for twenty-four hours. Cultivate level, just about as you would corn. The beans are produced in pods of various lengths. If they are allowed to become too ripe, they burst open, and the beans are wasted. As soon as the pods begin to turn brown, they should be cut off, and placed on a floor or sheet with boards placed around them to prevent their wasting off the sheet or popping open. They begin ripening in July and continue until frost. After they begin ripening it will be necessary to go over the field at least twice a week. If this is not done your beans will be wasted on the ground. The beans should not be allowed to get wet, as this causes them to lose some of their value.

CHUFAS.

Chufas are raised in the South for the purpose of fattening hogs. A crop of one-third of an acre at the Arkansas Station supported three hogs averaging 122 pounds in weight for 46 days. They gained 66 pounds

Fig. 8.—Chufa.

each, or a total of 198 pounds. The nuts are more effective for fattening purposes than corn. Chufas grow on light sandy soils, and produces starchy roots

or bulbs about the size of peanut kernels. A great number of these roots or bulbs are attached to the plant, and are near the top of the soil. The crop is excellent for hogs, as they do their own harvesting. Chufas will grow on thin land where many other plants will not. They should be planted in April in rows, and cultivated about as peanuts are, giving them light, shallow cultivation. The crop re-seeds itself, as the nut can stand the winter without harm to itself. However, it is not such a pest as some of the other nut crops.

CRIMSON CLOVER.

Crimson clover is an annual leguminous plant and grows from one to two feet high. It makes a very fine orchard crop, as it does not draw on the land as much as many other crops. It is also used as a soil renovator, and hay crop. It is said to be as good as red clover. It is an annual and consequently not good for permanent meadows and pastures. It should be planted in August or September. Some recommend planting when you lay by your cotton, but it will not do as well then, for the hot sun of July and August is liable to kill it. It can be sown in cotton or corn, and will make good hay the next spring. About 12 to 15 pounds per acre should be planted. It should be covered very lightly with harrow, say one-half an inch. It is hard to cover it too shallow, but it is a very easy matter to get too much dirt on it, unless your land is very rich. The inoculated seed should be planted, as this will insure you a crop. As soon as it comes into bloom is the proper time to harvest it, as after the seed begin to ripen the long tough hairs on the head are dangerous to stock. As a hay plant it is good, and as a soiling plant, it stands at the head of the list. It is very helpful in improving land.

CORN.

There is more corn grown in the United States than any other grain. However, this crop in the South has been neglected. Too many farmers believe in raising cotton and buying corn. Corn is used throughout the South as a feed more than any other grain. Corn will grow on more different varieties of soils and different conditions than any other crop, and the Southern farmer will never reach the greatest success until he devotes more time to

this crop. A great many farmers select the very best land that they have for their cotton, and the land that will not produce cotton they plant in corn. They buy most of their fertilizers for the cotton, and if they happen to have any more than they think they will need, they place that on the corn. If the corn and cotton both need plowing, the cotton gets the work, while the corn is allowed to suffer. When fall comes and the cotton is placed on the market, the merchant informs the farmer that he has not made enough to pay off the debts he has made in buying corn and meat. If you do not raise enough corn and meat to do you, you have no right to complain at hard times, for you alone are responsible.

Corn needs a deep, rich, well drained soil, whether it be heavy clay or light loam, to do its best. And this point should always be borne in mind when preparing your land. If the land is well filled with vegetable matter, it will stand drouths better, and this is one reason why stable manure gives such good results. Bottom lands are excellently well suited for corn, as they contain more moisture, and, therefore, produce better crops. A good supply of moisture is very necessary and deep, thorough preparation helps greatly along this line. As stated above, corn needs land well filled with decayed vegetable matter. This vegetable matter can be supplied by applying manure, or by sowing cow peas, velvet beans, and sowing other crops of like nature, and turning the vines under. In the North the best crops of corn are grown on a clover sod. The roots of the clover furnish the humus and other plant food needed by corn. In the South we must substitute other crops for the clover. The time the land should be broken, is an open question. If the land has a great deal of tough sod on it, it is better to plow it under in the fall; but if not, it is perhaps as well to wait until it becomes dry enough in the spring. It is not a good practice to leave the bare soil exposed to the washing and leaching of the winter rains; and if plowed in the fall it should be thrown into ridges running the furrow on a level to prevent washing. As a rule the heavier the land the deeper it should be plowed. As to whether the land should be plowed flat or in beds is an open question. If the land is sufficiently rolling to allow the surface water to run off without washing, it may be plowed flat in the fall; but as a rule most land will dry out quicker in the spring and leach less when thrown into ridges. Formerly all corn land

Fig. 9.—Corn field situated in Nacoochee Valley, White County, Georgia. This farm is owned by Dr. L. G. Hardman, Commerce, Georgia.

was plowed in 4 or 5 foot beds, by throwing four to six furrows together; but this practice is being abandoned. Even on river and bottom lands, where the lands have to be surface drained the beds are made eight feet in width, allowing two rows to each bed. It requires more work to bed than it does to plow flat, and it has no advantage over flat plowing except to drain land liable to overflow.

Where land is broken in the fall it can usually be fitted for corn in the spring by giving several good harrowings with a disc or cutaway harrow, working the land to a depth of six inches and then drag level before laying off the rows. Where this is impossible the land should be re-plowed with small plows. This should be done as early in the spring as possible, and several harrowings given with smoothing or drag harrow before planting.

No question is of more importance in raising corn than that of selecting the seed corn. Many farmers insist on having pure bred stock on their farm, but are careless about the breed of corn they use. The laws which govern the breeding of animals apply with equal force to the breeding of plants. Pure bred or improved varieties of corn means the same, as pure bred animals, that is, strains and varieties have been

kept pure and selected for a number of years, and are noted for large production and high quality along certain lines. To show you the importance of using good seed corn, one farmer stated that he made an increase in yield of 25 bushels per acre by using pure bred corn over that made by using ordinary seed corn. If you feel enough interest in this subject, go to some reliable seedsman and get the very best from him and then take care of it yourself by selecting your seed every year in the field.

It is quite important that you buy your seed from men who are known to be perfectly reliable, as there are fakers among seedsman as well as other lines of business. If you do not feel enough interest in it to buy seed, then breed up your own corn. Go through your field before the crop is harvested and select the best ears from the best stalks. As a rule the largest yield of grain is from corn producing two ears to the stalk. Prof. M. F. Miller in a circular issued by the Missouri Experiment Station gives the following methods of breeding up corn:

"It will be well in any system of corn improvement or corn-breeding to begin with a good variety, preferably one that is well bred. It may be that a particular variety which has been grown in the community has given good results and has been kept fairly pure, or it may be necessary to buy improved seed from some man living at a greater or less distance; but whatever the source, the seed should be good. There is nothing to be gained in beginning with very poor corn, as several years may be saved by beginning with a strain that has received some care in the matter of selection, providing it is fairly well adapted to the community. If there are any marked peculiarities of soil or climate, however, such as hardpan or drouth, the best yielding variety of the community should be used."

The simplest method of corn-breeding is to set aside each year a plot of ground of two or three acres on which to grow seed corn for the next year. The idea in this is to allow only good individuals to cross with good individuals; consequently, only the very choicest ears should be used for this purpose. The plot should be located preferably in a spot removed from the other corn, or it may be located in one corner or along one side of the main field. Corn pollen will often blow a long distance, so that the plot should be located as far from corn of another variety

as possible. It should never be nearer than 200 yds. If the plot is placed in a part of the field with the same variety, the east side should be selected, as prevailing winds are generally from the west or south-west, and there will be less danger of outside crossing. The only disadvantage in crossing with corn of the same variety is that pollen from an undesirable stalk in the general field may blow into the plot and fertilize some of the silks of the seed ears. The soil on which this seed plot should be the average of that used for corn on the farm.

together. From this mixture take enough to plant a plot of the desired size. The corn may be planted in the same manner as the rest of the field, but it should receive good cultivation and care. When coming into tassel it may be well to go through every day for a week and cut out with a knife all barren stalks, in order that their pollen may not fertilize the ears on other stalks. This is not absolutely necessary, but is desirable. It has been found that barren stalks vary in number with the season rather than with the variety, and it is nature's tendency to breed them out, since they produce no ears. Nevertheless, better results would undoubtedly be secured if they were removed.

Allow the corn to become thoroughly ripe on the stalk and then go through and select from desirable stalks sufficient perfect ears for planting the next season's crop. See that the ears are thoroughly dried before frost, following directions already given for preserving seed corn.

Each succeeding year's planting will be exactly similar to the first, always keeping the corn pure and tending by this careful selection and the crossing of good with good to build up a variety of high yield and high quality. Some such method as this should be practiced by every corn-grower.

Stable manure is without doubt the best fertilizer for corn. Its value, however, depends very much upon how it is taken care of, and if left out in an open lot for the rain to leach away it will not be worth half as much as if kept packed down under a shed or left in a stable until you are ready to haul to the field. Where you have an abundance of manure it is doubtless best to broadcast it, but where there is only a limited quantity apply it in the drill. If barnyard manure is not available, cotton seed, cotton seed meal, potash, and phosphate, may be used. Under the head of fertilizers we give formulas for commercial fertilizers for corn. But just a word about cotton seed and cotton seed meal. Next to stable manure it is one of the best fertilizers we have for corn. Two hundred pounds of cotton seed meal, applied on each side of the row at the second plowing will frequently add ten bushels per acre to the yield. As a general proposition it is better to sell the seed and buy meal, or exchange them for meal to use in this way. This in addition to two hundred or four hundred pounds of commercial fertilizer used at planting

Fig. 10.—Flint corn. Dent corn.

Select 30 ears that are nearest ideal in character, and which represent perfectly the type which it is proposed to breed. It is never advisable to select less than 25 ears, as there is danger of inbreeding if the number is few. It is best to test the vitality of each ear used in the plot before planting, in order that only those of strong germinating qualities may be used. Remove butts and tips and shell the ears

time. For commercial fertilizers see Chapter on Fertilizers.

As to varieties, use that variety which will produce the greatest number of bushels of shelled corn per acre in your locality, regardless of the time of ripening or the size either of the ears or stalks. In the South the seasons are long enough for any corn to

Fig. 11.—Coker's Prolific Corn.

reach maturity, and you do not have to select quick growing varieties. Of course where corn is planted after some crop, such as oats, wheat, clover, or some early crop has been cut, some of the earlier maturing sorts may have to be used. The United States Department of Agriculture recommends the use of white varieties as they claim that in one hundred tests made with white varieties and colored varieties the best results were secured from the white. However, the colored variety is richer in food value, and perhaps its richness in that line makes up for its lack of productiveness. Altogether we would prefer a smaller cob, to a larger one. When the cob is small 50 pounds or a bushel of ears will produce 62 or 63 pounds of shelled corn, while 50 pounds of corn in the ear of a large cob variety will only give from 52 to 55 pounds of grain. It has been found where land has to produce

large ears of corn, it will not produce as many of them. When corn is grown for ordinary purposes, it should have the following characteristics:

- (1) It should be a dent rather than a flint variety.
- (2) It should have a growing period of from 150 to 170 days.
- (3) The stalks should have well-developed roots and should average nearly two ears each.
- (4) The ears should be of good size, of uniform diameter throughout, well filled at both ends and should point downward when ripe.
- (5) The cobs should be small in proportion to the size of the ear.
- (6) The individual grains should be long and so broad at the upper end as to leave only a slight depression between the rows.
- (7) The variety should be of local origin.

As to planting, if the land is well drained it is much better to plant flat, than to plant on beds, and many of the most successful growers plant in furrows below the level, claiming that the corn stands drouth better. The land can then be worked to the corn, which will keep it from blowing down. As a rule never plant on a bed unless your land is very poorly drained. Corn should be planted from March 1st, to May 1st, according to locality; but don't be in too big a hurry. Better be a little late and get your land in good condition than to rush the seed into poorly prepared ground. As to the distance it should be planted, depends upon the productivity of the ground: if the land is fertile and will produce from 25 to 40 bu. of corn to the acre, the rows should be from three and a half to four feet apart, and planted about thirty inches in the drill. If the land is not so fertile, it should be given more space, say four and a half to five feet, and a little further in the drills. The more fertile the land, the thicker should be the corn.

Thorough cultivation of corn is necessary, but this does not mean deep cultivation. Deep plowing should be done before the corn is planted and never after the first working. Corn has not a large tap root like cotton, but is a surface feeder, and has a large number of long roots that run along near the top of the soil. To plow deep, say four or five inches, cuts these roots and the corn is checked in growth and never recovers from it. Corn should never be plowed over two inches deep after it is six inches high. It is a good plan to begin the cultivation of corn be-

fore it comes up, by using a light smoothing harrow or weeder with the teeth pointing backwards. A hay rake will do good work, with the teeth running into the ground very slightly. This breaks the crust, stops evaporation, and kills the weeds and grass in the seed bed, leaving the land smooth for future cultivation. The weeder and hay rake can be used only when the soil is fine and mellow. Cultivation should follow each rain to prevent a crust from forming, and to kill the new crop of weeds germinating. The weeder and harrow can be used until the corn is six inches high. Some ten or fifteen acres per day can be gone over with a harrow or weeder. When the corn is from four to six inches high it should be thinned to the proper distance, leaving one stalk in a place, on poor land three feet, and on rich land eighteen inches to two feet. In the South it is better to

tests of shallow cultivation gave an average yield of 74.7 bushels per acre, a difference of more than 15 per cent. in favor of shallow cultivation. In only 5 cases out of the entire number reported did the deep culture give the better results."

In times of drouth cultivation should be as frequent as possible, but deep cultivation at the time of a drouth is ruinous. If the soil is stirred an inch or perhaps two inches deep evaporation is checked. While the soil at the top frequently has the appearance of being very dry, underneath this dust mulch will be found a moist soil, which will remain moist much longer than it would were the whole surface to become compact.

There are several plans of harvesting corn. The plan that has been in general practice in the South is

Fig. 12.—Corn crop on Anderson's Farm, Marietta, Ga.

leave the corn thicker in the drill than to leave more than one stalk to the hill. It is, as a rule advisable to give one good deep working to start with, but after that, all the cultivation should be very shallow. The plan of ridging up corn by throwing the soil towards the rows at the time of the last cultivation, in order to assist the brace-roots of the corn to take better hold, and thus prevent the corn from being blown down so easily by storms, has some advantage but it has its disadvantages. This "ridging up" cuts the roots of the corn at the time they are needed most. The seed have already been formed, and what is needed is an uninterrupted supply of nourishment to enable these seed to develop to their fullest size. Many experiments have been made to determine which is the better, deep or shallow cultivation. The following is the result of such tests:

"The records of 116 such tests made at 13 different stations show that 61 tests of deep cultivation gave an average yield of 64.9 bushels per acre, while 55

to pull the blades from the corn when ripe and allow them to cure for fodder. Then gather the ears when they are dry. This plan of harvesting is a poor and expensive one and lessens the production of corn; that is, shelled corn. An experiment made at the Georgia Experiment Station produced results showing that corn weighed heavier when fodder was not pulled.

This experiment shows a gain of a small amount by pulling the fodder when considering the sale of the fodder, but it shows conclusively that corn produces less when fodder was pulled. The farmer is after practical results, and when he considers the trouble and expense of gathering fodder there is certainly nothing in it for him. For fodder to be any good it must be cured at the proper time, and not allowed to get wet. As it ripens usually during the rainy season there is very little money in it and a great deal of trouble. It is estimated by conservative farmers that fodder is worth, when properly cured, just about

what it costs to gather it. And then when you consider the risk that he runs, and the loss in the weight of the shelled corn, it is certainly not a paying business.

Corn should not be harvested too soon, as it is not so rich in food value as it would be if allowed to stand longer. Most farmers make the mistake of pulling the fodder or cutting the corn too soon. The best plan is to let it stand until the blades begin to burn up, then cut and shock in large shocks, putting not less than 150 stalks in a shock, and when dry shuck off the ears and shred the stalks and shucks. It is claimed that corn stover hay is an excellent and palatable food for horses, mules, and cattle, and the yield of grain is not diminished when the corn is pulled at the right time.

In some of the corn growing States the corn and fodder remain on the stalk until the corn is matured, when it is pulled and housed. In practicing this method you lose the stalk and fodder. But this plan is better than to pull the fodder from the stalk, as the stalk dies immediately when the fodder is stripped from it. As soon as the corn is stored in the bin or barn, one pound of bisulphide of carbon for every 100 bushels of corn should be poured over it, as it will keep the weevils and moths away for several months. It is a good plan to keep a close watch on the corn and if the weevils and moths begin to bother it, make another application of bisulphide of carbon. The U. S. Department of Agriculture, Bulletin No. 81, sums up the corn-growing question as follows:

"(1) The best soil for corn is a rich sandy loam which contains a good supply of humus. Land which has been used for growing red clover, melilotus, cowpeas, or other leguminous crops is much better than that which has been used recently for hoed crops.

"(2) In using manures and fertilizers it is better to use the coarse stable manure and the whole cotton seed on the heavier soils, and the well-rotted manure and the cotton-seed meal on the lighter soils.

"(3) All well-drained lands should be plowed flat, and high beds are advisable only on lands which are subject to overflows. When beds are used they should be wide enough for two rows each.

"(4) The best variety of corn for ordinary purposes is the one which will produce the greatest amount of shelled grain per acre, regardless of the number or size of the ears.

"(5) White varieties will usually make a heavier

yield than colored varieties, though many colored varieties are more vigorous and hardy than are some of the more prolific white varieties.

"(6) The best yields are secured from dent varieties, which require about 160 days for maturing and average nearly two ears per stalk. The ears should be of good size, have small cobs well filled at each end, and should hang downward when ripe.

"(7) Nothing is gained by planting before the ground is sufficiently warm and dry to promote immediate growth. Early plantings should not be covered so deep as late plantings.

"(8) Cultivation should be shallow and frequent, and the surface of the ground should be kept as nearly level and smooth as possible.

"(9) When other hay can be saved readily and the cornfields can be pastured immediately after the crop is gathered, it is not usually profitable to cut the stalks for fodder.

"(10) Corn which is to be stored for some time should be treated with bisulphid of carbon to destroy insects.

"(11) Seed should always be selected in the field by taking the best ears from the best stalks."

COTTON.

Cotton is a fiber plant, and is grown in the Southern States of the United States. It is grown as far North as southern Virginia, and northern Oklahoma, and as far west as Texas. There are two species of cotton grown in the United States, the upland, or short staple cotton, and the long staple, or sea island cotton. The short staple is raised much more extensively than the sea island, but the sea island brings the higher price. The sea island is grown mostly on the islands off the coast of Florida, South Carolina, and in the lowlands of South Georgia, and South Carolina. The Short Staple is raised practically in all the remainder of the cotton belt. The flowers of the short staple, or upland cotton, are white or cream colored on the first day, become reddish on the second, and fall off on the third day, leaving a small boll enveloped in the calyx. This boll continues to grow until it is about the size and shape of a hen's egg.

The cotton plant has a long tap root, which enables it to stand drouth well and to thrive better on poor land than most other crops. It is almost unnec-

essary to say anything about the soil that is best adapted to cotton-growing. Clay loams well drained and sandy loams resting on clay are both highly recommended for growing cotton. Thorough prepara-

compared with 272 pounds planted in the usual way. Cotton cultivated with a cultivator gave as good results as that cultivated with a sweep.

A week before planing at least, all the land should be in readiness for the seed. It is well to place the fertilizer in the ground two or three weeks before planting, and bed on top of that. The rows should be from three and a half to five feet apart, according to the fertility of the land. The richer the land the wider the rows. The same rule applies to the distance in the row. If the land is fertile it should have a good space, but if the land is poor it should be close together. The average farmer leaves it about twelve inches apart in rows four feet wide. We are convinced, however, that the majority of farmers leave their cotton too close.

A good cotton to be grown
(From H. G. Hastings & Co.).

tion of the land is essential to successful cotton-growing. The great trouble with Southern cotton-raisers is that they try to cultivate too much, and do not give it sufficient attention. If the farmers would plant half the acreage in cotton that they do now, and give it the same work and fertilizers they use at present, they would have better returns in the end.

Along the line of deep breaking of land the Alabama Station made an experiment about as follows: Land plowed six and one-half inches deep yielded seventy-six pounds of seed cotton and sixteen pounds of lint more than land plowed three and a half inches deep. So the experiment shows that it pays to break your land deep. There may be cases in which sub-soiling will pay, but it is the exception and not the rule. Cotton planted on ridges at the Alabama Station yielded 344 pounds of lint cotton per acre, as

Fig. 14.—Picking Cotton.

Perhaps barnyard manure stands at the head of the list as a fertilizer for cotton, and many farmers do not realize how much it costs them each year to allow their manure to go to waste. It is good to have cotton follow a crop of small grain or leguminous crop. For commercial fertilizers for cotton see chapter on Fertilizers.

The planting should be done with a good planter. The old practice of dropping the seed by hand is long out of date. These planters are cheap, and every

Fig. 15.—Ruralist Cotton.

farmer who knows what is business, will have one. Cotton should be planted in April or the first of May. The earlier it is planted, provided there is no danger from frost, the better. The seed should be covered from one and a half to two inches deep. It may be

gone over after the first rain with a weeder or harrow as suggested for corn, which will do much to facilitate the early cultivation of the crop. It will also keep the crust broken and help the seed to come up. It will kill the young grass before it has a chance to start. This is a great benefit to the crop, for cotton and grass are bitter enemies. It is, therefore, urged that the farmer plant a crop small enough to handle easily during rainy years, as these years come quite frequently. If he plants a large crop, he may manage to scratch over it once in a while, and keep the grass from taking it during dry years, but what will he do at other times? Cotton should be worked after every rain, if possible. At first, you can give it a deep plowing, but never after that. It does not pay to plow deep, for this cuts the roots and stops the growth of the plant. Do your deep plowing before you plant the crop, then it will not be so hard upon the mule or the cotton either.

As to topping cotton, there is no definite rule. It is practiced by some farmers, and others would not under any circumstances, permit their cotton to be topped. At the Georgia Experiment Station at times it increases the yield, while at other times it diminished it.

Farmers should keep their land well drained and practice rotation of the crops. Cotton should not be planted after cotton where it is possible to avoid it. In this way, the danger from rust and other diseases of cotton are avoided to a large extent.

COW PEAS.

The cowpea is a leguminous plant that is grown for both forage and human consumption. A great deal of land is void of nearly all vegetable matter and sadly in need of same. Cowpeas furnish this vegetable matter, and the crop can be grown successfully on almost every variety of soil. The cowpea is a tropical plant and quite sensitive to frost, but delights in the long hot summers. In addition it is one of the best soil renovators grown in the Southern States. It is to the South what red clover is to the North and alfalfa to the West, and it has been cultivated in the South for more than 150 years. The peas are all colors, white, brown, black. A few early varieties ripen seed in sixty days after they are planted, while it takes some of them eight or nine months to ripen seed. In between these two limits,

we have all grades. As a forage crop the cowpea has few superiors and from two to three tons of hay per acre can be made under proper conditions. There are many advantages in growing cowpeas, its greatest advantage being that it will grow on poor land and make a profitable crop, while at the same time, it improves the soil, making it more productive for other crops. As before mentioned, the cowpea is a leguminous plant, and has the power to appropriate the free nitrogen from the air, and as the air is four-fifths nitrogen, this is very important, especially since so much of our Southern land is in sad need of this element. Another advantage is that it shades the soil in the summer, keeping it in a condition most suitable for the formation of nitrogen and leaves it in fine mechanical condition for the next crop. It has a large root development, and pumps up from the subsoil much of the mineral matter needed by land in the Southern States. It grows rapidly, enabling the farmer to grow two crops of the earlier varieties in one year.

The cowpea being a legume, it is best that it follow a crop that has drawn heavily upon the nitrogen in the soil, such as oats, rye, or wheat.

The manner of cultivation depends upon the purpose for which they are grown. If vines are wanted, it would be better to plant early, as soon as danger from frost is past and the ground is warm; but if the peas are wanted it will be better to plant later. The later they are planted the less vine they make, and the quicker they set peas. They may be planted at any time from April to August. They are sometimes planted in the drill, and sometimes broadcast. If you desire to make hay, perhaps it will be better to sow them broadcast. If you want to raise the shelled pea, plant in drills two to three feet apart, using from one to two pecks of seed per acre. If you plant for a forage crop, broadcast, sowing from one to two bushels. As a rule, we think they make better hay when not sown too thickly and one bushel per acre of good seed is a very good quantity. It will pay to use a little nitrogen in the fertilizer for cowpeas, to give the plants a quick start; but if the soil is inoculated with the necessary bacteria, they will obtain this element from the air. The mineral elements, phosphoric acid and potash, however, should be liberally applied. For fertilizer for cowpeas see Fertilizer Department.

It will pay you to prepare the land thoroughly for

cowpeas, by breaking deeply, harrowing down the land and applying the fertilizer. It is better to wait until it rains before planting, as you will usually get a better stand. Cowpeas love the sun, and will not do well if sown before the soil is warm. Soon after planting, they may be harrowed, say just before they come above the ground. It will perhaps be better to use some weeder, or hay rake, as the harrow will go too deep and disturb the peas. This cultivation should be sufficient where they are sown broadcast. If planted in drills they should be cultivated at least twice.

To cure cowpeas they should be cut when the pods are about two-thirds ripe, as at this time the vines contain the greatest feeding value. The following method has been tried, and found to be a success in curing cowpea hay. First, construct what might be

Fig. 16.—Showing flue and post for curing pea vine hay.

called a ventilator tube, as shown in illustration. (Fig. 16.) This should be made of two 1x6 or 1x8 planks five feet long with slats one by three by eight nailed to the edges, forming a square of eight inches, similar to those used frequently around trees. Then a stack pole is made, say five inches in diameter and ten to twelve feet high, sharpening the lower end a little.

Then a frame is made similar to the one shown in the illustration, using pieces four or five, and sometimes six feet long. The outfit is set up, putting pole inside of the ventilator, and setting the frame shown in Figure 17 about eight inches from the ground. This platform should be eight inches from the ground. Around the ventilator, hay may be placed, as green as you please. However, the hay should not be packed with the feet, as it will be too close together. When you have piled your hay nearly to the top of the ventilator, then by getting on a ladder you may raise the tube nearly its entire length, and the hole will still remain. You can keep it in place by running a small stick through the slats near the bottom of the ventilator, and allowing the stick to rest on the hay. As you proceed toward the top, bring the stack to a point. When you have reached a point

Fig. 17.—Showing frame and flue ready to place hay on same.

take the ventilator out and use it for the next stack, and cap the stack just made, by placing a forkful of crab grass on the sharpened end of the stack pole. Then with a string, or twine, tie the cap tightly to the pole a foot from the top of the pole. In a few hours the hay will wilt and settle down, leaving the cap there like an umbrella over the ventilating flue. A cool stream of air rushes up through this flue, and cures the hay as well on the inside as the outside.

After it has remained there for a week or ten days, you can then go over the field pulling the cap nearly to the top of the hay stack.

By this method hay can be placed in the stack as soon as it is cut. There is no need of spoiling on account of rain. As soon as it is cured, it can be hauled to the barn. In doing this work, care should be observed that the hay be not packed with the feet, or any one allowed to get on the stack with their feet. This is undoubtedly the best method for curing pea-vine hay known, especially when there is danger of the hay getting wet. Of course the hay should not be cut when wet, and the mower should not be started until after the dew is off; but there is no need to fear the rain after you have stacked it.

Another method.—Nail a piece of plank one by four inches across the stack pole, and at right angles to this piece, nail another just above it. These pieces should be as long as the stack is wide. On top of these two poles place a layer of hay two feet thick, and place another set of cross bars across the pole similar to the others. Continue to place these cross pieces until you get to the top of the stack. The hay should not be stacked on the ground, but on a platform as suggested in the former method. This method is not quite as good as the other.

GRASSES.

Bermuda Grass.—There is not a more valuable pasturage in the South than Bermuda grass. It is very resistant to heat and cold, but will not grow in the shade. It is also used for hay, but is especially recommended for pastures, and will flourish where other grasses perish. It is propagated by sowing seed or planting chopped sections of the roots. The grass spreads very rapidly on good land and will soon cover the whole ground. It will pay every farmer to have a good Bermuda pasture for his stock. They need something green to eat at all times, and Bermuda will come nearer answering this demand than anything that we know of. Every farmer has some land that could be planted in Bermuda, which would bring in much better returns than it does at present. The man who owns a good Bermuda pasture can keep his stock a great deal cheaper and in much better condition than the one who does not. The seed are very fine and should be sown in the Spring after

the soil is warm, on thoroughly prepared ground, and covered by dragging a light brush over the ground. If roots are used plant in April, dropping the pieces in rows two feet apart, and cover with the foot.

Carpet Grass.—This grass is very common in Mississippi and Alabama. It is a low creeping perennial grass, and is too short for hay, but is very valuable for pastures. It spreads quite rapidly, and will drive other grasses and weeds out. It withstands frosts well, and in sections of the extreme southern part of Louisiana and Alabama, stays green all the winter.

growing perennial, growing from three to six feet high. It thrives best on rich alluvial soils, but will grow on the poorest soils, withstanding all drouths. It is valuable for hay, yielding for 3 to 5 tons per acre, and giving two or three cuttings. If cut at the right time it is equal to timothy hay in feeding value, and stock eat it readily. For a pasture, Johnson grass has no value, as pasturing will soon kill it out. The grass should be cut as soon as the head appears. It takes about one bushel of seed to plant an acre. Root cuttings may be planted a foot apart each way, and excellent results will be obtained. After it has been cut for hay for three or four years

Fig. 18.—Crab Grass and Pursley Hay—Two tons per acre.

Grown by C. E. Pleas, Chipley, Georgia.

It is usually propagated by sowing the seed. It is easily killed by cultivation, and is not a dangerous grass to have around.

Crab Grass.—Every Southerner knows what crab-grass is without any explanation. It is never sown but comes up spontaneously and frequently grows so rapidly that you can get two cuttings of hay from it in one season. The hay is much relished by stock. It is easily leached of its nutritive qualities by the rain. If it is stacked in the field it should be capped with some other kind of grass.

Johnson Grass.—Johnson grass was introduced into this country from the old world in 1830 and is now scattered throughout the whole South. It is a rank

the roots become so matted that the yield is decreased. The field should then be plowed up and thoroughly harrowed, after which the grass will grow very luxuriantly. It is the most prolific perennial grass grown in the South. It is difficult to eradicate when once firmly established, but it can be done by persistent effort. Perhaps the best way is to plow the land four inches deep in the Fall and rake out all the roots possible with a new tool called a grass hoe which has a number of sharp teeth pointing forward. Then pile the roots and burn them. The grass will not come up from the roots left below four inches plowed. In the spring if there are any pieces of roots left in the surface soil they will sprout and come up. It will then be necessary to go

over the field and pull all of these up by hand. When they are about a foot high this can be easily done and the root will come with the plant. Haul these off and burn them and you are rid of the grass.

Kentucky Blue Grass.—This grass is a native from South Carolina, west to the Pacific Coast, and north to Labrador and Alaska; but it attains its highest development in the limestone regions of Tennessee and Kentucky. This is the best pasture grass grown, and the regions where it abounds most plentifully have become world famed for their stock. As a hay crop it is not so good, for it does not grow high enough, and makes a light yield. It spreads rapidly

Fig. 19.—Tall Meadow Fescue.

by means of seed, and various runners or suckers forming a close compact sod which withstands trampling and grazing well. Blue Grass does not do well on sandy land, or land deficient in lime, and for that reason will not thrive in a great deal of the southern territory. From one-half to two and a half bushels of seed are required per acre.

Meadow Fescue.—This grass was introduced from Europe and has become naturalized all over the United States. It is of special value as a pasture grass and as a hay. South of Virginia and Kentucky

it remains green nearly all the year around, and for that reason is very valuable for pasture purposes. It is grown from seed sown from two to three bushels per acre. It takes about three years for this grass to become fully established. In good soils it will yield from one to one and a half tons of hay the first year and double this amount the next year. Overflows do not injure this plant, but some claim that it actually does it good. In Virginia it is known as Randall Grass; in South Carolina, Evergreen Grass, and sometimes it is called tall fescue.

LESPEDeza.

This is an annual leguminous forage crop. It is grown a good deal in the South, but is too tender to be grown in the North. It is used quite extensively in the South on poor clay soils. It is seeded at the rate of twelve pounds per acre and reseeds itself from year to year unless it is too closely pastured. It grows from a foot and a half to two feet high and makes a fine crop of hay. It is sometimes called Japan clover. It can be sown with melilotus, also among oats in the early spring, and will come on after the oats are cut.

MILLET.

There are a large number of grasses grown principally for forage that are called millet. There are three varieties of millet grown in this country: The foxtail millet, which is characterized by a compact bristly foxtail head, including several varieties, such as, Common, German, Hungarian, and Golden Wonder Millet. The barnyard millet includes several varieties which are characterized by dense panicle heads, and are the true barnyard millet, Shama millet, Sanawa millet. The broom corn millet, characterized by brushy heads and consists of the broom corn or Hog millet, Manitoba, etc. Millet is a very valuable catch crop, and can be grown from six to eight weeks in the summer. It will grow best on good soil, but will make a fairly good crop on poor soil.

Many feeders have a strong prejudice against mil-hay, especially for horses; but this objection is because the millet is not cut at the proper time. If the crop is allowed to become mature, or nearly so, the hay will be of poor quality, the stems being hard and unpalatable, while the excess of seed frequently causes founder. Millet should be cut for hay while the

head is still in the boot, or just beginning to show. If it be allowed to stand until the seed begins to harden, it will make a very poor feed. If millet be cut at the proper time the hay will compare favorably with that produced from any other grass. The plant grows very rapidly, and when ready to cut for hay, will not do to wait until next week. As a seed crop millet is quite valuable. It yields from twenty to forty bushels of seed per acre, and these seed sell from one to two dollars per bushel at wholesale. So you can readily see that millet is quite a paying crop to grow for seed.

Pearl or Cat-Tail Millet ("Pencillaria").

Millet is a summer plant, and requires warm weather. It will do best on a rich, well drained sandy loam, but will not thrive on heavy clays or wet lands. It may be planted from May to August. The ground should be well plowed and harrowed to free it from clods, grass and weeds. When planted for hay about one-half bushel per acre of Hungarian, German, or Common millet seed is required, but about

three-fourths of a bushel of seed, per acre, of broom corn millet. It may be sown broadcast. Millet is cut in a more immature state than other crops, and therefore should be allowed to cure thoroughly.

OATS.

Oats are grown in every State in the Union. The oat crop ranks second in number of bushels produced, and third in number of acres sown, to any other grown in the United States. Oats are successfully grown on a wide range of soils, such as poor clays, sandy loams, peaty soils, even marshy and undrained lands. The lands should be prepared by plowing and harrowing and the seed put in with seed drill or cut-away harrow. They should be planted in the early fall, in most sections of the South, as has been shown by experiments. Plant about two inches deep, and from one to two bushels of seed per acre should be sown. Seeding oats with some other grain has been practiced in the North, but if you want the greatest amount of grain and straw, it is best not to plant anything with them. Oats, when planted early in the fall, require less seed than when planted late, or when planted in the spring.

The winter turf sod oat will withstand a great deal of cold and make excellent grazing in the winter. It also makes a large growth of straw and is therefore excellent for forage. The Rust Proof variety is usually planted for grain, as it makes very heavy heads, although it is more sensitive to cold. As for fertilizers for oats, see small grain in the Fertilizer Department. It is well to let oats follow corn or some leguminous crop. They should be harvested when the lower part of the stalk or straw has turned yellow. This is better than to wait until the grain is fully matured, as a considerable amount is lost in shattering out.

Enemies to Oats.—The smuts are the most dangerous enemy to oats. One of the best treatments for any of the smuts is to soak the seed in formalin solution, using one pound to fifty or sixty gallons of water. Soak for two hours.

PEANUT.

Peanuts are trailing leguminous plants, sometimes called Ground-pea, Goober, Pinders, Earth-nuts, etc. This crop is one of the best, if not the best, for fat-

tening hogs that is grown in the South. It is strictly a Southern crop and one of great value. It would be still more valuable, however, if the farmers would cultivate it more extensively. The peanut will grow almost anywhere corn will, requires about five months to mature, and is easily killed by frost. A sandy loam is best suited for peanuts, as in

Fig. 20.—Portion of Peanut Plant.

the heavy soils the pods cannot push their way into the ground or mature. You do not need a soil rich in vegetable matter, for such soil produces vines instead of peanuts; but you do need land containing considerable lime; as without lime the peanuts will make pops instead of full nuts. When lime is lacking it can be supplied by broadcasting from 20 to 50 bushels per acre as more or less seems to be needed. There are several advan-

lent hay. Pull up the vines in the afternoon, and allow them to sun until the next afternoon, and you have a hay that you will be proud of.

Peanuts should be planted about the same time cotton is. They are frequently planted with corn, planting the corn in seven foot rows with a row of peanuts in between. When planting peanuts by themselves have the rows from two to three feet apart, with the hills from one to two feet apart in the row. They should be cultivated shallow, and not ridged. Recent experiments prove it is not necessary to shell the nuts before planting, as breaking the pods only, produces as satisfactory results, as where the former plan was practiced.

If the crop is grown for hogs, they can do their own harvesting, by turning into field just after the first frost. If grown for hay and the market they should be harvested just before the first frost. A plow is run under them, cutting the tap root, and loosening up the ground. The vines can be thrown in wind-rows, and after a day can be stacked in piles seven to eight feet high. The nuts are then picked off, and allowed to dry, when they should be sacked.

When some of the nuts are cured and fed with the hay the feeding value is greatly increased.

POTATOES.

When one speaks of potatoes, in the South, he is usually supposed to be speaking of what is known as sweet potatoes; but the most generally accepted meaning, taking the United States as a whole, is the Irish potato. So our first subject will be the Irish Potato.

Fig. 21.—Spanish Peanuts.

tages in growing peanuts. In the first place, it grows on soils that will not produce other crops, and it has no insect enemies. Nearly all crops have enemies in the insect world, but the peanut seems to be an exception. The vines of the peanut make excel-

Next to the cereals, potatoes are probably the most important food crop grown for man. The annual potato crop in the United States, is 200,000,000 bushels, and there are some counties in Europe whose crops exceed even that amount; so you can readily see that the growing of potatoes is no small business. The average yield for the whole country is a little under 100 bushels per acre, and 200 bushels per acre is considered a fair yield, while a great deal of land will produce 300 bushels per acre. An ideal soil for potatoes is one which is so light it offers no great resistance to the enlargement of tubers, so supplied with organic matter as to be rather moist without being

wet, and so rich as to furnish an unfailing supply of the necessary plant food. A rich sandy loam well supplied with vegetable matter and one naturally well drained is preferred. Very heavy clays should not be used if the farm contains a lighter soil. If sufficient vegetable matter be applied to sandy soils, good potatoes can be produced, and of better quality than where grown on a heavy soil. Potatoes should not be planted in the same field more than one year, or at the most, two years in succession. Potatoes thrive best on land which has been made rich by a liberal application of stable manure on some previous crop, or by turning under a clover sod or heavy peavine stubble. It is not advisable to apply stable manure directly to the potato crop, as it has a tendency to produce scab. For this reason a complete high-grade commercial fer-

The pieces should be covered lightly about two inches deep, using a cultivator or double foot stock, after which apply the fertilizer in a broad band ten or twelve inches wide, and cover the whole with two good furrows, which leaves a ridge over the row. As a general rule, growers distribute the fertilizer in the row and mix it well with the soil before dropping the potatoes, but better results have been obtained from the method outlined above, as the fertilizer is placed right where the new potatoes form above the seed piece.

It will require about four barrels of potatoes to plant an acre, the amount varying according to variety, size of potato, and distance.

From a recent bulletin we take the following general considerations on amount and size of seed pieces:

Fig. 22.—Loading potatoes on cars, Atlanta, Texas.

tilizer should be used directly on the crop, and the fertilizer should contain a relatively large per cent. of potash. For fertilizer for potatoes see Fertilizer Department.

The land should be thoroughly prepared, and laid off in rows about three feet apart, running them out deeply so the potatoes when dropped will be four to six inches below the general surface of the field when level. The potatoes should be cut to two good eyes and the pieces dropped from 8 to 15 inches apart according to variety, early sorts being planted closer than later varieties.

A number of investigators have noted that large seed pieces (either large cuttings or entire potatoes) afford an earlier crop than very small cuttings, a matter of much interest to growers of early potatoes. However, some growers have reported that uncut potatoes germinate more slowly than large cuttings. Most of those who raise potatoes for the early market use large cuttings rather than whole potatoes.

In this connection it may be said that the seed end half gives an earlier crop than the other half. This suggests the expediency of cutting a potato lengthwise when halves or quarters are to be planted, thus securing on each piece one or more of the eyes which

germinate first. Another advantage of cutting lengthwise is that it insures a more even distribution of the eyes on the several pieces. Of course this system is not practicable when very small cuttings are to be made from long, slender potatoes, since the large amount of exposed surface would render the long pieces susceptible to injury both from moisture and dryness.

If it is desired to cut the potato into small pieces the operator should begin at the stem end, and the pieces should be cut in compact shape, and of as nearly equal size as is practicable without leaving any piece entirely devoid of eyes. There are special implements for cutting potatoes, and their use is reported as enabling a man to cut four or five times as many bushels of seed per day as by hand. The character of the work is said to be satisfactory.

No definite rule can be given as to the best size of seed piece, for this depends somewhat on the distance between the hills and on the character of the soil and season. Another important factor in determining the proper amount of seed is variety. Some varieties are able to produce a crop almost as large from small cuttings as from large pieces. Thus, in several experiments, the variety Clark No. 1 has given indications of this capacity to produce well even with light seeding.

Soon after planting the field should be harrowed with a smoothing harrow, and just before the potatoes begin to come up; then just as the young plants begin to appear above the ground, harrow again or cultivate with horse weeder. The harrow destroys young weeds, and prevents the formation of a crust. After that they should be cultivated shallow with cultivator and weeder. Mulching with straw, leaves, hay, etc., often increases the yield, but is only practical in small gardens, and not in planting for commercial purposes. The crop should be dug when the vines die. Of course for early market it is not necessary to wait until the vines die, but as long as any portion of the vine is green the potatoes will continue to grow. In gardens early potatoes are sometimes secured by removing carefully some of the larger tubers, then replacing the dirt, allowing the small potatoes to continue growing.

In harvesting potatoes if one has a large area in cultivation a potato digger is almost a necessity. In storing potatoes they should be exposed to the light

as little as possible, and they should also be kept cool. If they are allowed to become warm, they are liable to sprout or decay, which will injure their sale, as well as their reproducing value.

The early crop of Irish potatoes cannot be kept easily, owing to the fact that they ripen and are dug in hot weather. Usually the sooner they can be sold the better. There is no difficulty in keeping late potatoes. The following summary of a bulletin issued by the U. S. Department of Agriculture on this subject puts the matter in a terse form:

“(1) A rich, sandy loam, well drained and well supplied with vegetable matter is the best soil for the potato. Stiffer land may be improved as a potato soil by green manuring and drainage, and lighter soil can often be made sufficiently rich by the addition of green manures and fertilizers.

(2) Potatoes should not, as a rule be grown continuously on the same land, but should be alternated with other crops. Barnyard manure may be freely used, but should, as a rule, be applied to previous crops in the rotation.

(3) If commercial fertilizers are used, a mixture containing nitrogen in form of nitrate of soda, phosphoric acid as superphosphate, and potash as sulphate, and in which potash predominates, is recommended.

(4) Preparation of the land should be deep and thorough.

(5) Planting without ridges generally affords the larger yields, but a stiff soil and the desire for an extra crop sometimes necessitates planting on ridges.

(6) The best time for planting depends on the climate of each locality. The planting should be so timed as to bring the period when the tubers are rapidly forming at the date when the average rainfall is ample.

(7) On mellow, well-drained soil deep planting (3 to 5 inches) is best, especially when the season happens to be dry. For the early crop, or on stiff soil with a tendency to bake, the depth of planting may be decreased.

(8) The use of the harrow before the plants are all up and frequent shallow cultivation afterwards, until the vines shade the land, is advisable.

(9) Seed potatoes grown in New England in several tests proved superior to Maryland seed both in New England and in Maryland. However, the data seems insufficient to determine the relative value of seed potatoes from different climates.

(10) Cutting the seed pieces a few days before planting appears to exercise no injurious influence, provided, of course, that the cuttings are carefully stored in the interim.

(11) The yield from planting the seed or bud end is generally greater than from the stem or butt end of the tuber. The eyes on the seed end are the first to germinate, and hence are especially important when an early crop is desired.

(12) Exposing unsprouted tubers in a warm place before planting hastens growth, but if continued until sprouts form (which are rubbed off) the yield may be considerably reduced.

(13) Experiments indicate that it is more important to cut the tuber into compact pieces of nearly uniform size than to so shape the pieces as to have a definite number of eyes on each set. No piece should be entirely devoid of eyes, and the majority of the seed pieces are large enough to support at least two eyes, and better three or more.

(14) At distances of 1 by 3 feet, and with seed tubers averaging 4 ounces, an acre requires of quarters, about 15 bushels.

(15) The total yield increases with every increase in the size of seed piece from the single eye to the whole potatoes. This increase occurs both in the large and in the small potatoes, but chiefly in the latter.

(16) The gross yield of salable potatoes (large and medium) also increases with the size of the seed piece from one eye to the whole potato.

(17) The net yield of salable potatoes (found by subtracting the amount of seed potatoes and the yield of small potatoes from the total yield) increases with every increase in the size of seed piece from one eye to the whole potato. The half potato affords a larger net salable crop than the whole potato, on account of the excessive amount of seed required in planting entire tubers. Taking the average of many experiments, it was found that for every 100 bushels of net salable crop grown from single eye pieces there were 114 bushels from two-eye pieces, 131 bushels from quarters, and 139 bushels from halves, but only 129 bushels from planting whole potatoes.

(18) These results favor the use of halves instead of wholes as seed pieces if seed potatoes and crop are assumed to be of equal value per bushel, but when seed potatoes command a very high price quarters may be used to advantage.

SWEET POTATOES.

Perhaps the Sweet Potato is of greater importance in the South than Irish potato. The climate here is better suited for sweet potatoes than in the North and sweet potatoes thrive better here than Irish potatoes. A temperature below 45 degrees is injurious to sweet potatoes, and frost is immediately fatal to them. For profitable culture, sweet potatoes require four months of warm weather, without frost, and without cold winds. The sweet potato will thrive on any well drained land, but heavy peaty soils do not make as good potatoes, so far as quality is concerned as lighter soils. The best soil is a light, but not leachy sandy loam. The fertilizer, (See Fertilizer Department) should be thoroughly mixed with the soil, otherwise it will injure the crop. The land should be plowed early in the spring, and replowed several times, so as to have it in the best possible condition when you are ready to set your slips or vines. It is not necessary to break the land as deeply as for Irish potatoes, but it is important to keep the land you intend to plant in sweet potatoes cultivated so as to retain the moisture, and keep down the grass until you are ready to plant, otherwise you will have trouble in getting your vine to live, unless the weather is very favorable. The rows should be from three to four feet apart, depending, of course, upon the fertility of the soil. If the soil is very fertile, three feet, but if rather thin, three and a half or four feet.

Most every one knows how to bed potatoes for plants. There has been a tendency in some sections to bed small potatoes, but we are satisfied that better results will be obtained in the long run, by selecting a medium well-shaped potato for this purpose. When there is a good season in the ground set the plants, allowing them to stand from eighteen inches to two feet apart in the drill. The plant should be planted a little deeper than it was in the seedbed.

Potatoes and grass are bitter enemies. It is necessary to cultivate potatoes often and to keep the grass down until the vines take possession of the fields. If they have been well cultivated up to this time, there will be no more trouble. Every one knows when the sweet potato vines come in contact with the ground they form roots. It has been a question as to whether this rooting injured or helped in the formation of

potatoes. It was for a long time thought to be injurious to the formation of potatoes, but this has been proven untrue. It has been found by experiment that such rooting in no way affects the formation of potatoes. The most critical period in the life of the sweet potato begins when it is transplanted, and ends when it begins to send out a vigorous growth of vines. It is only during this period that damage from insects amounts to much, except in the case of the sweet potato weevil or beetle, which is proving quite destructive in some parts of Louisiana and Texas. Potatoes should be dug in dry weather as soon as they are mature. When a potato is broken, and the milk oozes out and turns green, it may be considered as a safe sign that the potato is not mature. When it remains white, and very little appears, the potato is ripe.

When digging, great care should be exercised to handle the potatoes carefully, and avoid bruising them. To do this, it is better to throw the potatoes into heap-rows, instead of throwing them into piles, as generally practiced. Then go along this row with baskets or boxes, select the perfect potatoes, hauling them to the bank or house in these baskets. This saves one handling and prevents bruising. The cut and bruised potatoes should be fed to stock, and the small ones banked by themselves. If they are to be shipped they should be shipped in barrels, as they are easily bruised. One of the most important questions connected with sweet potato growing, is that of storing and keeping them through the winter, as potatoes will bring twice as much in April as they will if sold before Christmas.

The old plan of banking potatoes is about as good as the average grower can do. Cellars are as a rule damp, and for that reason unsatisfactory. The banks should have a foundation of sand, over which should be placed a good thick layer of pine straw. Then thirty or forty bushels of potatoes can be put in, and a good thick layer of pine straw placed over them. A flue made of six inch boards, should be perforated with auger holes, and placed in the center of the bank so that the potatoes can be well ventilated. This flue should be stopped up during cold weather. On top of the pine straw should be placed a layer of corn-stalks which will keep the weight of the dirt off. And a thin layer of dirt should be put on the stalks, and just before a freeze, this dirt should be made much thicker. However, if you are going into the business for

the money, it will be better to make preparations for taking care of your crop by building a potato house. It is of the utmost importance that your potatoes be stored in such a way as to keep them. The following plan has been used for a long time, which we take from bulletin No. 25, Georgia Experiment Station:

A close shed with an alley running through; double doors at both ends of the alleyway, so vehicles may pass through. On either side of the alleyway a bin eight feet interior width and as long as the alleyway or shed; the bin four feet high and constructed of double walls of inch and a quarter plank, the walls fifteen inches wide between the boards, the interstitial space filled with dry sand. This is the permanent structure. The potatoes are banked in bulk, cross divisions, however, being run for the purpose of preventing the possibility of rot in one portion of the bin extending to the entire mass. Dry pine straw is placed on the bottom of the bin, which is on a level with the natural surface of the ground—no excavation. The potatoes are piled carefully by hand in the bin, straw keeping them from touching the plank sides. They are piled nearly as high as the side walls of the bin and are heaped in the center say two feet above the sides. A horizontal cleat is tacked on the sides of the bin just below the top of the side walls on the inside to afford a resting place for a series of roof-boards which are made of 1x12 plank cut with a bevel at each end and about four feet, eight inches long. One beveled end of each board rests on the horizontal cleat of the side walls, the other bevels make a mitred joint in the center of the bin, touching each other and forming solid and substantial, though removable, rafters—or rather rafters and roof in one. After the potatoes are piled up in the bins, straw is placed several inches thick on top, and the rafters put in place as stated. The bin is then left until cold weather sets in—the potatoes meanwhile going through their “sweat.” On permanently cold weather setting in, several inches of dry sand are placed on top of the roof, thus making the bin air tight, though access can be easily had at any time to the interior by scraping away a portion of the sand and removing a couple of the boards. The sand once hauled and the roof-boards once cut, only the straw remains to be annually renewed, thus reducing the yearly cost almost to the interest, only, on the plant. A large quantity of potatoes can thus be safely and economically stored with reasonable assurance of immunity from rot.

The by-products of the potato are quite important. The vines and culls are worth a great deal to the farmer as stock food, and it is by saving these by-products that the farmer saves money.

RICE.

Rice constitutes the chief food of over half the people of the world. It is grown more in China, Japan, and India than any other country. The United States produces only about one-half of what she consumes, the rest being imported. There is no reason why the United States should not produce all she uses, and have some to spare. If she does this, then the South must do the raising. There are sections of the South that do not yield enough to pay taxes on the land, which could be made to pay good money by growing rice. From fifteen hundred to three thousand five hundred pounds of rice can be raised per acre, and this will sell anywhere from \$25.00 to \$150.00. Mr. J. C. Fletcher, of Katy, Texas, writing of his experience in growing rice, has this to say:

"One man can prepare enough land during the winter season to raise his corn, oats and vegetables for his own use and have them laid by before pumping season begins. Some use wells, others use tanks or small canals. I use a well.

"My well is one hundred and sixty feet deep. I pump from the second strata of water. I use a pit thirty-five feet deep to put my pumps in. That (35 ft.) being my lift. I use a five-inch pump with an eight-inch discharge. My boiler and engine are thirty-five horse power. It throws one thousand gallons of pure sparkling water per minute. This water runs through a flume and empties into the first levee. The ground is surveyed into levees so as to water the high and low places. These levees are thrown up as high as can be conveniently done all around the field so as to hold all the water. Cross levees are thrown up so as to hold permanently 4 inches of water all over the rice field. Small pipes are run through the cross levees at the spot set, just so the water will run into the next levee. When the water gets above the four inches in the first levee it will run through the pipe into the next levee and so on until the whole field is flooded. When I begin to pump I need two men. One to run the engine during the day, the other at night. I look after the levees and haul oil.

"I use 'Beaumont' oil. I use about six barrels every twenty-four hours at a cost of fifty-two cents per bar-

rel. I hire two men for two months at twenty-five dollars per month each and board. Average fifteen sacks per acre, three dollars and twenty-five cents per sack makes forty-eight dollars and seventy-five cents per acre or four thousand eight hundred and seventy-five dollars from one hundred acres. Expenses, one thousand dollars. Net for use of land and machinery and four mules, three thousand eight hundred and seventy-five dollars. Can you do so well with cotton and corn?"

Rice as a rule grows on land which is low and level and easily irrigated; but there are varieties which grow on fertile uplands without irrigation. The crop grown upon upland, however, is not nearly so certain, and the quality of the rice greatly inferior to that grown on lowlands. The best soil for rice is a medium loam, containing about 50 per cent. clay. The rich soils of Texas, Louisiana and Arkansas are remarkably well suited to rice culture. Rice has generally failed on peaty soils. Among the best rice lands of Southeastern Louisiana, are the so-called buckshot-clay lands, which are so stiff that they can hardly be plowed up unless first flooded to soften them. Gravelly or sandy soils are not adapted to rice growing, for they are not able to retain water. In selecting land to be planted in rice, one must keep in view the fact that rice needs water. We do not mean to say that a man cannot grow rice without artificial irrigation, nor do we dispute the fact that a man can make a crop without hoeing. To make a crop without artificial irrigation is about like making a crop without hoeing. In Louisiana, Arkansas and Texas, there are vast prairie lands that produce excellent rice. There is no expensive ditching or leveling to be done to prepare the land for rice.

Some planters recommend shallow plowing for rice, because it appears to thrive best in compact earth. But this is not sufficient evidence against the deep plowing of your land. We believe that much better results can be had by deep preparation. Deep plowing just before planting frequently brings too much alkali to the surface on alkali lands in the West. The remedy for this is to plow just a little deeper than the previous plowing just before the harvest. The alkali will then be washed out before the spring plowing. After plowing the land thoroughly, it should be gone over with the harrow, after which it should be rolled with a heavy roller.

In planting rice, care should be observed in select-

ing seed, for you should be sure that your rice does not contain any red rice, or any grass or weed seeds. Rice can be sown between the middle of March, and the middle of May, but it is a safe rule to have your rice in the ground by the 20th of April. The amount sown varies with the method to be used in sowing. Anywhere from one to three bushels per acre is the proper amount. Rice should be planted with a drill, for this distributes the seed more evenly, and the quantity used will be exact. The seed will be planted at a uniform depth, and the dirt packed over them with the drill roller. The land should be rolled before planting, for if it is not, the feet of the animals drawing the drill will push some of the rice down four or five inches lower than the other. Rice sown broadcast does not germinate and grow with any uniformity. In some cases the variation of the germination in the same field has been as much as eight days.

There are three different methods of treating rice just after planting. Some let in just enough water to thoroughly saturate the ground immediately after sowing and harrowing, and then draw off all the surface water. Others sow and trust to the amount of moisture in the land to germinate the seed. This is rather uncertain, and rarely produces good results. Then some sprout the rice before planting, by placing bags of rice in water. This plan is sure to be a failure if the land is dry when the rice is sown. If you plant in dry soil without saturation, rolling the land after seeding, and harrowing have been found beneficial. But of these methods it is believed the first gives best results. As has been stated above, rice should not be gone over with stock of any kind after it is planted.

If that be true, then we would insist that no roller or harrow go over the land. As for trusting to there being sufficient moisture in the ground to germinate the rice, that plan is too uncertain. So we recommend the use of the first system.

Flooding is one of the most important features of rice culture. Rice can be grown without any irrigation, and it can be grown with continuous irrigation, so you can readily see the wide scope between the two. We cannot lay down invariable rules for governing the flooding of rice. Usually flooding is not practiced until the rice is six or eight inches high, except where water is used to sprout the seed. The

depth of water that should be maintained from the first flooding until it is drawn off, depends upon the following conditions: If the growing crop thoroughly shades the land, just enough water should be used to thoroughly saturate the land. It is better to keep from three to six inches of water on the land all the time, and then you will be on the safe side of the question. To prevent stagnation it should be as near continuously flowing in and out all the time, as possible. It has been found that when the stand of rice is thin, the water should be deeper. In South Carolina the practice is as follows:

"Under the usual method the water is let on as soon as the seed is covered, and remains on four to six days, till the grain is well sprouted. It is then withdrawn. As soon as the blade is up a few inches, the water is sometimes put on for a few days and again withdrawn. The first water is locally called the "sprout water." After the rice has two leaves the so-called 'stretch water,' or 'long-point flow,' is put on. At first it is allowed to be deep enough to cover the rice completely—generally from 10 to 12 inches—then it is gradually drawn down to about 6 inches, where it is held twenty to thirty days. It is then withdrawn and the field allowed to dry. When the field is sufficiently dry the rice is hoed thoroughly, all grass and 'volunteer' rice being carefully removed. After hoeing it remains without irrigation until jointing commences, when it is slightly hoed, care being used to prevent injury to the plants, and the water is then turned on again. During the time water is held on the rice it is changed at least every week to avoid its becoming stagnant. When this occurs rice is liable to be troubled with the water weevil. This 'lay-by flow,' or final irrigation, continues until about eight days before the harvest, when the water is drawn off for the field to dry."

In Arkansas where the rice fields have recently been developed, the field is never dry from the time it is flooded, when the rice is six or eight inches high until it is ready to harvest, when it is drained, and cut. This practice produces as good rice as that of South Carolina, and is done with perhaps less expense.

To flood land it is necessary to have levees, and they should be constructed as follows:

"In coast-marsh and river-bottom culture a canal is excavated on the outer rim of the tract selected,

completely inclosing it. The excavated dirt is thrown upon the outer bank to form a levee. The canal must be of sufficient capacity for irrigation and drainage. The levee must be sufficient not only to inclose the flooding waters, but to protect the fields from the encroachment of the river at all seasons. When practicable the rice lands are flooded from the river, and find drainage by a canal or subsidiary stream that enters the river at a lower level. The embankment must be sufficient to protect the rice against either freshets or salt water. Freshets are injurious to growing rice, not only because of the volume of water, but by reason of the temperature. A great body of water descending rapidly from the mountains to the sea is several degrees colder than water under the ordinary flow. Any large amount of this cold water admitted to the field not only retards the growth but is a positive injury to the crop. In periods of continued drought the salt water of the sea frequently ascends the river a considerable distance. Slightly brackish water is not injurious to rice, but salt water is destructive.

"The tract of land selected and inclosed is then cut up by smaller canals into fields or subfields of suitable size, a small levee being thrown up on the borders of each. The entire tract is usually level, but if there should be any inequality care must be taken that the surface of each subfield be level. The main canal is 10 to 30 feet wide, about 4 feet deep, and connects with the river by flood gates. Through these canal boats of considerable tonnage have ready access to the entire circuit of the tract, while smaller boats can pass along the subcanals to the several fields. The subcanals are usually from 6 to 10 feet in width and should be nearly as deep as the main canal.

During the flooding period the ditches and canals become more or less filled by the mud which flows into them with the water. As soon after harvest as possible the ditch banks should be cleared of all grasses, weeds or brush, and the ditches cleaned. The levees should be examined to see if they are in repair."

The irrigating plant is a very important question to some people. If you have a stream you can use for irrigating you are fortunate, and of course this stream solves the problem. You can use artesian wells for the purpose of irrigating, using of course a tank or large receptacle to hold the water. Very frequently by digging a canal, a stream of water can be so turned

as to be used for flooding purposes. Wells are also used, and the water pumped into a reservoir. Of course circumstances will govern in this matter. A good engine, boiler and pumping outfit can be placed in service at a very reasonable price, depending upon the size of the body of land to be irrigated. A plant recently visited, capable of irrigating two hundred acres, cost about three thousand dollars in all, but the first crop of rice turned in from \$75.00 to \$100.00 per acre.

Red rice, which is a wild variety of rice containing red grains, causes rice growers no little annoyance.

The presence of a few red grains in milled rice lowers its grade and reduces its price. If it once gets a foothold in a field it increases rapidly from year to year until finally the product becomes unsalable.

The red rice and the common white rice are two separate and distinct strains. The seed of one will not produce the other. Being stronger, hardier, and more persistent than the cultivated white rice, the former becomes a dangerous weed in the rice field. Its first start comes from the sowing of seed containing red grains. The fields are reseeded from year to year mainly in this way: After the crop is harvested the stalks which have been cut off frequently send out suckers from the lower joints which mature seed. As these seeds possess remarkable resistance to premature germination, spring finds the ground well sown with red rice.

Remedies.—Two things must be accomplished to keep the fields clear of red rice: First, seed planted must be free of red rice, and the utmost caution must be exercised to secure this; second, red seed must be prevented from maturing in the field if accidentally planted.

To this end it is exceedingly important to prevent a second crop of red seed from maturing after the general harvest, which is almost certain to occur if the field is left fallow till the following winter. The land should be well drained at the time of the harvest, and within a few weeks thereafter the stubble should be plowed under. In October the land should be thoroughly cultivated with a disk harrow and sown to oats for winter pasture. If the harvest be early, the stubble may be plowed under immediately and the field planted to vetches or crimson clover for pasture. In pasturage care should be exercised not to allow any stock on these fields in wet weather. It is quite customary to burn the stubble. This may destroy

a few seeds and prevent sprouts from maturing seed, but it destroys fertilizers and leaves the land bare. Fall plowing and planting to forage crops is far more advantageous. Plowing in the early spring and thorough cultivation just before planting is helpful in reducing the red rice, but not sufficient for complete eradication.

While some of the methods mentioned for eradicating weeds and red rice are helpful, none of them have proved completely successful except summer fallowing with cowpeas or planting in corn. This plan increases the fertility of the soil, so that more rice is produced in a series of years than by uninterrupted cropping with rice.

On new land seed absolutely free from red rice should be used; then, with care, the land may be kept free from it. In case land is already filled with it, if sufficiently well drained, cultivate to corn or cotton a few years; if not sufficiently well drained, summer fallow; if this can not be done, pasture to sheep or hogs. Every rice planter should use great care, in selecting a new piece of ground upon which to raise seed, to choose a plot without possible taint of red. The seed should be examined so closely as to prevent the sowing of any red seed.

When the rice is in the dough stage, it is allowed to drain, as there is sufficient water in the ground to finish the maturity. In eight or ten days it should be sufficiently dry for you to begin harvesting. It is ready to cut when the straw begins to turn yellow. Harvesting machinery is used to harvest it with where any amount is planted, but where a small amount is planted it is harvested with a sickle. After being cut it is handled very much like wheat or oats. It is allowed to cure, and then it is thrashed from the straw. After the rice comes from the thrasher, it is known as paddy rice, or dough rice. Paddy rice consists of the grain proper, and around it a close fitting cuticle, which is enclosed in a somewhat hard stiff husk. The rice is carried through a mill, and this husk is removed. This milling process is as follows, as given in a recent Bulletin issued by one of the Stations:

"The improved processes of milling rice are quite complicated. The paddy is first screened to remove trash and foreign particles. The hulls, or chaff, are removed by rapidly revolving 'milling stones' set about two-thirds of the length of a rice grain apart.

The product goes over horizontal screens and blow-

ers, which separate the light chaff and the whole and broken kernels. The grain is now of a mixed yellow and white color. To remove the outer skin the grain is put in huge mortars holding from 4 to 6 bushels each and pounded with pestles weighing 350 to 400 pounds. Strange to say, the heavy weight of the pestles breaks very little grain.

"When sufficiently decorticated, the contents of the mortars, consisting now of flour, fine chaff, and clean rice of a dull, filmy, creamy color, are removed to the flour screens, where the flour is sifted out; and thence to the fine-chaff fan, where the fine chaff is blown out. On account of the heat generated by the heavy frictional process through which it has just passed, the rice next goes to the cooling bins. It remains here for eight or nine hours, and then passes to the brush screens, whence the smallest rice and what little flour is left pass down on one side and the larger rice down the other.

"**Polishing.**—The grain is now clean and ready for the last process—polishing. This is necessary to give the rice its pearly luster, and it makes all the difference imaginable in its appearance. The polishing is effected by friction against the rice of pieces of moose hide or sheepskin, tanned and worked to a wonderful degree of softness, loosely tacked around a revolving double cylinder of wood and wire gauze. From the polishers the rice goes to the separating screens, composed of different sizes of gauze, where it is divided into its appropriate grades. It is then barreled and is ready for market.

"**Hulling machines.**—In mills more recently erected the foregoing process has been modified by substituting the 'huller' for the mortar and pounder. The huller is a short, cast-iron, horizontal tube with interior ribs and a funnel at one end to admit the rice. Within this tube revolves a shaft with ribs. These ribs are so adjusted that the revolution of the shaft creates the friction necessary to remove the cuticle. The rice passes out of the huller at the end opposite the funnel. It resembles externally a large sausage machine. It requires six hullers for each set of burs. The automatic sacker and weigher is used instead of barreling, sacks being preferred for shipping the cleaned rice.

"With the above modification of the milling processes considerable reduction has been made in the cost of the mill. Mills of a daily capacity of 60,000

pounds of cleaned rice can now be constructed at a total cost of \$10,000 to \$15,000.

"A portable mill.—A portable mill has also been devised for plantation use, costing \$250, aside from the power to run it, and capable of cleaning 8,100 pounds of paddy rice per day. Such small machines do not give the finish required by the general market, but turn out excellent rice for local use."

BY-PRODUCTS OF RICE.

From a recent Bulletin issued by one of the Experiment Stations, we take the following on the by-products of rice:

"Rice bran contains 12.1 per cent. protein, 8.8 per cent. fat, and 59.4 per cent. fiber and carbohydrates; rice hulls, 3.6 per cent. protein, 0.7 per cent. fat, 35.7 per cent. fiber, and 38.6 per cent. other carbohydrates; and rice polish, 11.7 per cent. protein, 7.3 per cent. fat, and 64.3 per cent. fiber and carbohydrates. According to an estimate made by Dr. Stubbs, director of the Louisiana Experiment Station, rice polish is worth \$21.55 per ton; rice bran, \$20.80; rice straw, \$9.13, and rice hulls, \$8.34. These values are based on the assumption that the nutritive elements in rice are digestible in the same degree as those contained in the by-products of wheat and other cereals.

"Straw.—Rice straw is worth preserving. As a fodder for stock its value is about equal to good Southern prairie hay. Rice straw contains 4.72 per cent. crude protein, 32.21 per cent. carbohydrates, and 1.87 per cent. fats. The sweetness and excellent flavor of well-preserved rice straw adds very materially to its practical feeding value, because stock will consume large quantities of it. Digestion Experiments have not been made with the straw or any of the by-products of rice milling.

"Rice hulls.—The hulls removed from the rice in the first process of milling possess a low degree of feeding value, and being also deficient in flavor and digestibility they are of little value as food for stock; they are more valuable as a fertilizer. They not only restore to the land part of the elements of fertility removed by the crop, but increase the porosity of the soil. They also make an excellent mulch for garden and orchard.

"Hull ashes.—In passing through rice-milling dis-

tricts large quantities of hull ashes will be noticed. These are very little used by farmers and gardeners, under the general impression that they are of no value. One hundred pounds of hull ashes contain 0.82 pound of phosphoric acid and 0.93 pound of potash. There are many other better sources of potash and phosphoric acid. The amount contained in the hull ashes would not pay the cost of scattering them over the fields.

"The planter who burns his straw and sells his rice in the paddy loses 63.92 per cent. of the total mineral matter of the crop. If the rice straw and the hulls be returned to the soil as manure, 86.36 per cent. of the mineral matter of the crop will be restored, and the loss would be only 13.64 per cent. The present method of burning rice hulls cannot be too severely condemned, but doubtless will be continued as long as rice is sold in the paddy. Hulling is a process requiring very simple and inexpensive machinery. It can be done profitably upon the farm, and is done in most of the great rice-producing countries. In addition to their fertilizing value, the removal of the hull on the farm saves the expense for sacks and freight charge for extra bulk and weight, the hulls forming about 20 per cent. of the weight of the paddy. It also enables the farmer as well as the miller to determine with greater exactness the quality of the grain, thereby removing that element of uncertainty which always operates to the detriment of the farmer. It should be mentioned, however, that the hard husk of the rice tends to prevent attacks of weevil on the grain, and that rice with all or a portion of the husks on keeps better in storage or long shipment."

"Rice polish.—This is the fine flour resulting from the polishing process. It is a valuable stock food, being rich in albuminoids as well as carbohydrates."

RYE.

Rye is grown in this country for green forage and milling purposes. The grain is also used for malting, and the straw in the manufacture of paper. The yield of grain for the United States is about fifteen bushels per acre. It will grow on poorer soils than any other cereal, and as a soiling crop in the South is excellent, giving several cuttings during the winter and spring. For bread, a rather dry, sandy soil of medium fertility is best, but a fair crop can be produced on soil too poor to produce wheat or corn, and with less

care. It will not do well on wet soil. The ground should be prepared in the same way as for wheat, and if it is intended to be cut green, should be well manured with stable manure a little earlier in the fall. As it is likely to be affected with the fly, the best time to sow is in September and October. If the soil is not fertile, you should plant your rye early, so as to give it plenty of time to get a good foothold before freezing weather.

The seed should be put in about two inches deep, sowing about one bushel per acre. If you are growing the rye for forage and have good land, you will want to use more seed than otherwise, and in this case two bushels would not be too much. Be sure to secure Southern grown seed, as Northern seed will not succeed well in the South. Rye is ready to cut when the straw changes color and the kernels pass into the hard dough stage. The grain is harvested in the same manner as wheat. Special machines are in use for threshing out the grain, which will not injure the straw. These machines are valuable where the straw is used for packing or for making into paper; but of course such machines cannot be used unless one goes into the business very extensively.

SORGHUM.

Sorghum resembles Indian corn in habit of growth, but it produces its grain upon the head instead of forming ears.

It is used both as a forage plant and for the production of syrup. It will grow wherever Indian corn will grow, but will withstand drought better and yield more forage on poor land. The cultivation of sorghum has assumed quite large proportions in the South. It should not be planted until after the ground gets thoroughly warm, as it is very sensitive to cold.

As suggested, sorghum is worth more as a forage plant, than it is for the syrup. For forage it should be sown broadcast, at the rate of about one and a half or two bushels per acre. Many farmers sow sorghum and cow peas together, but the crop is more difficult to cure and we do not recommend it. If you use cow peas with the sorghum you should use from one-half bushel to three pecks of each. One great difficulty in growing sorghum broadcast is weeds. Consequently the ground should be thoroughly prepared before the seed are sown. Sorghum should be cut

when the heads are about ripe. It is important that it be well cured, for it will not keep unless it is. It yields anywhere from one to three tons of dry forage per acre. In many places, and where you have favorable seasons several cuttings may be had. As a syrup plant it is planted in rows four feet apart, the seed, as a rule, being drilled in.

Fig. 23.—Seeded Ribbon Cane. A species of Sorghum grown in Texas.

Cultivate shallow the same as corn. When grown for sprout, it should be well manured with stable manure, tankage or cottonseed meal.

"Press Bulletin 14, of the Nebraska Experiment Station, is on 'The Danger Limit in the Use of Sorghum.' The publicity given to the injurious effects of sorghum through the investigations carried on by this station to ascertain the cause has moved people not heretofore acquainted with this occasionally exhibited peculiarity of the plant, to become suspicious of it. While no further positive information has been obtained on the subject, there yet remains a word or two that may be profitably spoken.

"The records of this station do not show any cases of sudden death from sorghum occurring in the eastern portion of Nebraska, with the exception of a few which occurred on second growth sorghum. There is also reason to believe that plants producing this disastrous effect have not made a healthy growth, and are yellow and wilted, a condition easily detected by

the farmer. It would, therefore, seem reasonable to conclude that no danger is to be encountered in pasturing sorghum of healthy growth in Eastern Nebraska.

"Again it would appear that no danger is incurred if the sorghum is fed after cutting and allowing to lie for some time. A sample of sorghum was recently received by the station with a letter accompanying it, stating the plants were parts of a very few partially eaten by a cow which was killed by them in two minutes. The sample was fed to a cow on the station farm without injuring her in the least. This, together with the fact that no poison has been detected in samples sent to the station for analysis, would indicate that any toxic substances which the plants might have contained have become dissipated after cutting. The length of time required for this is not known, but it is certainly accomplished in a few days.

"As sorghum is undoubtedly the best annual mid-summer forage crop for this region, it is important that its limitations should be well defined. The use of healthy sorghum for pasturage with the ordinary precautions in Eastern Nebraska, and of sorghum hay, may be considered safe."

SUGAR CANE.

Sugar cane is a tropical plant, and grows more or less in all of the Gulf States. It is planted more extensively in Louisiana. In this country it is propagated altogether by cuttings, as it does not produce seed in the United States, and it was only recently discovered that the seed would reproduce sugar-cane at all.

Sugar-cane flourishes on rich alluvial bottom lands, but it may be grown on any fertile soil in a warm climate where water is abundant and the land well drained, and worked. The sugar soils of Louisiana range from loamy soils to almost pure clays. It is important to have the land well drained, and some experiment stations recommended using drains one hundred feet apart deep enough to hold the ground water at least three feet below the surface.

The growing of sugar-cane is deserving of more attention from the farmers of the South. While the industry is large in Louisiana, it is not grown so extensively in other portions of the South as it should be. Dr. W. C. Stubbs of the Louisiana Experiment Station while on a visit to Georgia, had the following to

say about the possibilities of Georgia in the production of sugar-cane:

"A previous visit to this State during the season of syrup-making, and a critical examination of your fields of cane and your methods of manufacture, and a subsequent examination of many samples of cane in our laboratory, convinced me of the fitness of your soil and climate to this industry. The superior saccharine richness of your canes and your abundant and cheap labor, your large supply of cheap fuel, the low prices of your land, and the ease with which it can be cultivated and drained, all suggested to me the possibility of this section making sugar and syrup in competition with the world. The large sugar content of your canes should attract readily the attention of manufacturers of sugar and central factories would surely come as soon as the farmers would guarantee the necessary cane. A central factory would not only increase the present value of a ton of cane by saving therefrom nearly double the juice which is now obtained by your small mills, but would furnish a market for many of your other products which are today unsalable. The community would find a central factory a veritable increment to the volume of business transacted. Railroads would not only profit by the transportation of cane to the factory and the sugar market, but by the increased transportation of all kinds of wares needed by the factory and its clientele, and the increased travel which a constantly growing population would indulge in. Every environment declares for central factories, and if the local farmers guarantee an ample supply of cane, few business communities can afford to be without them. In the absence of central factories, continue to make syrup. Remember three cardinal principles in the growing of cane and the manufacture of sugar or syrup.

"1. The sugar is made only in the field; therefore aim to make each acre as productive as your soil, climate and your own intelligence can effect it.

"2. After making the sugar in the field, it is almost a criminal waste to leave it in the bagasse or in the scums. Therefore mills should be adjusted to get the largest percentage of extraction possible, and arrangements should be made by which the scum should be greatly reduced in quantity.

"3. After getting all the juice possible and decreasing the losses from scums, the operations of concentration and the preparation for market should be effected in the most approved styles, remembering that

attractiveness to-day is demanded in every article, which meet with a ready sale.

"A good acre of cane in Georgia should yield at least 20 tons of cane. A ton of Georgia cane should give 1,400 to 1,500 pounds of juice containing at least 15 per cent. of total solids, and should yield an evaporation of 25 to 30 gallons of syrup. Thus an acre of Georgia cane should yield at least 500 to 600 gallons of syrup of standard density and weight, if properly handled. With a larger density of the juice which experience has shown actually exists, and an increase in tonnage, 800 or even 1,000 gallons per acre might easily be obtained."

What is true of Georgia is true of other Southern States. They are depending entirely too much on one crop. Diversified farming is the salvation of the South, and much of the diversification can commence in planting sugar-cane. More than twice as much sugar is now produced in the United States from sugar beets than from sugar-cane.

For sugar-cane, as for most other crops, the land should be thoroughly prepared by deep plowing and harrowing. When farmers realize the real value of deep plowing, they will stop scratching the surface of the land. After the land has been deeply broken and harrowed it should be thrown in beds from five to seven feet wide. Sometimes only one line of continuous cane is laid. This will not always insure a stand, and it is far better to use two layers than one. When two canes are laid side by side it will require four tons to plant an acre, using seven foot rows. In Louisiana it is planted in the winter, which results in an earlier growth; but in Georgia and Florida it is thought best to bank the seed and plant in the early spring. The cane should be covered with the good furrows. In many sections, the tops or mature joints are used for planting. In Louisiana and many other sections in the extreme southern part of the South, cane is allowed to grow from the stubble, and makes quite excellent cane. That is, when they cut the cane to make into syrup or sugar, by using a turning plow the roots from which the cane has just been cut are covered with dirt and the next year produces as good cane as before.

"The yield per acre on good land not fertilized was twelve tons cane and the maximum yield on the same land with 2,000 pounds of guano per acre, was thirty-nine tons, thus giving a gain of twenty-seven tons cane per acre as the result of 2,000 pounds of gu-

ano; the twenty-seven tons cane at \$3.50 per ton is worth \$94.50, and the 2,000 pounds guano cost \$21, this shows a net gain of \$73.50 per acre as the result of this fertilizer.

"On my crop last year I used 1,200 pounds of guano per acre at two applications of the following formula. Twelve hundred pounds 16 per cent. acid phosphate, 400 pounds, 8 per cent., cottonseed meal, 200 pounds nitrate of soda, 200 pounds muriate of potash."

Nitrogen and phosphoric acid are used as fertilizers in most cane growing sections. The nitrogen is supplied by cotton seed meal, and turning in a heavy crop of cow peas every third year. Phosphoric acid is supplied by using dissolved bone, Thomas slag, or acid phosphate. Many successful cane growers also use large green titus of tankage which supplies both nitrogen and phosphoric acid. The cane should have shallow cultivation.

As to the manufacture of syrup, perhaps we cannot do better than give a concrete case. Explaining how he manufactures his syrup, Mr W. E. Roddenberry, of Cairo, Ga., has the following to say:

"My manufacturing plant consists of one 45 horse-power steam boiler, two 15 horse-power engines, two 2,600 No. 3 roller mills, large rolls 18 inches in diameter, two galvanized iron cooking vats, with copper coils for steam heat, and the necessary pumps, piping and tanks, also wagon scales, cane derrick, cane car, bagasse carrier, etc. The total cost of this outfit approximates \$2,500, including the building.

The two mills are not geared together so as to get the best extraction by running same cane through both mills, as is done in modern mills, but are set up on the ground side by side, both mills being run at the same time and fed lightly in order to be able to key them tighter than if fed full. I have frequent breakdown in the mills, as they are too frail to do the work I try to make them do.

"I secured an extraction of juice estimated at about 64 per cent. of the weight of the cane with these mills. One fifteen horse-power engine is sufficient to drive both mills, and I have the second engine simply as a reserve in case of accident to engine in use.

"The cane is tied in bundles with ropes laid across the wagon beds in the field, about 1,000 pounds in each bundle, two bundles to the load; after weighing each load on wagon scale, the cane is lifted from the wagon by a hand derrick and placed on small car which is shoved to an inclined platform in front of the

mills and dumped from the car, which works on pivot, on to the inclined platform, the bundles of cane sliding down the incline to the mills so that one hand can easily feed each mill. The Bagasse is carried by elevators from each mill to a platform from which it is carted in dump carts direct to the field and scattered on the land as fast as ground to be plowed under later.

"The juice is filtered through a small box of black moss as it comes from the mills to remove the coarse fibre, and is then elevated by a steam jet to a larger

used for defecating or skimming and after the juice is thoroughly skimmed in same it is allowed to flow into second vat where it is evaporated into syrup, and another charge of juice let into first vat, and this process goes on in this way continually. At the outlet from the first vat into the second vat, I use a bag filter, made of thin sea island sheeting, this bag is about six feet long and two feet wide, it must be this large to allow the juice to run through rapidly; this filter or strainer removes a considerable portion of sediment that cannot be skimmed off, because it will not rise to

Fig. 24.—Sugar-cane field of W. E. Roddenberry, Cairo, Ga.

moss filter, this filter being a 50-gallon barrel packed full of black, cleaned moss, this filter barrel is placed in the top of the building so that the juice will flow from the same into the juice tank which is made of galvanized iron and is large enough to hold two charges of juice.

The two cooking vats are placed side by side and at such elevation as will permit juice to flow by gravity from juice tank into first cooking vat and from this vat into the second cooking vat. The first vat is

the top. The solid matter thus removed is largely the same class of matter that is removed by use of settling tanks in up-to-date cane mills. The skimming process is kept up constantly in the second or finishing vat, until the juice is reduced to syrup of a density registering 34 degrees Beaurne; then the syrup is drawn out into syrup tank from which the syrup is canned or barreled. If canned, it is done while the syrup is very hot and hermetically sealed at once. The syrup is strained through heavy flannel bag, as it flows from finishing vat into syrup tank, and it is sur-

prising to see how much of the black solid matter we get from the syrup with this flannel strainer, when it is considered that the juice has been filtered through three feet of moss, then skimmed thoroughly in the first vat, and strained as it goes into second vat and then skimmed continuously while evaporating. Just here I will mention that I have found it advisable to allow the heavy scum commonly called the blanket, to rise slowly and thoroughly in the skimming vat before breaking or removing the same, being very careful not to let any of it boil in, and to wait a minute or two after shutting off the steam before removing it in order to allow the scum to harden somewhat, and it is decidedly better to remove the blanket by raking it off with a paddle than to skim it off with the ordinary skimmer, commonly used by our farmers. In order to facilitate the removing of the blanket, I have my skimming vat constructed with a flange on one side twelve inches wide, and inclined at an angle of about 45 degrees and under the lip of this flange, I have a gutter into which the scum is raked and from which it flows into the skimming barrels.

"I have 4 barrels for skimming, the bottom of each being tapped with iron pipe, which is connected with same steam jet with which I elevate the juice from the mill. I fill the skimming barrels in rotation, and by the time I begin filling the last barrel, the skimmings in the first barrel have become clarified by slight fermentation, so that practically all the scum has risen to the top and left the clear juice in the bottom of the barrel. I then pump this clarified juice by means of the steam jet from the first barrel into the moss filter, from whence it flows to the juice tank. I then keep up this regular rotation of filling and emptying these skimming barrels, and by this method I am able to use about two-thirds of the skimmings. This clarified juice from the skimmings is slightly acid when it goes into the juice vat and this aids somewhat the clarification of the juice in the skimming vat.

"I use no lime or sulphur in clarification and have succeeded in making as bright a syrup by the above method as some of my neighbors make by the use of sulphur and lime. I will state, however, that these parties do not use settling tanks, which may account for the fact that they do not make any better grade of syrup with sulphur and lime than I make without it. This is one of the problems among many others that we are looking to the department of agriculture to settle for us.

"As to the quality of the syrup thus made, I will

say that I have here samples of the product for your inspection. I do not claim that this syrup is better than that made by some others in my section who are equally careful and painstaking and who employ practically the same methods, and in justice to the smaller cane growers of my section who are still using the old-fashioned mill and iron open kettle, I desire to say that in some instances they succeed in making an excellent grade of syrup, but the great disadvantage in this method is the lack of uniformity in the grade of the syrup.

"My cooking vats are elevated sufficiently to allow the condensed steam from copper coils in the vats to flow into a tank, which is elevated slightly above my steam boiler, and from this tank it is pumped while hot into the steam boiler. This is an important factor in cutting down expenses for fuel.

"My plant described above is a fair representation of a dozen or more such plants located around Cairo and represent our largest and best outfits with the exception of one at Ingleside plantation, operated by Messrs. Wight, where they have a three-roller mill weighing 8,000 pounds, and where they use sulphur and lime for clarifying; also except one now being located about 18 miles from Cairo, in Decatur county, with a capacity of 200 tons of cane per day. This plant is a second-hand outfit from Louisiana, and it is proposed to make sugar on same as well as syrup.

"The capacity of my plant is 35 tons of cane in 24 hours, and by buying cane from my neighbors, I am able to run day and night.

"I will now go back to the proposition that with a modern and first-class outfit my profit would have been increased about 50 per cent.

"By a modern outfit I mean a six-roller mill with a crusher or a nine-roller mill with a capacity of at least 200 tons of cane in 24 hours. Such a mill should give an extraction of 78 per cent. by the aid of saturation between the rolls. This mill should be equipped with chain carrier and feeder, and best cooking outfit, including sulphur and liming process, settling tanks and filter process so as to utilize practically all the skimming. Such a mill would make possible the use of bagasse for fuel, and would save about two-thirds the fuel, and would also greatly reduce the expense of manufacturing.

"With a mill of this description of large enough capacity, I could have waited to begin grinding until my cane was matured. This would have saved a con-

siderable waste, as will be seen from the following data.

"I began grinding cane October 20, and finished December 18. During the first half of this grinding season I secured an average of 19 1-2 gallons of syrup from a ton of cane, and during the latter half I secured 23 1-2 gallons per ton. Thus you see I could have gained four gallons of syrup on every ton ground during the first half of the season by waiting until the cane was matured to begin grinding. This would have given me 1,752 gallons increase in the syrup output. This increase in syrup at 27 cents per gallon is \$473. As stated above, my mills gave an average

on a smaller scale than the gentleman just quoted from, less expensive machinery must be used. He must be contented with a one or two horse mill, or a mill run by a smaller engine. The evaporator is more successful than the kettle for making syrup, for you can make a better grade of syrup, and make it much faster than the old style kettle process.

The Japanese sugar-cane has been grown quite extensively in Florida with excellent results. It has one advantage over the other cane, and that is, it can stand drought better than any other cane, is not sensitive, and for that reason can be grown in places

Fig. 25.—Russian Sunflowers.

extraction of 64 per cent. With a mill that would give an extraction of 78 per cent. the increase would have been 4,136 gallons of syrup at 27 cents—\$1,116.72

"The approximate cost of manufacturing on my outfit is \$1 per barrel of 30 gallons, whereas on a first-class plant the cost would be reduced to about 50 cents per barrel. This would have been a saving on my crop of \$315. These three items aggregate \$1,904.72, which is slightly more than 50 per cent. of my entire profit on this cane crop. This gain does not include the saving by using practically all the skim-mings. With an up-to-date cane mill, the net profit per acre on my cane crop in 1902 would have been approximately \$128 instead of \$84.

Of course for the man who goes into the business

where the regular sugar-cane cannot. When it is once planted it will last for six or eight years, while the other canes only last for three or four years, although the stalks become smaller each year. In planting the Japanese variety the rows should be placed perhaps a foot wider than the other varieties. It is said that it produces more syrup than any other cane, but will not make good sugar. It is worthy of investigation by anyone desiring to raise cane.

SUNFLOWER.

The sunflower is a native annual growing from three to fifteen feet high. The seed are used for feeding birds and for poultry, and are quite valuable as a

medicine for horses and cattle. If you desire to raise them very extensively, prepare the land about the same as you would for Indian corn, and cultivate in the same way. Many terraces and other ridges that are allowed to grow up in weeds could be profitably used to raise sunflowers on. They will be found quite valuable for chickens, and can be used all right around the house.

TOBACCO.

Tobacco is a rank growing plant which reaches the height of from two to ten feet. The plant is a native of America and was first made known to the civilized world by Columbus. It requires a very

er in leaf, and less sweet. There is another striking feature about tobacco, and that is, the readiness with which varieties mix. You may take two varieties, one a long, narrow leaf, and the other a broad, short leaf, and plant them on the same farm, and you will produce a modification of the preceding crop, although you use your utmost pains to prevent them from mixing. Thus you can see how easy it is for one to improve tobacco, and how easy it is to allow his own variety to run down. You can create a new variety or improve the old one by crossing with a plant that has the qualifications you desire. There are a great many new varieties of tobacco brought out, but when traced up, they are found to be only modifications of old varieties.

Fig. 26.—Seed beds. Plants ready to set. Connecticut Experiment Station.

short period for its growth, and is very sensitive to frost. It is grown extensively in North Carolina, Kentucky, and Virginia. The treatment here of the tobacco subject, is not intended to instruct those who have already learned to grow tobacco, but is intended only to aid those who are not familiar with it. However, the crop is of so much importance that we will go into details.

No plant is so modified by climate, soil, and method of cultivation. The inodorous product of the seed-leaf districts of our Northern States, when transplanted South in a few generations becomes as sweet as native Southern tobacco. North it becomes larg-

The German Kali Works has issued a pamphlet on the cultivation of tobacco, and we take the following, upon the classification of tobacco:

"The location, soil and climate in which the tobacco crop is grown, and the widely differing properties of these crops lead to very marked differences in cultivation. In the trade there are many sub-divisions for each class, or type, of tobacco handled, but for our purposes here we will treat of four classes as follows; (1) Cigar Leaf, (2) Export Tobacco, (3) Bright Leaf and Manufacturing and (4) Perique.

(1.) **Cigar leaf.**—Tobacco for cigar manufacture includes three different types of leaf, viz. the Con-

necticut seed leaf, the Cuban, and the Sumatra varieties. Moreover, there are different grades, resulting either from crossing or from local conditions of soil, climate, planting or methods of fertilizer employed.

Cigar Tobaccos are grown for two distinct purposes, namely: for flavor or aroma, and for texture of the leaf which properties adapt it for use as cigar wrappers. For aroma, the Vuelta Abajo may be accepted as typical, while for wrapper purposes, Connecticut seed leaf and Sumatra tobaccos are typical.

(2.) **Export Tobaccos.**—These tobaccos include several different types, each meeting various demands of the trade. Usually they are of rank growth, heavy, coarse grained and strong flavored. They are used for manufacturing smoking products required in foreign countries. Their value lies in their strength, as they are chiefly used in mixtures, either with inferior tobaccos, or with other vegetable adulterants.

(3.) **Bright Leaf and Manufacturing Tobacco.**—Bright Leaf is produced largely in the Carolinas, Virginia, and Eastern Tennessee, and is valuable for its flavor and aroma; its bright yellow color adds to its popularity. It is used almost entirely for pipe and cigarette tobaccos, and for wrapping for plug tobacco. White Burley Tobacco is grown in the Southern counties of Ohio and in the north central counties of Kentucky, and is used for plug tobacco. It is very mild, has a good flavor, and is an excellent absorbant, and for these reasons, it is popular with manufacturers.

(4.) **Perique.**—This tobacco belongs to the coarse, heavy types of tobaccos. Its distinctive properties are the result rather of the method of curing than of the quality of leaf. It is grown exclusively upon the moist alluvial bottom lands of St. James River, and one or two other Parishes in Louisiana, but its commercial importance is comparatively small. Peculiarities of flavor and form of marketing, however, make it necessary to consider this class under a special heading.

All classes or types of tobacco, belong to a single species, *Nicotiana tabacum*, closely related to wild and cultivated plants, among which are: the petunia, Irish potato, egg-plant, and "Jimson weed."

Tobacco plants of all varieties have much the same habits of growth and characteristics. They grow from three to nine feet in height, possess wide-

spread, lanceolate leaves attached spirally and alternately to the stalk, at distances of about two inches. The flowers form large clusters with pink-tipped white corollas, which, when grown in masses, present so attractive an appearance, that the plant is frequently grown for purely ornamental purposes."

The soil upon which tobacco is grown should be selected in accordance with the object of the special

Fig. 27.—Tobacco unfertilized. Experiment Farm, Southern Pines, N. C.

Fig. 28.—Tobacco, fertilized with potash, phosphoric acid and nitrogen (complete fertilizer)—Experiment Farm, Southern Pines, N. C.

kind of tobacco grown. The heavy shipping tobacco is grown upon soils that contain a large proportion of clay, or a soil that retains the moisture. On lighter sandier soils, a thinner, more delicate leaf is produced. In order to make a selection of the soil, you will have to study the effects of soil upon tobacco, as this

information cannot be given in a brief work of this kind.

Perhaps the greatest question connected with the growing of tobacco is the fertilizer question. Tobacco requires a great amount of plant food, and cannot get a sufficient supply from the natural ground. While tobacco requires a great deal of plant food, still it does not exhaust the soil. The point is this, the tobacco returns to the land the plant food it takes from it, and leaves it about in the same condition it was before. Of course it exhausts the soil to a certain extent, but only to a very small degree. There was a very prevalent idea a few years ago that tobacco exhausted the soil more than other crops, but this is not true. There is one thing true in the cultivation of tobacco, as with any plant requiring clean cultivation, vast quantities of surface soil is washed away by the rains, and in this the soil is exhausted more than by the crop itself. The remedy for this is rotation of crops.

The question of fertilizing must be studied, and printed matter can be of help, but it cannot supplant actual experience, and cannot be substituted for experience. The effect of one fertilizer upon one kind of land will be different from the effect produced by the same fertilizer upon a different soil; and in fertilizing tobacco it is quite important to avoid applying to the soil any substance that is liable to injure any desirable quality of the tobacco. While the use of chlorides will sometimes produce a superior quality of tobacco, still growers will do well to avoid the use of chlorides, as experience shows that it is liable to injure the burning quality of the tobacco. Chlorides exist as common salt, chloride of potash, or muriate of potash. Low grade sulphates of potash, such as kainit, carnallite, krugit, etc., contain a large quantity of common salt, and should not be used as a fertilizer for tobacco, and use potash in the form of sulphate.

Manure is one of the best fertilizers for tobacco known, as it contains all the elements that the plant needs, and this is an advantage no other fertilizer has. It, however, is not best to use alone, as it decomposes very slowly, and tobacco needs a fertilizer that will act quickly. The best results will be obtained by using a commercial fertilizer with stable manure.

Land for tobacco should contain plenty of humus

or decaying vegetable matter. This humus absorbs moisture and heat, and its decay makes available plant food in the soil, and for this, manure should be used as part of the fertilizer.

Tobacco requires a great deal of nitrogen, as has been shown by experiments and experience in the fields. It is not a leguminous plant and must depend upon the soil for its nitrogen, and it is important that the nitrogen in the soil be in an available form, or the plant cannot use it.

Nitrogen is obtained from a number of different products and chemicals. Cottonseed meal is one of the most popular sources of nitrogen. It acts very rapidly, and furnishes nitrogen in easily available form. For tobacco you use a good dressing of manure, a thousand pounds of meal should be applied to the acre in addition, putting on at least two weeks before setting the plants.

Linseed or flaxseed meal is often used as a fertilizer for tobacco. It is not quite so rich in plant food as cottonseed meal, but the difference is very slight. Cottonseed meal, however, being a Southern product, is cheaper and more generally used at the South.

Tobacco requires more potash than any other element, and the necessity of supplying potash is obvious to anyone. Tobacco is a potash feeder, and it is quite important to note that your land contains a sufficient amount of this element. Every farmer can test his land by planting tobacco on land without applying any potash, and planting tobacco on another spot using potash. The difference in the growth of the plant will demonstrate to you whether or not potash is needed. Also by using fertilizers containing different amounts of potash, on different plats of ground planted in tobacco will soon show how much is needed for best results.

No. 1—

Composed of	Containing
2000 lbs. cotton-seed meal,	Nitrogen, 130 lbs. Potash, 230 lbs. Phosphoric acid, 126 lbs.
1000 lbs. cotton hull ash,	
500 lbs. lime,	
500 lbs. plaster,	

"The essential elements are derived from the meal and ash; the plaster and lime only being supplied to affect the soil mechanically and to assist the burning qualities of the tobacco. Linseed meal is used instead of cottonseed when it can be bought to better advantage. This formula has also been modified by omitting the lime and plaster, adding more ash or

meal, and sometimes by adding small quantities of superphosphate, or tankage. It is also used in the following combinations:

No. 2—

Composed of

1000 lbs. cotton-seed meal
1250 lbs. castor pomace,
500 lbs. cotton hull ash,
500 lbs. double sulphate of potash,
500 lbs. lime,
500 lbs. plaster,

Containing

Nitrogen, 128 lbs.
Phosphoric acid,
45 lbs.
Potash, 288 lbs.

No. 3—

Composed of

1000 lbs. cotton-seed meal
600 lbs. dry fish scrap,
500 lbs. 96 per cent. sulphate potash,
500 lbs. lime,
500 lbs. plaster,

Containing

Nitrogen, 116 lbs.
Phosphoric acid,
60 lbs.
Potash, 267 lbs.

No. 4—

Composed of

1000 lbs. castor pomace,
500 lbs. dry fish scrap,
100 lbs. sulphate of ammonia,
500 lbs. 96 per cent. sulphate potash

Containing

Nitrogen, 113 lbs.
Phosphoric acid,
60 lbs.
Potash, 267 lbs.

No. 5. On old tobacco fields that are in good heart, a favorite formula at present is 2000 lbs. cottonseed meal and 1000 lbs. cottonhull ash.

No. 6. One well-known tobacco grower says: "My formula for a homemade tobacco fertilizer is 2000 lbs. cottonseed meal, 1000 lbs. double sulphate of potash, 1000 lbs. plaster, 1000 lbs. lime, and it is the best and cheapest fertilizer for tobacco I have ever tried."

No. 7. Another applies 10 cords of manure per acre, from 1000 to 2000 lbs. cottonseed meal, and 400 to 500 lbs. Peruvian guano.

No. 8. A formula used by several successful growers is for one acre of land that has a good supply of manure or vegetable matter in the soil:

Composed of

300 lbs. lime, or about 1 cask,
400 lbs. sulphate of potash,
500 lbs. pure bone meal,
2000 lbs. cotton-seed meal,

Containing

Nitrogen, 166 lbs.
Phosphoric acid,
140 lbs.
Potash, 234 lbs.

No. 9. Another favorite formula is

Composed of

1500 lbs. cotton-seed meal,
1500 lbs. cotton hull ash,
500 lbs. lime,
500 lbs. plaster,

Containing

Nitrogen, 97 lbs.
Phosphoric acid,
150 lbs.
Potash, 400 lbs.

Fig. 29.—Tobacco unfertilized. On farm of C. K. McQuarrie, De Funiak Springs, Fla.

Fig. 30.—Tobacco fertilized. On farm of C. K. McQuarrie, De Funiak Springs, Fla.

No. 10. A homemade tobacco fertilizer that gave good satisfaction is

Composed of

2000 lbs. cotton-seed meal,
1000 lbs. cotton hull ash,
1000 lbs. lime,

Containing

Nitrogen, 152 lbs.
Phosphoric acid, 164 lbs.
Potash, 360 lbs.

No. 11. Another, used with excellent results at the rate of two tons per acre:

Composed of

1000 lbs. cotton-seed meal,
500 lbs. cotton hull ash,
50 lbs. lime,

Containing

Nitrogen, 76 lbs.
Phosphoric acid, 82 lbs.
Potash, 160 lbs.

No. 12.

Cotton-seed meal	900 pounds
Nitrate of soda	100 pounds
Sulphur of potash, high-grade ..	250 pounds
Acid phosphate, 14 per cent..	750 pounds
	<u>2,000 pounds</u>

This mixture will contain: available phosphoric acid, 6.3 per cent.; potash, 6.9 per cent.; nitrogen, 3.7 per cent. (equal to ammonia, 4.5 per cent.).

No. 13.

Dried blood, high grade	500 pounds
Nitrate of soda	125 pounds
Sulphate of potash, high grade..	310 pounds
Acid phosphate	1,065 pounds
	<u>2,000 pounds</u>

This mixture will contain: available phosphoric acid, 7.4 per cent.; potash, 7.7 per cent.; nitrogen, 4.3 per cent. (equal to ammonia, .2 per cent.).

No. 14.

Fish scrap	725 pounds
Nitrate of soda	100 pounds
Sulphate of potash, high grade..	300 pounds
Acid phosphate	875 pounds
	<u>2,000 pounds</u>

This mixture will contain: available phosphoric acid, 7.2 per cent.; potash, 7.5 per cent.; nitrogen, 3.8 per cent. (equal to ammonia, 4.6 per cent.).

No. 15.

Dried blood	500 pounds
Nitrate of soda	100 pounds
Sulphate of potash, high grade..	400 pounds
Acid phosphate	1,000 pounds
	<u>2,000 pounds</u>

This mixture will contain: available phosphoric acid, 7 per cent.; potash, 10 per cent.; nitrogen, 4.1 per cent. (equal to ammonia, 5 per cent.).

No. 16.

Cotton-seed meal	700 pounds
Nitrate of soda.....	100 pounds
Sulphate of potash, high grade..	300 pounds
Acid phosphate	900 pounds
	<u>2,000 pounds</u>

This mixture will contain: available phosphoric acid, 7.2 per cent.; potash, 7.7 per cent.; nitrogen, 3.1 per cent. (equal to ammonia, 3.8 per cent.).

No. 17.

Cotton-seed meal	1,140 pounds
Sulphate of potash, high grade....	115 pounds
Acid Phosphate	745 pounds
	<u>2,000 pounds</u>

This mixture will contain: available phosphoric acid, 6.6 per cent.; potash, 3.7 per cent.; nitrogen, 3.8 per cent. (equal to ammonia 4.6 per cent.).

Four hundred to one thousand pounds of these mixtures should be used to the acre.

Fig. 31.—Cuban tobacco on new ground. Florida Experiment Station.

It will of course be necessary to use the proper amount of phosphoric acid and nitrogen in the fertilizer on the different plats. Under the head of potash in the Fertilizer Department, we give some attention to its source and forms used. Lime has been found quite valuable on tobacco lands. As a plant food, it has little value in itself, but its mechanical effect on the soil is excellent, and it has the power of making available plant food in the soil. A great many different materials can be used in fertilizing tobacco. We give here seventeen formulas, and these are based upon the supposition that you have used a great supply of stable manure. A mixed nitrogen supply gives better results than a single material, for if the action of one is hindered, or too rapid, the other corrects this defect.

In raising tobacco, no step is of more importance

than proper care and work in the selection and preparation of the seed bed. If this matter is neglected failure is almost certain. The spot selected should have a southern or south-eastern exposure, so as to get the advantage of the sun as much as possible in the early spring. The bed should not be nearer than thirty or forty feet from any tree, as they sap the moisture. If you have a place where there are woods to the North or West, so much the better, as they

Fig. 32.—Tobacco on new ground. Shading transplanted Plants. Florida Experiment Station.

will protect the seed-bed from the cold wind. As a rule, soil that is fresh is much better to use for a seed-bed, for there are not so many weed seed present. However, if you have not the virgin soil, select a good rich spot, black loam, and prepare your bed. Wood and brush are then piled on the bed and burned for about an hour to destroy all weed seed and insect eggs, also to supply potash for the young plants that will germinate. One tablespoonful of seed should be put on every one hundred square yard of seed bed, proper care being observed in the selection of these seed. This should produce enough plants to set six or seven acres. It requires from ten days to two weeks for the seed to germinate. The seed bed should be protected by having a good cloth placed over it on a frame, as this protects it against sudden changes in the weather, until the seed germinates. Six or seven weeks after the plants appear they will be ready for transplanting. In the meantime they should be watered each week. After they are up the cover or cloth can be removed.

The land for tobacco should be thoroughly prepared just as you would a garden. The rows are laid off

three feet apart as a rule, though sometimes three and a half feet are allowed. The fertilizer is placed in the furrow, mixed with the soil, and planted on. The plants are set about three feet apart in the row. The distance varying in some instances; the further apart the larger and coarser the leaves. Cuban tobacco in Florida is given fourteen inches apart in the drill, with the rows three feet wide. When removing the plants the bed should be thoroughly wet first, and the plants taken up from the bed one at a time. The plants are set out in a similar manner to sweet potatoes. A hole is made in the ground with a peg or dibble, of the proper size and depth, and the plant placed in position, a little water poured in, and the dirt placed about it firmly. Machines have been made that transplant tobacco very successfully. It is said that the work done by the machine is superior to that done by the hand.

As soon as the tobacco takes root it should be hoed and see that the cultivation of the crop be shallow.

Topping tobacco is the breaking off of the bud at the top of the stalk. This should be done when the button is well put out; and causes the leaves to grow much larger and ripen up more evenly. Priming consists in the removal of the four or five bottom leaves. Not all tobacco growers prime their tobacco, for they claim that the leaves should be left on as a protection to those above. When it is practiced it is topped. Soon after topping, sprouts put out, and these should be removed every ten days.

Tobacco is harvested by cutting down the entire stalk, or by gathering the leaves separately. The former method is perhaps the better. Tobacco is ready to gather when the leaves turn a greenish yellow color, or when they are brittle, and crack when bent together. After the plant is cut, if you cut the entire plant, which is advisable, it is left in the field to dry for an hour, when it is carried to the barn and placed on a stick. This is done either by splitting the stem, or by hanging the stem on a nail driven through the stick. The sticks used are laths about four or five feet long, and the plants are placed on these about six inches apart.

If you desire to cure by the leaf method, the leaves are brought in in baskets, and four or five tied together and hung over a stick. This involves more work than the other method.

Worming tobacco.—Worming tobacco should begin immediately after transplanting. The cut worm

makes his appearance at once, and you will have to look after him. A hole the size of a pin head now will develop to one the size of a dollar by the time the tobacco is matured. Mix with one gallon of corn meal one tablespoon of Paris green and sprinkle on the plants. This mixture is also good for the bud worm.

The horned worm appears in May, the second and worst brood appearing in July, by which time Florida tobacco should be safely housed. The best preventive of the big horned worm, is to plant Jamestown or "Jimpson" weed around the borders of the

Cigar tobacco barns should be near the field, 32 feet wide, 16 feet high, at least, and as long as necessary. A barn 32x50, and 16 feet high will house five acres. Tobacco left long on bottom tier poles will mould in Florida. The first cutting may often be stripped and boxed to make room for the next—say in thirty-five or forty days. Peeled poles, four or five inches thick, make good tier poles. Posts should be 4x6, set in four rows, making a driveway in the middle, with rows of 12-foot poles on each side. The two middle rows of posts should be 20 feet high, to give pitch to the roof, and eaves and gables should project 12 or 15 inches. The poles should be four

Fig. 33.—Setting and watering tobacco by machine. Connecticut Experiment Station.

field, and put into the blossoms a few drops of cobalt dissolved in honey and water or sugar and water. The moth which lays the eggs is very fond of Jamestown blossom, and the cobalt kills him. Each moth killed, prevents 500 worms. If these worms get into the field, a good flock of turkeys will search them out most industriously. The common wasp, the mud-dauber, yellow jacket, hornet, etc., all destroy these worms, as do toads, lizards and green crickets, but the last also occasionally takes a chew of tobacco. A single red wasp is said to be worth 15 cents a day in a tobacco field.

As to curing tobacco, this can only be learned from experience. We give some general details, but this is all we can do.

feet apart and laths 4 feet 2 inches long. Posts should be eight feet apart, with window between. Windows should be three feet wide and ten feet long, hung at top with strap hinges, to push out for ventilation at night, closing in day time.

When leaf stems are cured, cigar tobacco is ready to strip and box, even though all green has not disappeared from the leaf. The dampness coming in at the open windows at night, will put the leaves "in case" to handle without breaking every morning. Separate into four grades, placing each in separate boxes: First, wrappers (perfect leaves); second, binders (partially perfect leaves); third, filler, (ragged and imperfect leaves); fourth, trashy pieces, which if sold at all, should not be included

Fig. 34.—Preparing tobacco for curing. Experiment Farm, North Carolina State Horticultural Society, Southern Pines, N. C.

with the crop. If in doubt to which grade to give a leaf, put it in the lower one. Bind in "hands" or bundles of twenty or thirty leaves of even lengths, and keep under a cover till noon or after, then place straight and compact in boxes, lapping the tips and leaving space of an inch between butts and end of box, to allow escape of heat from the sweating process, which will begin at once. Till box is full, keep covered with cheap oilcloth. When full, press top down by standing on it, or with small lever. When leaves are primed off in the field, much of the grading can be done as they are strung on a cord, stringing each grade to itself. Do not allow tobacco to hang too long on poles or its life will evaporate, and never sprinkle or dip it to bring it in case for handling. Trust to air dampness to put in cellar. Early strip-

Fig. 35.—Tobacco ready for curing. Experiment Farm, North Carolina State Horticultural Society, Southern Pines, N. C.

ping and boxing preserve fineness of texture and of flavor, and prevent waste. Boxes should be 2 feet wide, 2 feet deep, and 3 feet long, for smaller kinds, and 6 inches longer each way for Sumatra and Old Florida.

It pays to sell soon after boxing, even at a smaller price rather than hold tobacco too long, as a general rule.

Fig. 36.—Typical Connecticut tobacco barn.

VELVET BEANS.

The velvet bean is a leguminous plant, which has been grown in Florida for years as an ornamental covering for porches, arbors, etc., and its value as a manuring and forage plant has only recently been discovered. Experiments in Louisiana, Alabama, and Florida, show that for the southern half of these States, the velvet bean is as valuable as the cowpeas. As cited above, experience in the growth of the velvet bean is limited, but from the experiments made, we learn that it is best to have the rows four or five feet apart, and place two beans in a hill, two feet apart in the row. Light sandy soils are best for this crop, but it can be grown on almost any kind of land. Clean cultivation should be practiced until the vines interfere. It should be cut between the time the plant is in full bloom, and the time the pods are well formed. It is quite a difficult matter to harvest the crop for hay, but it is used principally as a winter pasture for cattle and hogs, as the cattle relish the vines better after they have been killed by frost. A mowing machine with the blades in between the wheels has been used. Also a hand sickle or grass hook is used.

From two to three tons of hay are produced on the acre. The hay should be allowed to lie on the ground for two days, when it can be carried to the barn, or served in a similar manner to that suggested for cow peas.

on account of the high price of the seed they are not so popular as they would be otherwise. Hairy Vetch produces numerous slender branches from 3 to 6 feet in length. In character and growth it is somewhat similar to the English. The leaves and

Fig. 37.—Field of Velvet Beans. (Illa. Expt. Sta. Bul. 60.)

VETCH.

There are several varieties of vetches grown in this country, one of the most important of which is Hairy Vetch. Vetches are all leguminous plants, but

Fig. 38.—Hairy Vetch grown, on (a) uninoculated and (b) inoculated soil. (U. S. Dept. Agr.)

branches are covered with a coat of fine hairs, hence the name. The pods burst open when ripe, and reseed the field when not pastured too closely. If grown for forage it should be planted with rye or oats. It should be planted the latter part of August, or the first of September. If you drill the seed, one bushel per acre should be used, but if you broadcast the seed, a bushel and a half per acre should be sown. If you use oats or rye or wheat use one bushel of these seed with the vetch seed. It does best on sandy soils, but will grow well on almost any good soil after the soil becomes inoculated, and it is said to be better than cowpeas or clover as a renovating crop. This is one of the best winter renovating crops Southern farmers can use. If your land has never grown the vetches it may be necessary to inoculate with the proper bacteria. It grows all winter in the South, and for that reason is quite valuable to sow on a Bermuda sod for pasture. The common or English vetch is preferred by some, who claim that it makes the best hay and is relished more by stock.

WHEAT.

Wheat stands second in acreage, and third in yield, of cereals in the United States. It is used principally as a food for human beings, but occasionally it is fed to stock. It makes excellent forage when cut in the dough. It is quite important that Southern farmers devote more time and attention to the growing of wheat. Roller mills are established in many places throughout the South, and it is no trouble for the farmer to produce first-class flour right at home. It is much cheaper to raise wheat and make your own bread than it is to raise cotton and buy flour. One great advantage in raising wheat, corn, potatoes, and such things is, that you can rotate your crops. Crop rotation is impossible where only one or two crops grow. By planting land in wheat, you are able to use a leguminous plant afterwards, which builds up the land. It may be of interest to discuss the growing of wheat and the fertility of the soil in this connection. The University of Minnesota made experiments upon this subject, and they issued a bulletin, in which the following conclusions are given. The Bulletin is No. 70:

After careful experiments extending over a series of years, the results of which are given in this bulletin, the following conclusions were reached:

First—When wheat has grown continuously upon the same soil for eight years, there was a loss of 1,700 pounds per acre of nitrogen, about 300 pounds being utilized as plant food and 1,400 pounds lost by the decay of the animal and vegetable matter of the soil and the liberation of the nitrogen as gaseous and soluble compounds. During the eight years of continuous wheat cultivation there was a loss of over 21 per cent. of the total nitrogen of the soil, equivalent to an annual loss of 175 pounds per acre in addition to that used as plant food.

Second—When wheat was grown in rotation with clover and oats, five crops of wheat being removed in eight years, larger yields per acre were secured and the total loss of nitrogen from the soil was reduced to 800 pounds or about 450 pounds in excess of that utilized as plant food. When corn was grown with clover and oats in a rotation and farm manure was used, the total loss of nitrogen from the soil for

eight years was less than 100 pounds in excess of that removed as plant food.

Third—When the oats and barley were grown continuously the losses of nitrogen from the soil were nearly as large as when wheat was grown continuously.

Fourth—When corn was grown continuously the loss of nitrogen from the soil was less than half as large as when wheat was grown continuously. When corn is introduced into a rotation of crops, the losses of nitrogen are less than if wheat were grown.

Fifth—When wheat was grown continuously there was an annual loss of over 2,000 pounds per acre of humus due to the fermentation and decay of the animal and vegetable matter of the soil. When wheat was grown in a rotation with clover and oats, no material loss of humus from the soil occurred.

Sixth—The loss of humus changed the physical properties of the soil, causing it to be less retentive of moisture, lighter in color, and heavier in weight per cubic foot. During times of drought the soil from the continuous wheat cultivated plot contained less water than the soil from the plot which produced wheat in rotation with clover. Humus conserves the moisture of the soil, while the rotation of crops, the use of farm manures and the growing of clover, conserve the humus of the soil.

Seventh—When bare summer fallowing is practiced, a heavier loss of nitrogen occurs than when wheat is grown continuously. Summer fallowing favors the decay of the humus and the loss of the nitrogen. While larger crops of wheat are produced after a year of fallow, this increase is followed by a heavy loss of the total nitrogen of the soil. Summer fallowing exhausts the soil of its nitrogen.

Eighth—When the nitrogen and humus of the soil were conserved by the rotation of crops, and the production of clover, an increase of 20 bushels per acre of corn and 5.6 bushels of wheat were secured.

Ninth—Wheat is not an exhaustive crop when it is grown in a rotation, but when grown continuously the fertility of the soil is impaired. It is not the

crop itself that reduces fertility, but it is the lack of systematic methods of farming which cause the decline of fertility. Old wheat soils readily recuperate when some humus form of materials are returned to the soil. By the rotation of crops, the use of farm manures, and the cultivation of clover, the heavy losses of nitrogen and humus from the soil can be checked and larger yields and a better quality secured.

To get the very best results wheat should be planted on fertile soil. Rich clays and heavy loams are the best when they are thoroughly drained. Calcareous soils are also considered good wheat lands. Land for wheat should be well broken and thoroughly worked down with harrows and rollers until you have a firm, fine seed-bed. When we consider the fact that most, if not all the cultivation is done before planting, it becomes more necessary than ever to thoroughly prepare your land. It may possibly take longer, but time that is spent in preparing land for crops is never lost. The object of every farmer should be to produce the most wheat possible on a given tract of land and thorough preparation is absolutely necessary in order to get the best results. If you are going to raise wheat, and if you are a farmer in the highest sense of the word, you will, take pains when preparing your land to make it do its best. It has not been found advisable to subsoil land for wheat. It is necessary to have the soil firm underneath, and subsoiling makes this more difficult.

For fertilizers for wheat see Chapter on Fertilizers in another part of this book.

Wheat should be planted in the South from the middle of October to the middle of November, or as soon as possible after the first white frost. The object in planting at this time, is to give the plants a chance to get started before the cold weather sets in. Spring wheat should be sown as early in the spring as the soil and weather will permit, but this is seldom, if ever, practiced in the South. Wheat should be drilled in rather than broadcasted, as the drill puts it in more evenly. It may be, however, sown by hand broadcast, and worked in with a disc harrow or cultivator. From one to two bushels of seed should be sown per acre, according to the size of the grain and the time of sowing. A bushel of small grains will contain two or three times as many kernels, as a bushel of grain containing large grains. As a rule, about a bushel and a half is the proper amount to plant. Harrowing winter wheat in the spring does not pay, as experiments on that question prove that the yield is smaller when harrowed than otherwise.

Wheat should be harvested when the grain is fully in the dough stage. It can, at this time be compressed between the finger and the thumb and is still not milky. By the time the grain is fully ripe, the cutting should be complete. If you defer harvesting, much of the grain is lost by shattering, also the feeding value of the straw is less when you wait too late. Reapers, binders, and headers are used to gather the grain in most places. The cradle is used little, and should be used much less than it is at present. It does not pay unless you have a very rough piece of land or very little wheat is planted.

SIX HEADS CABBAGE GROWN BY NEW NOAKES, NUECESTOWN,
TEXAS (Near Corpus Christi).

(Courtesy of H. G. Hastings & Co.)

BOOK II.
GARDEN DEPARTMENT

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ATLANTA, GEORGIA.

MARKET GARDENING.

There is no question of more interest to the South than market gardening. The Southern cities are coming to the front, cotton factories are being built, and many industries established. All these industries require vegetables for the employees. These vegetables must be furnished by some one, and the Southern farmer is the one to furnish them. Up until a few years ago, little attention was paid to gardening in the South, but developments have been made, and now around every city, and most of the towns will be found many men who make their living by selling vegetables. About \$100,000,000 is invested in truck farming in the United States, the products of which will reach a valuation of \$75,000,000 which is produced upon 534,440 acres of land. Formerly each vegetable had its season, and any attempt to secure that vegetable out of its regular season, which only lasted for a few weeks, would prove futile. Now, every vegetable can be secured at any time.

That there is money to be made in truck farming there is no doubt. The South must, to a large extent, supply the early vegetables for all the United States. Market gardening is just in its infancy. It is an industry that requires a great deal of study and brain work; but it is a business that will yield good returns. It requires more money to grow vegetables than it does to grow field crops; still, the returns amply pay for the greater expenditure.

Alluvial soils with gravel or porous clay subsoil, are best for vegetables. But this, like many other things connected with agriculture, cannot be placed under definite laws, for here, also, circumstances alter cases. It frequently happens that nearly pure clays and apparently inert sands have been made to yield satisfactorily for the time and attention devoted to them. A lighter soil means an early crop, while a clay soil means a later crop. As a rule, it is the early crop that pays best, though there are many exceptions.

Success in market gardening depends more on the proper location than anything else. No matter how good the land may be, how fine the vegetables produced, unless the garden be located where produce can be easily shipped or sold in a good local market it is almost worthless. So you must locate where you

will be accessible to the market, if you wish to succeed. If you have to haul your produce a long way over rough country roads before reaching a shipping point, the quality of your goods will be materially affected. Moreover, the question of the necessary supply of labor must be considered by the wise man before he embarks in the business of growing vegetables and small fruits. This question is of great importance, for it will be useless to try and grow vegetables without plenty of labor.

The question of fertilizers is of great importance to the truck grower, and it is safe to say that stable or barnyard manure is the best for gardening purposes. However, in some localities it is impossible to obtain it in sufficient quantities, and for this reason it cannot be used. Wood ashes are also quite valuable for fertilizing purposes when they can be procured. For commercial fertilizers we give a list of formulas under the Fertilizer Department.

In selecting a place for your garden try and get land that is warm and naturally well drained. If it is not naturally well drained, you had best tile drain it to begin with, as it is impossible to grow large crops of early vegetables on poorly drained land; and while tile draining is expensive to start with, your increase will soon pay the difference. Drainage is very important, as it enables the air to enter the soil, also keeps the soil warmer. The chemistry of garden plants is discussed under the Fertilizer Department. We also refer you to the Agriculture Department, proper, for treatment in the development and growth of seeds.

HOW TO PREPARE A SEED BED.

The ordinary size of a convenient hotbed may be ten feet by six or seven feet wide, or it may be only of the dimensions of a common window sash, three feet by four, more or less. The shape has nothing to do with the definition, which may be to the effect that a hotbed is a box covered with glass, the whole placed upon a bed of soil resting on a bed of fermenting stable manure, the heat from which rising in the form of vapor warms and moistens the soil within the box, while at the same time, the sun's rays passing through the glass are retained to warm and vivify the surface.

The location of the hotbed has much to do with its success or failure. It should only be placed on

land always free from flooding, preferably on a declivity, with good subsoil drainage, sheltered from cold winds, and facing south or southeast. As an example of a hotbed frame, we will describe it as a box for one, two, or four sashes, each seven feet long by three and one-quarter feet wide. This dimension of sashes is given because it is easy to handle. The width named will allow for four lengths of 8x10 glass placed lengthwise. Whatever the dimensions of the sashes, all should be alike so as to be interchangeable. The frame may be permanent, of brick or stone; or temporary, of boards; it may be regularly built by a carpenter, with strong corner-pieces, or a gardener can do all the work himself and attain

Fig. 1.—The Early Hotbeds.

just as practical results. Doing the work himself, he may proceed as follows: The length and breadth of the frame having been decided upon, excavate a space 2 ft. wider and 2 ft. longer than the indicated dimensions and 18 in. deep. After the excavation is completed, drive down at four corners post of proper lengths, four by four inches square, to which nail the sideboards; the posts on the back of the frame being twelve to fifteen inches above the surface level, and those in front of the frame 6 or 8 inches; nailing the boards only to those portions of the posts which are above the earth level; the boxes, as it were, standing on stilts; it being desirable to use as little lumber as possible. The excavation is for the purpose of keeping the material and contents of the bed as much removed as possible from frigid air currents, and thus economize manure.

Into the excavations of eighteen or twenty inches of depth, throw one foot in thickness of cornstalks, leaves, halfrotten, straw and coarse manure; these principally for preventing dampness and to facilitate drainage. On top of this coarse strata spread a layer of three to four inches of good horse-stable manure, just beginning to ferment. Avoid pig or cow manure, as they do not heat. The manure for hotbeds must be well manipulated, that the fermentation may be prolonged, and this is best done by shaking out the manure loosely with forks, and, if exceedingly rich, mixing it with some poorer material. Otherwise the fermentation will be too fierce and of too short duration. Indeed, to secure thorough mixing, it is well to turn the manure intended for hotbeds at least three times at intervals of two days, and when transferring the manure from the pile to the bed it should be done quickly that the manure be as little exposed to the chilling influence of the air as possible.

Tramp the manure down and spread it from end to end and side to side; when done, repeat with a layer of three or four inches, and when this is spread and well tramped down add a third layer of the shortest and best unfermented manure, as this will subsequently be a feeding ground for plants. The various layers of manure make twelve to fourteen inches in total depth. If the tramping, spreading, and quality of material be not evenly distributed in the bed it will be irregular, and the subsequent growth of the plants the same. For early beds use the manure liberally. Very late hotbeds can be made without any, as the sun in the late spring will give sufficient heat.

Manure for Hotbed.—As fresh horse-stable manure when used alone is very heating and soon cools; it is best to mix with it leaves or half-rotten straw, as seed will be burned over manure of too high temperature. Of course, it is impossible to indicate fixed dates for sowing over a country so broad as this, and with such a variety of climatic conditions.

COLD FRAMES.

Many farmers and gardeners do not know how to make a cold frame. This is a very simple matter in the South. Select a protected spot and stake off where you wish your bed to be, a strip six feet wide

and as long as necessary. Plow this up and fertilize heavily with rich old compost. The soil should contain a large proportion of sand, and if it is naturally stiff it will be best to add some sand to it and work it with the manure. After the bed is ready, put up a twelve inch board in front, having the two lines of boards about six feet apart or just far enough for a six foot sash to lay across nicely. Put in a cross piece of 1x4 every ten feet to hold the two lines of plank at an equal distance, and steady at the top. Then bank up earth around the outside against the boards, and your bed is ready for the sash. In the latitude of Atlanta it is best to use the regular 3x6 foot glass sash, but farther South frames covered with cloth can be substituted.

See that plenty of ventilation is given the plants in the beds during bright days and that they are not kept too warm, especially cabbage plants. Where the beds are allowed to get very warm the plants become very tender and are much more likely to get killed if there comes a big freeze.

SOWING SEEDS.

Every one familiar with farming knows it is quite important that land should be well prepared before any seed are placed in it. He who hopes to be successful raising vegetables without thorough preparation of the land, is a fit subject for the insane asylum. But many people do practice the plan of trying to garden without preparing the land. They think the tiny seed should be able to adapt itself to the same conditions under which the larger field seed germinate and grow. Many men, on the other hand, know that the land should be prepared, but they do not know how this preparation should be done. The only way they can learn is by reading, observation, and experience. And let us digress long enough to say that if any one fails to learn by experience, he stands in his own light. You cannot be truly successful unless you are a close enough observer to learn by experience. If you continue to make the same mistakes year after year, you cannot hope for success.

No definite law can be laid down for the preparation of land. The main thing is to try to have the conditions right for the germination of the seed, and this is to have your seed-bed fine and firm to the bot-

tom of the furrow. Much disappointment results in planting seed at the wrong time, covering too deeply, or not covering deeply enough; or from planting a variety or a vegetable that is unsuited to your conditions, climate, soil, etc. It is, of course, necessary that you plant the proper amount of seed per acre, but many farmers and gardeners make the mistake of planting too few seed. You must get a good start, for it is much easier to thin out than to replace. The real difference in planting a great many seed and in planting a few is in the cost of the seed, and you can readily see this is such a small matter that a farmer cannot afford not to have enough seed to insure a stand at the start.

In a country so large as the South, it is hard to lay down a definite rule for the cultivation of the garden. It is a good idea to watch the successful truck farmer in your neighborhood, and follow largely in his steps, until you have acquired experience. Above all things, the land should be well prepared, and made fine and mellow. Small seeds will not come up and grow well in tough, cloddy ground. Therefore, see that the land is in the very best condition to receive the seeds. As to when each different kind of seed should be planted; this depends largely on locality, and the kind of plant you wish to grow. It may be laid down as a general rule—though there are exceptions to it—that it does not pay to put the seed in the ground too early, that is, before the soil gets warm. Many of the seed will rot in cold, damp soil and those that do not rot will not germinate until the soil becomes warm.

THE GERMINATION OF SEED.

The process of germination covers that period of time from the moment the dry seed are placed in the ground until the appearance of the plant. Very few garden seed will commence germinating at a temperature lower than 50 degrees, many requiring the soil to be much warmer than that. On the other hand, too much heat dries up the grains, and prevents germination. Experiments indicate that most varieties of seed will germinate rapidly in a temperature of from 70 to 90 degrees. Spinach, on the contrary, will germinate best in cool weather, and will hardly come up at all in hot weather. It is quite important that the seed have a sufficient amount of moisture. Some seeds require more moisture than others. Some will only germinate in water, while others require

very little. Garden seed germinate best when the soil is moist but not wet. Too much moisture causes the seed to decay. The time required for seed to germinate varies very widely. Some seed, such as peas, beans, corn, and a few others, will germinate in three days; while cabbage, turnips, and radishes usually require a little longer. It is not always true that seeds which germinate will produce vegetation, for it is frequently the case that the sprout cannot push its way through the soil on account of being covered too deeply, or because of the ground baking on top of it. In growing vegetables you want to produce as rapid a growth as possible, for by so doing you can overcome the dangers arising from floods, grubs, insects, etc., which so often injure your plants. And the quickly grown vegetable is always the most salable.

Seed frequently lose their vitality. This is particularly true in the Southern States where the air is moist and the weather warm. Many seed, after one year, lose their vitality. This is especially true of onions and salsify. There are methods of testing seed. Placing seed between two layers of damp or wet blotting paper will determine whether they are sound or not, in a very few days. While we are speaking upon this subject, it will not be out of place to stress the importance of using pure seed. Many sore disappointments are brought about on account of the seed not being pure. See to it that you purchase your seed from a reliable seed house, and that they are fresh. Such a firm cannot afford to put out old or impure stock.

Many seed are first planted in beds and afterwards the plants are transplanted to their permanent place. This is done for several reasons: In the first place, the space where the crop will ultimately stand may be occupied by some immature crop. Then too, small plants, such as celery, would be overcome by weeds, or eaten down by insects. It is much easier to look after a small seedbed than it is the whole garden. It is also done in order to get earlier varieties of a fruit or vegetable. For instance, by planting tomato seed in a hotbed the plants will have a good start before it would be possible to plant them in the open field. Transplanting, as a rule, should be done in damp weather. Many farmers and gardeners make the mistake of pulling up the plants from the bed, thus stripping them of their rootlets. This

should never be done. Plants should be removed with a trowel or similar tool. Most plants should be transplanted deeper than they ordinarily stood in the seed bed. The root and rootlets should not be allowed to point upwards, but should be spread outward and downward, as is the natural tendency of the plant. The soil should be pressed down firmly around the stem so that the roots will come into firm contact with the earth.

In small gardens it is a good practice to mulch after transplanting the plants. This is simply covering the soil around fresh set plants, vines or shrubs with three or four inches of litter, straw, hay, leaves, manure or weeds, to prevent an excessive evaporation of moisture from the soil. Mulching has some advantage in that the crop that is mulched will remain comparatively free from weeds except when one will occasionally push its way through; but these can be easily pulled up. Moreover, it keeps the ground in a good mellow condition. If you have never tried mulching it would be a good idea to experiment with it.

ROTATION OF GARDEN CROPS.

Just as it is important for the farmer to rotate his field crops, so it is with garden crops. There are many reasons for this. In the first place, to keep planting the same land in the same crop year after year soon exhausts certain elements of plant food, and unless very large quantities of manure are used the land fails to give the very best returns. Then, too, there are certain fungus diseases that will live over the winter in the soil, and should your land be infested with these it will mean great loss to plant the land again in the same crop. In a proper rotation there are certain crops which do better if they follow certain other crops. Peas may be followed by kale or turnips, Irish potatoes by late cabbage or ruta бага turnips, but tomatoes or egg-plant should never follow potatoes. Beans may be followed by turnips, winter radishes, lettuce or collards. This list only suggests to you something of what is intended. It is a good idea to try to rotate crops as dissimilar in character as possible. Rotation is a great help in keeping vegetable crops away from insect pests, which are apt to become very disastrous where the same crop is grown in the same place a number of years in succession.

PACKING AND SHIPPING VEGETABLES.

One of the problems of gardening is marketing the vegetables after they are grown. And right on this point is where many farmers and gardeners lose money. It makes little difference if fine, large vegetables are grown, unless they can be put on a good market, in good shape. The price obtained for produce shipped North by Southern gardeners depends largely upon condition of produce when it reaches its destination, and the amount of such produce on the market at that time. It is useless to ship produce from the South to the North at a time when it will decay before it reaches the market. It is also a losing proposition to ship vegetables to the North when the market is supplied nearer home. For example, tomatoes shipped to Philadelphia from the South in March or April bring anywhere from \$3.00 to \$5.00 per crate, but in June they will bring very little, for they will come in competition with the crop from Maryland or Delaware; and besides, the weather is so warm in June that the tomatoes shipped then are liable to spoil before they reach the market. Many gardeners also lose money by shipping tomatoes too green. During the shipping season the field should be gone over every other day at first; and later, every day, and the fruit gathered just as soon as they start to turn. They should also be carefully selected, wrapped, and placed in good crates.

Vegetables generate heat and moisture, which increase as the temperature rises. If this heat and moisture is removed rapidly the fruit will keep much longer and much better. In other words, the crates for vegetables should be of such a size as to permit free ventilation. Barrels are poor things to ship vegetables in, with the exception of potatoes, as small packages carry much better. When you have secured the proper crate or package the next thing is to see that the fruit or vegetable is properly assorted before it is packed. A few spoiled or poor specimens of fruit or vegetable will injure the sale of your whole lot. The packing should be done in the shade, and it is much better to pack where they can be cooled by passing breezes. When packed in the hot sun they will not keep near so well. You see to it that the outside appearance of your package is neat and attractive. Some shippers are of the opinion that the transportation company will pay especial attention to their shipments, and are therefore careless in

regard to shipping them. Remember that you will be treated as any other shipper, and unless you go to the trouble of correctly packing, marking and shipping your vegetables you cannot expect good returns. The earliest crops command the best prices. But do not sacrifice quality in order to get your produce on the market first.

THE FARMER'S GARDEN.

How can a farmer living on a farm and always busy, so manage his garden as to secure the largest amount of fresh vegetables at the smallest expenditure of time and labor. "Now," says a writer in the Review, "I am in no sense a market gardener, nor do I raise vegetables for any other purposes than to secure for my family a succession of vegetables the year around; but anything I may say in this article is the result of fifteen years' experience with a farm garden. In selecting your garden have it as conveniently situated as possible; if not rich or well drained it should be made so. One-quarter of an acre is not too much, and if small fruits are to be included in it, it should be larger. I do not approve of such though, in the vegetable garden. While they are a great luxury and should be on every farm, it is better to keep them out of the garden. The shape of the garden should be oblong, giving long rows. All herbs, beds of asparagus, rhubarb, beds for cabbage and early plants should be placed on the same side together, leaving nothing to interfere with the thorough cultivation of the vegetables. The old way of having a small garden for the "women folks and children" to work in the spring, and which went to weeds in the summer, is mostly a thing of the past. The garden of the progressive farmer is as up-to-date as himself. He gives the same careful cultivation to his garden that he does to his corn or wheat, realizing its advantages and recognising the fact that it is a part of the farm; demanding and receiving its full share of work, and no longer left neglected.

Of the very greatest importance is your choice of seeds. Send early for the catalogues of the leading seedsmen. They are lovely to look at, and much useful information can be gleaned from them. If you are just starting a garden for yourself they will be a great help to you and their description of the different varieties grown which will enable you to de-

cide which is most suitable for you. It is best to order early and get plenty of seeds, so if a late frost or a hard rain injures your stand you can plant over at once. Prepare your ground thoroughly. Vegetables delight in a rich, well prepared soil. In laying off your rows keep them perfectly straight, as the cultivation is much easier. Make your rows 2 1-2 or 3 feet apart; I prefer 3 feet. A wheel hoe is a good thing, but I can take a mule and cultivate a garden quicker and better than any other way. My garden is treated like my crops; first plowing it deep, then I cultivate often and shallow. If dry weather comes on I cultivate more and keep a dust mulch to save the moisture. Just as fast as early vegetables come off, I replace them with others. My aim is to have no empty rows for weeds. I plant radishes every Friday, to have plenty, and beans every two weeks. After May, I plant all vacant rows in cow peas; in August sow turnips, winter lettuce, and radishes; in September set out winter cabbage; in October all my garden is broadcast to mustard, kale, and spinach, which gives an abundance of green for winter, and serves as a covering for the land. In short, I practice intensive farming. This requires plenty of fertilizer and high cultivation; but it pays. I save no seeds; I leave that to those who make a business of it and understand it. My business is to raise vegetables, not seeds. All chicken manure is put on the garden, scattering it between the rows as fast as made. I find it good for onions and cabbage, especially. That vegetables and fruit are healthy, is certain. I have a large family, but in fifteen years our drug and doctor's bills together will not average \$5.00 per year. Give a farmer's wife a good garden, milk and butter, and eggs, with a plump chicken, and she will prepare a dinner that is fit to be set, not before a king, but before an American farmer, who surely deserves the best in the land, for does he not feed the world? Prepare your garden, plant your seed, cultivate it well and enjoy the fruits thereof."

VEGETABLE NOTES.

If you let your strawberry patch get in the grass you are going to have trouble.

Try a small patch of Chinese Winter Rose Radish. They are fine for home use and the local market.

We have made our best fall lettuce in open ground by sowing the seed the latter part of August. Flori-

da Header and Big Boston are excellent varieties for this purpose.

When you set out those celery plants do not forget to make the land rich. Fill up the furrows with good, old compost; then try irrigation. Celery is 84 per cent. water.

If the land you wish to plant in vegetables in very grassy when plowed, run over it several times with a Planet Jr., or Iron Age Cultivator, with three inch scooter attached. This will tear up the grass so it will die. Then run a straight tooth harrow over the field and drag out as much as possible. Repeat the operation, and you will soon have your land in shape.

It is often a difficult matter to get seed to come up in hot weather, even when they are perfectly sound, unless the conditions are just right. If the weather should happen to be dry when you wish to plant, try tramping in the seed with your feet. We have often been able to bring up seed in this manner when otherwise they would not have come up at all. We like best to have land prepared ahead, get a good rain on it, and then rake or harrow off the rows and plant. We almost always secure a stand when we do this. We have also found it necessary to shade lettuce at this season in order to get it to germinate well.

Don't wait until the last minute to prepare those hotbed sashes, but begin to overhaul them now. A good coat of paint will add to their usefulness.

For the early crop, we find that the early varieties of cabbage like the Early Jersey Wakefield, pay us best. The second, or mid-section varieties, usually find a glutted market and show a much smaller margin of profit.

October is an excellent time to plant spinach. The weather is cool and the seed germinate well. Seven Top turnip for spring salad may also be planted in open ground.

We find it a good plan not to spread manure on land intended for early vegetables until after the land has been plowed in the spring. Where the manure is spread during the winter it prevents the land drying out, keeps it wet until late in the spring, and delays planting.

When sowing seed of almost any description very early in the spring we find it best to plant very shallow. In fact, it is hardly necessary to cover seed like turnips at all when they are sown on freshly prepared land. The rain will usually cover them as much as is necessary and they will sprout and come up much

quicker, and you will obtain a better stand than if they were covered deeper.

If you use cottonseed meal as a fertilizer, be sure to apply it at least ten days before you plant, and see that it is well stirred into the soil and does not come in contact with the seed; otherwise you are very likely to lose your stand. We have seen it kill turnip seed and even snap beans. It does not seem to affect beets, however.

Try an application of quick-lime on the land you intend to plant in turnips. It will help to prevent scab and make nice, smooth roots.

When applying lime to land for any purpose do not let it air slack, for in doing this it loses much of its strength. It is much better to haul the lump lime direct to the field, scoop out a hollow place in the ground at different places where the lime will be needed, put in several barrels of lime, throw on a little water and cover the whole pile with earth. In this position the lime will crumble to a fine powder so it can be spread without losing any of its strength, and you will find it much more effective. Use about 40 bushels per acre.

We have found that a good application of lime to land which we intended to plant in tomatoes prevented their dying from blight.

An application of lime to some soils has been found to more than double the size of lettuce. It will also prevent lettuce from damping off in cold frames.

Lime will make clay land more friable, and sand less loose. It will sweeten sour land and where land is poorly drained, is a great help toward making it productive. Do not let it come into direct contact, however, with either guano or manure.

ARTICHOKES.

No farmer who is raising hogs should omit a good supply of Jerusalem artichokes for the hogs to feed on during the late winter or early spring months. They can be grown with half the labor needed for sweet potatoes, will yield from three to five times as much, and, bushel for bushel, are worth nearly or quite as much. They can remain in the ground through the winter without injury by freezing, and are so available for fresh feed at a season when potatoes, peanuts and other similar hog feeds have been exhausted.

They are not particular about the soil on which they grow, though a rich, sandy loam is best, and a

dry, heavy, and barren clay the poorest. A good sweet potato soil is a good soil for artichokes. The land needs no special preparation, but we prefer it plowed broadcast so as to plant on a level. Seed can be purchased from most seed dealers, and about as much per acre is needed as is needed for Irish potatoes. The tubers are about as large as potatoes, and can be cut in the same manner. When to be planted early, on rich soil, which is in good condition, very small pieces may be used. Lay off in rows four feet apart, drop the seed about eighteen inches apart in the rows and cover with a plow. No fertilizer will be needed on good ground.

Fig. 2.—Jerusalem Artichoke.

The only cultivation necessary is what will be needed to keep the ground clean from weeds and to prevent the surface from becoming hard and baked. Usually one thorough harrowing about the time the plants come up, and two later cultivations are sufficient, and by the first of July the plants should be so large as to shade the ground and prevent any further growth of weeds. As the tubers are not formed until late in the season, and are clustered very close to the bottom of the stalk, we like to make the last cultivation with a turning plow, and then throw the dirt toward the rows.

Harvesting may be safely delayed until January, and then only enough for planting need be gathered. Plow up a few rows, gather up the tubers, and bury or store them away like potatoes; then let the hogs have the rest. If more convenient a small part of the field may be fenced off from the lot where the hogs run, and the tubers allowed to remain where they grew, until needed for planting.

A few who have grown this crop claim that their hogs did not relish the roots, and would not eat them freely. We have never heard such complaint from anyone after the first of January, though we are sat-

ified that there is often good ground for it early in the winter. The roots do not form until in the fall, September and October, and so do not become well matured until two or three months later. We have never heard of a hog which was not hungry for artichokes at any time from January to March.

Some farmers have objected to the crop on account of the supposed difficulty in getting rid of the plants when in a field wanted for other uses. It is true that artichokes will persist for many years, if not disturbed during the summer, but a single good plowing or hoeing out between June and September will kill every plant. This work can be successfully done at any time during the summer, after the old tubers have become exhausted and before the new ones are formed. On the other hand, some growers regard this persistent character as an advantage, as hogs usually leave enough tubers in the ground to make a crop the following year. We have never liked that way of doing, as the second season the plants are so irregular that it is impossible to cultivate them, and we have always found it more profitable, even when using the same field, to plow broadcast and replant every spring.

The yield, of course, depends on the soil; but on land of fair quality it is seldom less than three hundred bushels per acre, while on very good land double that amount may reasonably be expected. Try a few this spring.

ASPARAGUS.

Asparagus is one of the finest vegetables of the spring, and is grown quite largely for the market. It grows year after year from the same roots. As it is ordinarily grown in the garden it is a troublesome crop, but if it is planted in rows so as to be cultivated with a horse, it can be as easily grown as any other crop. Asparagus thrives best in a rich sandy low soil, and is a crop that cannot receive too much manure. There are two methods of making an asparagus bed. One plan is to get the roots from a seedsman, and set out your bed, and the other plan is to plant the seed and grow the plants at home yourself.

If you desire to raise your own plants, the seed should be sown in drills about eighteen inches apart early in the spring. One ounce will sow fifty feet of

drill, and these seed should be covered one inch deep. Before sowing the seed the land should be thoroughly prepared by plowing and harrowing or spading, using a liberal quantity of some complete commercial fertilizer, as the weed seed in the manure make it difficult to clean out the young plants. The seed germinate very slowly, so it will be well to plant radish seed with it, then break the ground and mark the row, so that you can cultivate and keep the weeds down. The radish will also get some benefit from the

Fig. 3.—Position of Asparagus Roots at Planting.

land. The ground should be kept free from weeds at all times, and by the next spring the plants should be large enough to transplant to their permanent bed. Sometimes they are allowed to stand for another year, but this is not the general practice.

The ground selected for the permanent asparagus bed should be well fertilized. By well fertilized we mean at least ten tons of manure per acre broadcast, or 1000 lbs. of high grade fertilizer. The rows in the asparagus bed should be four feet apart, and the plants should be set three or four feet apart in the rows. The plants should be set with their crowns about six inches apart under the ground. If they are planted at a less depth than this, the roots push up the surface and interfere with the cultivation. It will not do to cover them six inches at once, as the young shoots would not be able to push up through six inches of soil. They should be frequently cultivated with the cultivator and hoe. In the fall the tops should be cut off close to the ground and a liberal application of well-rotted manure worked in on the surface. No attention should be paid to the plants, but the whole surface can be plowed or harrowed to a depth of three inches. In the spring, as soon as the land can be worked, give one shallow cultivation in order that the soil may warm up quickly. When the crop has been harvested, or about the last of June, the whole bed should have another thorough cultivation to a depth of three inches, without regard to rows. These

cultivations should make unnecessary the hand weeding which so often makes asparagus growing a difficult task.

Asparagus is best when it is white, crisp, and tender, and to secure it so the hills must be mounded up somewhat to bleach the sprouts. Ordinarily, however, the sprouts are taken when from four to six inches long, and cut an inch or two beneath the surface with an asparagus knife. All should be cut when of the proper size, for if any are permitted to grow on, they interfere with subsequent cutting and stop the growth of new sprouts. The time between cuttings is largely dependent on the weather: Once in two

Fig. 4.—Florida Asparagus.

days is the average time. Frost kills shoots above ground, but does not injure subsequent cuttings. There are a number of good varieties, among the best of which are Conover's Colossal, Moore's, and Palmetto.

For the enemies to Asparagus see Diseases of Plants, and the Insect Department.

BEANS.

There are many varieties of beans, such as common field and garden, or kidney beans, Lima beans, Scarlet Runner beans, and horse or broad beans. The most extensively planted varieties for market purposes are Extra Early Red Valentine, Stringless Green Pod, Round Pod Refugee, Kidney Wax, Rust Proof Wax, and White Wax; also Henderson's Bush Lima. Beans thrive best on a well-drained clay loam, or sandy loam soil, with good clay subsoil. The land should be well prepared by plowing and har-

rowing, using a liberal application of rotted barnyard manure in the row. The bean is a leguminous plant, and therefore can draw nitrogen from the air; at the same time this will not take the place of ammonia in the fertilizer. Wood ashes are an excellent fertilizer for beans, used as a top dressing in addition to the manure.

Beans are very sensitive to frost, and therefore are easily killed, and the seed should not be planted too early. This is especially true of the Lima bean, which should never be planted until the soil is warm, or the seed will rot in the ground. Beans may be either planted in hills or drills. When planted in drills, the rows should be from two to three feet wide, and if planted in hills, the hills should be from a foot to a foot and a half apart, using from three to six beans to a hill. They should be cultivated often and shallow. This not only helps to furnish plant food and keep down the weeds, but it preserves the soil moisture.

The cultivation of the White Navy bean is similar to the above, except that it does not require as rich land nor as much fertilizer. If the crop is large the plants are pulled up when the pods are ripe, and this is sometimes done by running a plow along the side

Fig. 5.—White Mexican or Prolific Tree Bean.

of the row, cutting the vines off just under the surface of the ground. The vines are then thrown together in small piles, where they are left for a day or so. The vines should not be allowed to get wet, as this discolors the beans and lowers their market

value. When the vines are dry the beans are threshed out by using either a machine made for the business, or they are threshed out with a flail. They are then run through a fan, then cleaned; after which they are assorted.

The garden bean requires a much richer soil than the field bean. They will also stand very heavy fertilizing. When the running sort are planted, some recommend the placing of the poles in the ground four feet apart each way, and then planting the beans about them. We do not believe, however, that this plan has any advantage over the plan of planting the beans first, and after they begin running then to place poles or sticks where they are needed. If you do not care to use poles, you may use two wires, placing one about six inches above the ground, and the other about six feet. Ball twine may then be used for the vines to run on.

For enemies to beans see Diseases of Garden Plants in this chapter, also the Insect Department.

BEETS.

Fig. 6.—Eclipse Turnip Beet.

There are two varieties of beets, the sugar beet and the table beet. Sugar beets are not grown in the South, and hence we will only notice the table beet. Good table beets can be produced on most any friable soil, provided it is well-drained and made rich with plenty of old compost. If commercial fertilizer is used, apply broadcast about 2000 lbs. of a complete vegetable fertilizer per acre. If possible, the land should be plowed deeply in the fall and again in the

spring, making a fine seedbed by repeated harrowings. Beets as a rule are hardy, and may be sown just as early as the land can be cultivated after danger of many freezings is past. The rows are planted from a foot to two and a half feet apart. After they come up, they should be thinned to about four inches apart. Thin when about two inches high, or as soon as they can be handled easily. Plant about an inch deep and see that the seed go in thick enough to insure a good stand. There should be at least three to the inch. As soon as the beets are as large as a hen's egg you may begin pulling and bunching them for market, putting from five to eight in a bunch. They sell readily early in the season and are one of the most profitable of all vegetable crops to the market gardener. Early Egyptian, Eclipse, and Blood Turnip, are the most popular varieties.

CABBAGE.

The cabbage is largely grown all over the whole country, and market gardeners have found that it is one of the most profitable crops they can grow. Cabbage can be shipped much better than collards, and sell for better prices. The early crop is usually the most profitable, but of recent years gardeners have been making good money from the late crop as well.

Cabbage delight in a rich, well-drained soil, but one that retains the moisture. You cannot make the land too rich and many gardeners apply as much as 100 two-horse loads of stable manure or 3,000 lbs. of guano per acre. Land for cabbage should be broken deeply, thoroughly pulverized, and the manure and fertilizer worked into the whole land near the surface.

EARLY CABBAGE.

The early Jersey Wakefield is still the leading sort for this purpose, although there are a number of newer varieties which the originators claim to be superior. If they are earlier, however, they usually sacrifice size, and if they are larger they sacrifice earliness; but the Wakefield comes nearer filling the bill than any we have tried. You can set the plants eighteen inches apart in rows two feet wide, which will give you about 12,000 plants per acre, and they will make cabbage that will weigh anywhere from two pounds to ten pounds each.

Now, if you produce a crop of 12,000 cabbage aver-

aging five pounds each, that means 60,000 lbs. of cabbage altogether. But you cannot figure on such a large yield, as there will be some missing places, and the cabbage are not likely to average five lbs. each. With proper preparation, cultivation, and fertilizing, however, you can count on half this amount, or about 30,000 lbs.

Now, 30,000 pounds of cabbage will remove from an acre of ground 114 lbs. of nitrogen, 33 lbs. of phosphoric acid and 129 lbs. potash. To supply this amount of plant food it would require a ton of fertilizer that would analyze 7 per cent nitrogen, about 2 per cent. phosphoric acid, and over 14 per cent. potash. This crop of cabbage would also require 26,100 lbs. of water. I give you these figures to show what

way, and we want to sell as much water in the shape of cabbage as possible.

To obtain the best results we must have our manure and fertilizer worked into the first four or five inches of top soil, so it will all be where the plants can get at it. It is, therefore, best to break your land deeply, in the first place, and then apply and work in the fertilizer broadcast on the surface. A little guano can also be applied in the drill to advantage; but we must be very careful to see that it is all thoroughly stirred into the soil and that our land is well worked down and is fine and mellow. We do not want to see any lumps or clods, and we must be careful not to work the land when too wet, as this will lock up plant food and is very likely to cause failure.

Another very important point is to have good, strong plants, of an even size. It is impossible to make a good crop of cabbage with poor plants. You must have strong, healthy plants, as near a size as possible; then the whole field will head up evenly. If you must use some small plants, select them out and get them by yourselves. It will pay better, however, to throw the little plants away and procure enough strong large plants to set your whole field. When a man puts in an investment of \$75 or \$100 per acre for manure and fertilizer, he cannot afford to take chances with poor plants. If you purchase your plants from a grower, better have him send you a sample so you will know what you are getting, and better pay a dollar per thousand extra if necessary, to get selected plants.

When you set your plants wet the roots, and see that the soil is pressed firmly against the stem and root with the foot. The plant should be so firmly set that when taking hold of a leaf, it will break before pulling up the plant.

As soon as the plants begin to take hold give them a good hoeing and then see that they are either hoed or cultivated with a horse cultivator at least once a week, until they become too large to work.

When the plants start to head a little nitrate of soda sprinkled around them and hoed in will prove a great help. If you can irrigate your patch you make success doubly sure, and when this is impossible try to select a piece of bottom land or some that will not be likely to suffer from drouth. My cabbage will be planted on a piece of well-drained bottom land that I can irrigate.

Fig. 7.—Succession Cabbage.

a crop of 30,000 lbs. of cabbage would require, and, of course, the cabbage cannot be produced unless the fertility is in the land to begin with.

I am preparing to plant an acre in cabbage this spring myself, and I shall apply to that acre about forty tons of stable manure and at least a ton of high grade commercial fertilizer. And this on land that is already quite rich. A fertilizer for cabbage should analyze about 6 per cent. ammonia, 5 per cent. phosphoric acid, and 7 per cent. potash. If I were short on manure I should not hesitate to use one and a half or even two tons of such fertilizer per acre. For to grow a big crop of cabbage it is necessary to put down two or three times as much plant food in the fertilizer as we expect the crop to consume. We have to do this in order to force rapid growth and large size, for the bulk of the cabbage crop is water any-

While I have not gone very exhaustively into details in this article, I have tried to make clear the main points which must be observed to produce a big crop of cabbage; and after all, that is the only kind of crop that it really pays to grow. So do not forget to pile on the manure and fertilizer, prepare your land thoroughly, use only good, strong plants, and give them rapid cultivation. Whenever we fail to observe any of these principal points our cabbage crop has not been what it should.

For early cabbages, the seed bed should be planted in November or December for plants to set out in March. They will have to be planted in a cold frame. A small shallow box, placed in the kitchen window will answer; but here they need not be started until January. The seed should be covered about one-fourth of an inch deep. The plants should be hardened to out-of-door conditions by gradually exposing them to such conditions, so that when set in the field they would not be killed by a sharp frost. The rows should be about two and a half feet apart and the plants set eighteen inches to two feet in the rows.

In growing late cabbage the great difficulty is to get a stand. As a rule it is better to plant the seed in the rows in the field where you wish to grow the cabbage. In planting by this method you thoroughly prepare the land and then as soon as you have a good rain rake off the bed and place four or five seed in a hill every ten feet apart. They can be covered with the foot, pressing the dirt upon them with the ball of the foot. As soon as the plants appear, go over the field and dust them with air-slacked lime or ashes, so as to keep off the flea beetle, a little pest that is likely to destroy your plants before you know of their presence. You should be careful that a crust does not form around the plants, as they frequently die from want of moisture. To keep the crust from forming around them, you just keep the harrow and rake going. In fact, they should be pushed by thorough cultivation from then on.

When cabbage are grown for the market, it is generally advisable to dispose of as much of the crop as possible as soon as they head and not try to store them and wait. Cabbage should not be stored while wet, or handled while frozen. They keep well if stored in a cool, damp cellar, if stored in bins about four feet wide. They also keep well when the heads are buried in sand. They can be stored out of doors by digging long, narrow trenches, placing them in,

and covering with straw and dirt deep enough to prevent serious freezing. When stored pull them up by the roots and turn them up-side down, leaving on all their leaves.

There are a great many diseases of cabbages, and also enemies in the form of insects, all of which are treated in this book. For diseases, see Diseases of Garden Plants, and for insects, see Insect Department. Among the best varieties are the Early Jersey Wakefield, Long Island Wakefield, All-head Early, Early Summer, Sure Head, and Late Flat Dutch.

CELERY.

Celery is a hardy plant grown in almost all parts of the country for the leaf stalk. The celery industry

Fig. 10.—Savannah Market Celery.

of Florida is enormous. The best land for it is a muck, or sandy loam, but the sandy loam would have to be heavily fertilized, as celery is a rank feeder. A reclaimed swamp that is well-drained and in good tilth is a fine place for celery, but the celery grown on swampy lands is not so good as that grown on upland. It is a frequent custom to plant muck land in a crop of potatoes or onions, and follow it the same season with a crop of celery. It is sometimes the custom to set the celery plants out before the potato crop is dug, omitting every third row of potatoes.

Celery seed are perhaps the smallest seed used by gardeners, and the plants are very small themselves when quite young. It is often the case that a small

clod of dirt resting upon seed or plants will retard and sometimes prevent growth. For this reason it is incumbent upon the grower to thoroughly prepare his land, especially the seed bed, which must be as fine as an ash bank. The seed should be sown thickly on top of the ground in rows ten or twelve inches apart. Tread the seed into the soil with the feet, but do not cover them. The planting should be done while the soil is fresh as soon as the land is prepared, then sprinkle lightly with a watering pot with a fine sprinkler, and cover with wet sacks. Sprinkle the sacks every day until the seed sprout, when the sacks may be removed and a partial shade given until the little plants get started. As soon as the plants appear, cultivate between the rows twice a week, weeds or no weeds, and when two inches high thin out to about one inch apart in the row. Transplant to permanent field when six inches high, setting in rows 4 feet apart, and placing plants 6 to 8 inches in row.

Seed are sometimes sown broadcast, but this is usually done in flats in the greenhouse.

When the seed are sown in this manner they should be mixed with sand, using one part seed and five parts sand. When the plants are about three inches high they are transplanted to rows about two or three inches apart in other flats or beds. This plan of sowing broadcast in the bed is used for early celery, and the other plan is used for late celery. The work of transplanting should be given special attention. The time celery should be transplanted depends largely upon local conditions. In the central South this is done in August, the crop following some early vegetable crop. In Florida it is done late in the fall. When setting have ready a pail of mud, that is, earth and water stirred together, mixed to the consistency of cream. Dip the roots in this, using, of course, only large, strong plants. The plants should be dropped in the freshly opened row, anywhere from six to eight inches apart. Double rows, where the soil is sufficiently fertile to permit it, are better than single rows. The double rows are six inches apart, and the sets of rows are four feet apart. In this manner you get nearly twice the amount on an acre of land.

Irrigation is quite important in growing celery. Surface irrigation at one station doubled the yield of the crop, and increased its market value eight times. Sub-irrigation has proven very effective in many places. It is needless to state that land for celery

should be made very rich, and repeated top dressings of Nitrate of Soda will prove very beneficial in promoting quick growth. Golden Self-Bleaching and White Plume are the principal varieties used.

COLLARDS.

The collard is extensively grown throughout the South, but not so much as a few years ago. It grows about two feet high, but does not make a hard head. The leaves are tender and are used for greens. The

Fig. 9.—Collards.

collards should be planted in the same manner as cabbage.

CUCUMBER.

Cucumbers are sensitive to frost, and require for their best growth a rich, sandy, warm loam. Any land that will produce good corn will also produce good cucumbers, if they are properly manured in the hill. Some advocate not planting seed until the weather is warm, but one must run some risk in order to secure earliness. The following method will give you earlier cucumbers than the plan of waiting until the weather is warm before planting the seed: Take plant or strawberry boxes without bottoms, place them in cold frames or hotbed, and fill them with good garden soil, and well rotted manure. Plant your seed in them, and protect by placing sash, or some other glass over them. The seed can be planted in the early part of February, or about six weeks before it would be safe to set the plants in open ground. After the seed are up and the weather is warm, the sash can be taken off in the day, and replaced at night. If the

weather be extremely cold, hay or straw could be placed over them, and the sash on top of the hay. When setting in the field set a little lower than they were in the boxes, cut away the box, water well, and set firmly. By this method you can ship cucumbers before anyone else, and have good profits, in that they are the first.

Fig. 10.—Japanese Climbing Cucumber.

Land for cucumbers should be prepared about the same as you would for corn. The rows should be run out deeply from four to six feet apart each way, and a good shovelful of well rotted manure worked into the soil, and the hill made up at the check. Keep cultivated and keep free from weeds at all times.

For table and market use cucumbers should be picked when they are grown but still green; and for pickling purposes, according to size of pickle wanted. All large and over-grown cucumbers should be kept picked off and not allowed to ripen seed, for with the ripening of the seed the vine will stop bearing and begin to die.

For enemies to cucumbers see Diseases of Garden Plants in this chapter, also the Insect Department.

White Spire, Long Green and Evergreen are the most popular varieties.

CARROTS.

Corrots are grown almost the same as turnips. They should be planted very early in the spring on well-prepared and fertilized land in rows about eighteen inches apart. They are largely grown around New Orleans for shipping to Northern markets and here the crop is planted in the fall. Carrots are very valuable as a stock food as well as a vegetable for market.

Sow seed in shallow drills in early spring when the trees are leafing out. Make several sowings about a month apart so as to give a succession crop. When plants are well started, thin out to four inches apart in the row. Sow in rich or well manured soil worked deep. This is a deep-rooted crop and the soil should be prepared deep enough, so the roots can penetrate without difficulty. Cultivate frequently, keeping your ground free from weeds and grass. Best make drills 16 to 18 inches apart to allow easy working. In Florida sow seed in September, October and November. Oxheart is a good early variety; but Chantenay and Danvers Intermediate are probably most largely grown.

Fig. 11.—Oxheart Carrot.

EGGPLANT.

The eggplant is only grown in the South for commercial purposes, and its cultivation is similar to that of tomatoes.

The plants will have to be started under glass, and should be vigorous and at least six or eight inches high when they are transplanted to the field. They should be transplanted as soon as the soil is warm and all danger from frost is past. If you only want a few plants, it would be better to buy them than to try to raise them. 10 or 12 plants should be a plenty to supply the average family. It is best to plant the

Fig. 12.—Improved Large Purple Thornless Eggplant.

seed in small boxes or pots, say three inch pots, as these can be easily transplanted, and the plant will not suffer on account of transplanting. The main thing is to use only vigorous, healthy plants, and keep them growing after they get started. It is far better to throw away poor plants than it is to bother with them. The plants should be placed three feet apart in rows which are four feet apart. For enemies to the eggplant see Diseases of Garden Plants in this chapter.

KALE

Fig. 13.—Early Green Curled Kale or Borecole.

Kale belongs to the cabbage family. It does not head up, but has a thick crown of leaves. It is used as a vegetable for greens in the early spring or late fall.

Kale requires the same soil as cabbage, also similar cultivation. The leaves are cut and sold loose on the market by the bushel in the early spring when they are often quite profitable. The German kale or Siberian is very hardy and will grow all winter without protection in the South.

LETTUCE.

Lettuce is becoming one of the most profitable vegetables grown by the market gardener at the South. The seed are usually planted in the open field in the early fall and then plants transplanted to cold frames protected by cloth or glass sash, and sometimes heated by steam or hot water. Then they are forced and

Fig. 14.—California Cream Butter.

head up about Christmas for the fall trade. Seed are also sown in the frame in the spring, the plants to be transplanted to open ground in March. Lettuce grows best in a clay loam soil made rich with well rotted manure. It is usually planted in rows about one foot apart, with the plants six inches apart. If you desire first-class lettuce, the crop must be grown rapidly. A quick growth is sometimes secured by an application of 200 to 300 pounds of nitrate of soda broadcast and raked in. Apply after a rain, but when the plants are dry. Constant cultivation is also nec-

essary to success. The crop should mature from six to eight weeks after it is transplanted.

For enemies to lettuce, see Diseases of Plants, also the insect department.

The Iceberg is an excellent summer lettuce, but is very slow to run to head, but Big Boston and California Cream Butter are varieties usually grown for market.

MUSHROOMS

Few people realize the value of mushrooms as a food. Most of us allow these delicious plants to spring up, bear fruit, and we never take advantage of that fruit. There is an idea that most mushrooms are poisonous. Some of them cannot be eaten on account of being too woody, but the greater number of common, soft, fleshy mushrooms are edible and many are among the most delicious and nutritious foods that the vegetable kingdom affords. We take from a Bulletin recently issued by one of the experiment stations, the following: "Only the so-called 'cultivated mushroom,' *Agaricus Campestris*, is grown for market. The culture is very easy and almost any one can succeed at it. This mushroom thrives best at a steady temperature of about 55 deg. F. to 65 deg. F. The temperature must not fall below 50 deg. F. nor rise above 70 deg. F.

"In France and England, this mushroom is extensively grown for market in sheds, stables, cellars, disused quarries, mines and caves. It is also grown during the fall months out of doors in garden-beds, kept covered from direct sunlight. Mushrooms do not require sunlight as green plants do, but ordinary diffused light will do them no harm though direct sunlight is injurious. In eastern and central North Carolina the temperature of the air during the months of September, October, and November is well suited for growing this mushroom out of doors. The plant may also be grown in ordinary pits roofed over or under cold frames or disused hot-beds—the sashes being kept covered with straw to exclude the light.

"In preparing mushroom beds, whether for indoor or outdoor beds, horse or mule droppings must be obtained, though one-fourth the manure may be from cows. The fresh manure should be mixed with one-third its bulk of clean garden or pasture loam soil. The mixture is then firmly beaten down with a spade and allowed to stand under cover for a week unless in the meantime it ferments too violently, in which

case the pile must be turned over and made afresh, adding a little fresh soil to the pile. In making the beds, firm the mixture of soil and manure by treading on it with the feet or beating with a brick. Make the bed when firm about 8 inches thick. Let the bed stand for a few days, then insert a thermometer into a hole made in the bed, and when temperature falls to about 90 deg. F. it is ready for spawning. The spawn of the cultivated mushroom is sold in bricks by all the larger seedsmen. Another variety is sold in flakes, but the brick spawn seems to be better. The bricks weigh about one pound and cost from 12 to 15 cents each, or about \$7.50 per 100 pounds. Each brick is broken into a dozen or eighteen pieces. Make holes in the bed about 10 inches apart each way and insert the pieces of brick-spawn so that they will be covered two inches deep. Beat the covering as firm as rest of bed. Let the spawned bed stand for 6 to 8 days and then cover the whole with two inches of clean garden soil. This soil covering must not be put on until at least six days after spawning. The beds, if out of doors, must be covered with rain-proof cloth, such as the ordinary oiled plant-bed cloth. Over this if the air is very warm, mats of straw may be placed to keep the bed cool. The beds must be watered if the soil shows any tendency to crust on top. Use water heated to 100 deg. F. Cold water must not be used. Give just enough water to moisten the top two inches of soil and no more.

The fruits or "mushrooms" will begin to push through the soil in from 5 to 7 weeks, according to the temperature. The plants are salable in all stages of growth, but are most valued when just out of the "button" stage—when the cap can be distinguished from the stem. The mushrooms tend to come up in clusters. In gathering it is best to twist the stem off its hold on the underground spawn. If necessary the stem may be cut off. The crop should be gathered every day. If any mushrooms are allowed to attain full size, yield of bed will be diminished. The bed should continue to bear from four to six weeks. The average yield is about 3-4 pound per square foot of bed surface. After the first crop is gathered the bed should be copiously watered with warm water, to each gallon of which has been added one ounce of nitrate of soda. In lack of nitrate, use a strong decoction of hen manure for same purpose. A second crop can be obtained, often superior to the first.

The market price for mushrooms varies greatly. It sometimes reaches \$1.25 per pound, but as a rule the

price is from 25 cents to 50 cents per pound for young, fresh stock of uniform size. At present mushrooms are consumed chiefly by the wealthy and only first-class goods are salable at any price. The lower grade of mushrooms must be consumed at home or utilized in manufacture of catsups or sauces.

The 10-pound "Georgia" grape basket is a suitable package for shipping mushrooms. The basket should be lined with clean white paper. Pack solidly and keep as cool as possible until sold.

Some mushrooms are poisonous, notably the *Amanita* genus. If you are inexperienced in the mushroom business, you will do well to avoid eating the following kinds of mushrooms:

1. All mushrooms which are worm-eaten, or in the least degree decayed.

2. All mushrooms which are woody or corky.

3. All mushrooms which are bitter, sour or peppery to the taste.

4. All mushrooms which have a fetid or strong disagreeable odor

5. All mushrooms which have a sheath surrounding a bulbous or swollen base.

6. All mushrooms having a milky juice, unless the milk is reddish.

7. All bright-colored mushrooms having a sticky, warty or scaly cap with thickish gills.

8. All tube mushrooms whose flesh changes color when broken, or whose tubes have reddish mouths.

A good way to test the edibility of mushrooms is to break off a piece of the cap about the size of a grain of corn and chew it, rejecting the chewed matter after a few minutes. If the mushroom seems to agree with any species described in this paper as edible, and is pleasant to the taste, the chances are greatly in favor of its being wholesome. There is no reliable short test for determining the edibility of mushrooms.

MUSKMELON.

The muskmelon is a sensitive, annual, trailing vine, which is very sensitive to frost. The term cantaloupe is quite often applied to muskmelons, but should only be applied to one group, which is characterized by a hard, scaly and sometimes deep-furrowed rind. Cantaloupes are grown very largely in the South for shipment and has proven most profitable. They thrive best when grown on a medium, light, sandy loam. The land should be well prepared, by plowing

the fall before and frequent harrowing during the winter and spring. Where it is desired to get in an extra early crop, some growers start the plants under glass, as suggested for cucumbers, and transplant them as soon as the weather permits. It is often dif-

Fig. 15.—Eden, the Great Shipping Melon.

ficult to get the vines to live, and it is best to plant the seed in bottomless boxes or in cans. These can be removed to the field, when the weather is cloudy or late some afternoon, and the plants transferred to the ground without disturbing the roots. The advantage of this practice is questioned by some, who claim that the melons are no earlier than they are when

Fig. 16.—The Ponce de Leon Cantaloupe.

the grower waits until the weather is warm enough to plant the seed in the field direct. At the Arkansas Experiment Station, however, it is said that by start-

ing the melons under glass, the crop came off from 10 to 20 days earlier.

When the melons are planted out of doors, the rows for cantaloups should be six feet apart, and the hills three feet in the row. It is the custom to plant from ten to fifteen seed in a hill. Muskmelons and cantaloupes should be fertilized with well-rotted barnyard manure, or 500 pounds of commercial fertilizers, as recommended in the Fertilizer Department of this book. As soon as the plants are up and past the seed leaf they can be thinned out, say to the three largest in the hill, and later thinned to the two strongest plants. Cultivation should be shallow. After the

Fig. 17.

runners are about two feet long, it is a good plan to sow broadcast thinly, with some kind of field peas, and sweep out with long sweeps about five times to the middle, or a cultivator with three sweeps on running three times. The vines should then be placed in as nearly a natural position as possible, which should finish the cultivation. The melons at present in favor for shipping are mostly of small or medium size and high quality. A good shipping melon should possess the following points: 1, productiveness; 2, firmness; 3, high quality; 4, uniformity; 5, attractive appearance; 6, keeping quality. Firmness results primarily from a firm rind, and secondly, from firmness and thickness of flesh, or smallness of cavity.

As to quality, reputation for quality will sell the melons from a given region, at good prices, when otherwise they would prove a drag on the market.

Among melons grown here, the following are considered best for shipment. The varieties are named in the order of preference:

First Choice—Golden Netted Gem, Rocky Ford, New Jersey Improved Button Strain of Extra Early Jenny Lind, Early Netted Gem.

Second Choice—Matchless, Burpee's Melrose, Jersey Belle, Baltimore Market, Jenny Lind, Cosmopolitan, Champion Market, Wood's Perfection, Osage Long Island Beauty, Large Baltimore.

Varieties for Home Market—Early Hackensack, Emerald Gem, Paul Rose, Kinsman, Queen, Montreal Green Nutmeg, Bay View.

For enemies to muskmelons see Diseases of Garden Plants, also the Insect Department.

Fig. 18.

MUSTARD.

Mustard is grown for greens mostly in the South, but is grown some for seed. It requires a warm, rich soil, preferably a sandy loam. It is sown either broadcast or planted in drills. If broadcast, eight quarts of seed per acre are required. It requires about the same cultivation and fertilizers as turnips.

Fig. 19.

OKRA OR GUMBO.

Okra is a Southern plant, and is grown without

much difficulty, and thrives in all garden soils. It is planted about the same time as snap beans, and the cultivation is about the same as cotton. The rows are usually three or four feet apart, and the plants should be from one to two feet apart in the row. The seed should be covered about one inch deep and planted when there is a good season in the ground, as the seed are hard and slow to germinate. The green pods are used for cooking as long as they snap easily.

ONIONS.

Onions are coming to be one of the best paying vegetable crops in the South. Up until a few years ago little attention was paid to them except for local consumption, but now many growers are making splendid profits raising and shipping them, especially in the extreme South where the Bermuda onion is grown for early shipment in April and May.

There are three methods of growing onions which we will describe: First, with sets, second, by sowing in the fall and transplanting early in the spring, and

Fig. 20.—White Multiplier Onion Sets.

third, by sowing the seed in the open ground in the spring as soon as the weather will permit. Onions for sets are grown principally for bunching, and sold green to supply our spring market; they are not suitable for ripe dry onions, as they will not keep, although we have kept the Pearl variety through the summer for home use. Sets can be grown in the South as well as in the North, and are much preferred. The seed should be sown on very thin soil, too poor to produce weeds, and sown very thickly in the row, so as to produce very small bulbs; they ought not to be much larger than a pea. From seed sown in March or April, the sets will be ready to pull in July when

they can be laid by to plant in the fall for the young spring crop of bunch or green onions. It would be well to apply a dressing of chemical fertilizers to the soil devoted to growing sets, applying at the rate of 400 lbs. per acre, and this should be applied sometime before sowing the seed; this gives the fertilizers a chance to be assimilated with the soil.

Fig. 21.—Bermuda Onions just arrived from La Fourche, La.

Another good method that is practiced by some, is to sow the seed in shallow boxes in the hot-house then transfer them to the cold frames later, then transplant to open ground in the spring as soon as the weather will permit. There is some work attached to this method, and the work should be well done, but no more than planting the sets, and is less costly if you have to buy your sets. By following this method you can produce onions that will grow to large size, and ripen suitable to supply home markets or ship to more distant sections.

Another method is to grow the seed in February or early in March in open ground where you expect to mature the crop, but this method requires high culture and well prepared soil, and in fact either method requires this, but the latter method must not want for any conditions that are required to force an early growth, and grow the crop to maturity. A clay loam or a mucky soil is suitable for onions; in preparing the soil, it should be plowed deep and fine, so as to leave no lumps, finishing with a heavy roller to firm the soil, as onions form bulbs on the surface, only the roots penetrate the soil. This rule applies whether you follow either method.

The best soil for onions is a rich, well-drained loam. Heavy clays, hillsides and stony lands should not be planted in onions. Muck lands that have been in cultivation for three or four years produce excellent crops of onions. The land that onions are plant-

ed on should have been in some heavily manured, hoed crop the preceding year. It is a mistake to plant onions on weedy land, or on land that is run down.

Land for onions cannot be made too rich. The more manure you place under your onions the better crop you will make. If you are in the onion business, remember that fertilizers pay. Use anywhere from 40 to 50 two-horse wagon loads of stable manure, and from 500 to 1500 lbs. of commercial fertilizer, as directed in the Fertilizer Department of this book. Then during the growing season, the most successful growers apply from 250 to 500 lbs. of nitrate of soda, applied broadcast in three or four applications. Remember that fertilizer applied to onions is not lost,

Fig. 22.—Three Globe Onions.

for you do not have to rotate onions, but can grow them from year to year on the same land.

Onions are planted in rows from 12 to 14 inches and about 4 inches in the row in garden culture, whether you plant sets or sow the seed and thin to a stand. On an extensive scale it might be well to widen the rows to admit of horse culture, but with the improved implements for hand work, this crop with high fertilizing, will pay for close planting and hand culture. Some growers lay off their land slightly

ridged, but we prefer a level, but are careful to firm the soil before planting.

Cultivation should begin as soon as the young plants are seen. The soil should be loosened on both sides, and thrown slightly away from the plants. Throughout the season, the crop should be hoed whenever weeds appear, or the ground becomes hard. Of course shallow cultivation should be given. After the bulbs begin to form cultivation should not be so frequent.

As soon as the onion is mature, the stalks become weak just above the bulb and the top falls over to the ground. When this occurs the crop is ready for harvesting, even though some of the tops are green. They can then be pulled, but should not be allowed to dry in the sun, as it is liable to scald them. As a rule, the onion crop in the South ripens at a time when rains are frequent, consequently they should be cured under a shed. Here they should be spread out in slat trays on shelves so that the air can circulate through them freely, and in this position they will keep until they can be marketed. When ready to market trim off the tops and roots and pack in crates, assorting them to a uniform size. The dark red and yellow varieties are often shipped in sacks. A dry loft is a good place to keep them.

Within the last few years what is known as "The New Onion Culture," has come into practice. The seed are sown in cold frames in November or December under glass in rich soil and the plants transplanted to open ground in February or March, when they are about the size of a good quill. While the cost is a little more for transplanting them, yet it is claimed that the saving in work afterwards, thinning, etc., the gain in growing larger crops, more onions of a marketable size, more than pays for the extra cost of transplanting.

For enemies to onions, see Diseases of Plants, also the Insect Department.

PUMPKIN.

The pumpkin is grown for both man and beast, and is quite a paying crop, especially when grown with some other crop. It is quite a splendid crop to grow in corn fields. As a food for dairy cows, it is said to be equal to ensilage. If the land is very fertile and the vine grows very rapidly, the pumpkins cannot be

planted closer than ten or twelve feet apart. Six or eight seed should be planted in a hill, and two of the best plants allowed to grow. The crop is grown with comparatively little work, and brings in good returns when marketed, as the demand for them is increasing.

Fig. 23.

When grown with corn they do not need extra fertilizers or work other than given the corn. They should be planted in April, or when the soil gets warm.

RADISH.

The radish is a quick growing, early season garden crop. It grows best in cool weather and must continue until it is mature or it will not be tender. The crop is quite frequently grown in hotbeds or cold frames in the early spring. The seed having been sown in January or February, five or six weeks after planting the crop should be ready for use. The rows should be from a half to a foot wide, and the seed should be covered about a half inch deep. One ounce of seed should plant a hundred feet of row. They

should not be grown in the summer time, as they will be stringy and tough, which renders them unfit for use. Winter radishes can be planted from the first

Fig. 24.—Rosy Gem Radish.

to the last of September. The Rosy Gem, or White Tipped Scarlet Ball is a popular variety, also the Half Long Deep Scarlet, also French Breakfast are popular.

Fig. 25.—Improved American Rutabaga.

RUTABAGAS.

The rutabaga is also known as the Swedish turnip.

The root is a large fleshy bulb and is produced the first year, while the seed are not produced until the second year. Rutabagas do best on rich, well prepared loam soils. The crop is grown both for man and stock. Every farmer would find it to his interest to devote an acre or two to the rutabaga crop. The rows should be two feet apart, and should be planted from June to August, and harvested before freezing weather. It requires about two and a half pounds of seed per acre. The crop should be cultivated much the same as white turnips, but more care should be given to early thinning. The plants should be left no nearer than ten inches apart in the drill. The American grown seed give best results.

Fig. 26.—Salsify.

SAGE.

Sage is a perennial garden shrub which is used for seasoning sausages, meats, and for other culinary purposes. The plants are generally started in a hot-bed, then set in rows eighteen or twenty inches apart,

plants being 8 or 10 inches apart in the row. The plants should be kept free from weeds. When in bloom it is ready to cut. The roots should be protected during the winter with straw mulch.

SALSIFY, OR VEGETABLE OYSTER.

Salsify, or vegetable oyster, is a hardy biennial plant. The root is similar to the radish. It requires a deep, cool soil and the entire season to mature in. The seed should be planted in drills from one to two feet apart, and the plants thinned out to four or five inches apart in the row. The seed should be sown very early in the spring and covered an inch deep.

One ounce of seed should plant a row 70 feet long. The roots may be dug in the late fall, or they may be allowed to remain in the ground all winter, digging as required. The roots when cooked have the flavor of oysters.

SQUASH.

Squashes require a warm, fertile, sandy soil. They are grown in hills about four feet apart each way for the summer or bunch varieties, and for the trailing varieties eight feet apart each way. The plant is quite

Fig. 27.—Golden Custard Squash.

sensitive to frost and therefore should not be planted out of doors until the danger from frost is past. From eight to ten seed should be planted in each hill, and after the danger from bugs is past, these may be thinned down to three plants. The seed should be covered one inch deep. The hill should be well ma-

nured with a good shovel full of well rotted manure or compost.

Summer squashes should be eaten before the skin hardens, and winter squashes may also be eaten in this state, but if you desire to store winter squashes they should not be pulled until the skin hardens. After they are pulled, which should be before the first frost, they should be allowed to stand in the sun for a few days, covering them up at night with vines and other litter to protect them from the frost. Care must be taken that the skin be not bruised in handling them, or they will be likely to decay.

SWEET CORN.

Sweet corn is grown mostly for a vegetable and also for canning before the kernels are hard. It is claimed that sweet corn does not do as well in the South unless the seed are secured from the North each year. This, however, is a mistake, and if we could procure Southern grown seed, or save our own seed we would be much more successful. Sweet corn is grown and cultivated like field corn, except that it requires more intensive cultivation and richer soil for the best results. It should be planted in warm soil that has been well prepared and heavily fertilized by the use of stable manure. It will not stand as much cold as field corn. However, you can take some risk, as early corn brings the best price. Be sure to use plenty of seed, for if the ground is cold part of the seed will be likely to rot. It should be planted at the earliest possible moment after danger from frost is past and continuous plantings made every ten days thereafter to afford a succession until late in the fall. The rows should be about three feet wide and the stalks allowed to stand from one to two feet apart in the drills. Cultivate shallow until corn is in the roasting ear.

SWEET POTATO.

For directions for growing both sweet and Irish potatoes see Field Crops, under head of Potatoes.

TEA.

Experiments made at Pinehurst, S. C., on a plantation of 50 acres planted in tea indicate that tea culture can be made a profitable industry in the South.

Indeed if this be true, and there is no reason why it should not come to pass, there is nothing in the world that can keep the South down. As it is, all the tea used in the United States is imported, and for the South to come forward and furnish our tea as she is doing in furnishing our cotton, sugar and rice, there is nothing that can keep her from being the richest part of the world. Tea requires a moist climate, and the temperature should seldom go below 25 deg. Fah. It is propagated from seed sown in the nursery, and when about a foot high transplanted. The seedlings are set from four to five feet apart each way. It is allowed to then grow about four feet high. Tea comes into full bearing when it is about six years old. The tea of commerce is the immature leaves of the tea plant which have been dried. The leaves are first withered in the sun by artificial heat, and then rolled to give them a twisted shape, then fermented to bring out the peculiar tea flavor, and then fired by spreading in thin layers and allowed to dry in the sun or by artificial heat. For more complete information on this subject we refer you to Report of Agriculture No. 61 issued by the U. S. Department of Agriculture. These bulletins are distributed free.

TOMATOES.

Tomatoes are used more in canning than any other vegetable. They can be grown in almost any part of the United States. As a rule plants are grown from

Fig. 28.—Matchless Tomato.

seed started in a hotbed or flats in the greenhouse. They may also be started in the kitchen window. Growers should select their seed each year from per-

fect fruit whenever this is possible, as much finer tomatoes can be grown from such seed than from those usually purchased. Tomato plants should be started early. Most experiment stations agree that plants should be transplanted twice. Rich soils especially prepared should be used in the flats or hotbed. Scrapings from the horse lot, piled up and rotted and then run through a common screen are excellent. Pack this soil in the flats, wet thoroughly, then sprinkle your seed over evenly, and sift on enough fine soil to cover and place on the benches. They should begin to come up in from three to five days. The young plants should be given plenty of light and air

tion and remove to the field in a spring wagon. A rich sandy loam which has been heavily manured the previous year for some vegetable crop is the best place for tomatoes. Then apply from 500 to 1000 lbs. of a high-grade fertilizer per acre in the drill. Set the plants three feet apart in rows which should be five feet wide according to the fertility of the land. A light mulch of straw or hay is sometimes used under the plants to keep the fruit off the ground. Some kind of support will have to be used to hold up the vines, for they will not be able to support themselves.

Tomatoes are easily injured by handling, so in placing them on the market great care should be observed that only sound tomatoes are gathered, and that these are not bruised by rough handling. If applications of 50 lbs. nitrate of soda per acre is given when the fruit first begins to set it will add much to the size, quality and earliness of the crop. Cultivation should begin almost immediately after setting the plants and continue as long as possible without injury to the plants.

Chalk's Early Jewel, Dwarf Champion, Livingston's Beauty, Matchless, Imperial, etc., are good varieties.

For enemies to tomatoes see Diseases of Plants in this chapter; also the Insect Department.

TURNIP.

The turnip is grown in the United States principally as a table vegetable, and is used very little as a stock food. The seed may be sown either very early in the spring and an early crop secured, or in August and September and a winter crop produced. The

Fig. 30.—Dwarf Tomatoes Grown on Southern Ruralist Farm, Atlanta, Ga.

and kept well watered. You want to secure strong plants, and it is essential that they be kept growing all the time. Within a month or six weeks after the plants come up, they are ready for transplanting. They should be set four or five inches each way in the cold frames, or they can be placed in tin cans, berry boxes and the like. The soil in the beds should be rich. Continue to give them plenty of air and sunshine and stir around them once a week with a hand weeder. The plants should be twelve or fifteen inches high before they are transplanted to the field, but be sure that all danger of frost is past before they are removed to the open ground. In this last transplanting cut out a square of earth and remove with the plant so as not to disturb the roots of the plants. Wet the bed thoroughly before beginning this opera-

Fig. 31.—Early White Flat Dutch, Early Purple Red Top.

plant is not sensitive to frost, and grows best in cool, moist weather. They may be sown broadcast or they may be drilled in rows about a foot and a half or two feet apart. The plants are thinned from 4 to 8 inches in the row according to the variety sown. The White Egg, White Flat Dutch, Purple Top Globe, and Snow White are excellent varieties.

WATERMELON.

The watermelon is grown very largely in the South, not only for home consumption but for shipment. It is a native of Africa and many fortunes have been made and lost growing this delicious melon. Watermelons should have a well-drained, sandy loam. They do well after cowpeas or velvet beans and should never be planted on the same land more than once in five years, but should be rotated with other crops. An old straw field is an excellent place for melons, and if you desire them extra early select a southern slope. Prepare the land well by deep plowing, and if the

land is rough this should be done in the fall. Then in the spring lay off your rows ten feet apart and bed out to a center furrow. If the land is very poor it is a good idea to broadcast with barnyard manure before bedding out. Now lay off rows at right angles across these beds every eight or ten feet and put in a good shovel full of well rotted compost in the checks. Add to this a handful of high grade fertilizer, mix this with your manure and soil, and mix thoroughly with a hoe. When danger from frost is past plant eight or ten seed in a hill, an inch deep, firming the soil over the seed. After the plants are up and have started to grow, thin to 3 plants in a hill and later, after danger from insects is past, thin to one or two of the strongest. In cultivation, work the soil back towards the row, and after the first plowing cultivate very shallow, keeping it up until the vines begin to set fruit, after which cultivation should cease. At the last plowing it is a good idea to plant a row or so of cow peas in the middle to help shade the melons.

Fig. 32.—A Tempting Slice.

FUNGUS DISEASES OF GARDEN PLANTS

ASPARAGUS RUST.

This disease appears on the seedling and on neglected plants about the first of June. After a little, slits are formed in the bark from which the rust pro-

trudes. It has been the practice to cut and burn the affected parts. While this practice will get rid of the disease the plants are often injured. You are apt to see rust proof varieties advertised. These varieties while they are not subject to rust, still are sometimes

affected. One of the best remedies is to spray with Bordeaux mixture. The plants may be sprayed with a power spray where asparagus is raised over large areas.

ANTHRACNOSE.

Anthracnose appears on the bean pods in the form of dark colored pits, and spreads rapidly from pod to pod. The disease passes the winter in the bean, and when it is planted the next spring, the plant soon gives evidence of the disease and shrivels up and dies, or fails to develop. The disease also affects cucumbers, pumpkins, and muskmelons. It may be checked by spraying with Bordeaux mixture when the disease first appears. If it secures a hold the diseased portion should be removed and burned. It is a good idea to soak beans in hot water at a temperature of 149 deg. Fah. for 5 minutes before planting, or at 130 deg. Fah. for 15 minutes before planting, which will kill the fungi that are likely to be on the seed.

RUST.

Rust attacks more vegetables than perhaps any other fungi. It forms small brown spots on the foliage and these spots frequently change from brown to black. The disease appears on the inside of the leaf and works outwards, and for that reason it is difficult to administer a treatment. The diseased parts should be removed and burned, and the plants sprayed with a diluted Bordeaux mixture.

BLACK ROT OF CABBAGE.

This disease has come into prominence within the last few years, and is now a serious hindrance to cabbage growers in many States. On account of its seriousness, it will be treated in more detail than many of the other diseases. It appears on the plant at any stage of growth and is characterized with the following symptoms: dwarfing, or one-sided growth of the heads, or if the disease is very severe and began early in the growth of the plant, the plant will fail to head at all. It is frequently the case that the plant dies altogether. Sometimes the head rots and falls off. The cause of the disease is a yellow bacteria which enters the plant above the ground through small openings known as water pores. As yet there is no evidence whatever that the organism can enter the plant

through the root system. The disease is not confined to cabbage, but it affects all members of the mustard family. It has been found on turnips, causing a brown internal rot, also it affects cauliflowers, kale and rape. It is easily spread by animals going from one field to another, also from manure of animals that have been fed on plants affected with the disease. You can readily see the importance of destroying and not feeding affected plants. The parasite lives in the soil during the winter, and therefore makes it imperative not to plant cabbage or other plants of like nature on infected ground. So far no remedy has been found for this trouble that is any good. The only thing to be done is to prevent the disease from spreading. The following from a recent bulletin of the U. S. Department of Agriculture will be found quite helpful.

"1. Plant the cabbage on land where the disease has never appeared. When the plants are ready to set out inspect the seedbed very carefully, and if any cases of the disease are found reject all of the plants and set from some other bed. One cannot afford to run any risk of infecting his land by the use of seedlings from suspicious beds. It would be better to plant some other crop than to take this risk. A good practice is to strew the land to be used for seedbed with straw or dry brush and burn it over before plowing. The seedbed should be made in a different place every year.

"2. Set the plants on land which has not been in cabbages or other cruciferous plants for some time. If it is impossible to avoid following cabbages by cabbages, at least take the precaution to plant only on land which has never suffered from the disease. To follow any other course is simply to invite trouble. The practice of planting cabbages after cabbages for a long series of years also invites other parasites and must, as a rule, be considered very bad economy.

"3. As a matter of precaution avoid the use of stable manures, since these may possibly serve as means of carrying the disease into uninfested fields, that is, through cabbage refuse fed to animals or thrown into the barnyard or onto manure piles. As far as possible make use of commercial fertilizers in place of barnyard manures, both in the seed bed and in the field, at least until it shall have been shown conclusively that there is no danger in the manure pile. Too much stress cannot be laid on the necessity of keeping the germs out of the soil, and consequently on the

avoidance of practices which, if not absolutely proved to be dangerous, are at least questionable.

"4. Do not turn animals into diseased fields and then allow them to wander over other parts of the farm. Cattle or other stock should not be allowed to roam in cabbage fields where this disease prevails.

"5. All farm tools used on infected land should be scoured bright before using on uninfected land. The transfer of soil from infected to healthy fields ought in all cases to be reduced to a minimum.

"6. Keep up a constant warfare against insect enemies, especially the cabbage butterfly and the harlequin bug.

"7. As a palliative remove badly affected plants from the field as fast as they appear. In early stages

"9. Store cabbages from diseased fields only when it is impossible to sell them in the fall, and in such cases take particular care to reject all heads showing any trace of black in the stump and to keep all parts of the houses below 40 deg. Fah. If any affected heads are stored they should be put by themselves in the lowest, coolest part of the house."

CLUBFOOT.

This disease is quite common to cabbage and kindred plants, such as turnips, radishes, etc. It may attack the plants at any time, and cause them to appear sickly. The disease sometimes appears in the roots and causes the whole root system to become

Fig. 23.—Garden of Dr. R. L. McClurg, Atlanta, Texas.

of the disease—i. e., while it is still confined to the margins of the leaves and has not yet entered into the head or stump—go over the fields systematically about once every ten days and break off and remove all the affected leaves. Do not throw this refuse into cultivated fields or into ditches from which it can be washed to other fields or on roadways to be tracked about. It should be burned or put into a deep pit in some fence corner or other out-of-the-way place.

"8. Weeds which harbor the disease, especially the wild mustards, must be destroyed systematically.

one mass of diseased tissue. Spraying seems to do no good. An application of air-slacked lime, however, sometimes helps, if put on at the rate of 75 bushels per acre. The disease sometimes remains in the soil for a year or more, and we would therefore recommend the wide rotation of crops, and the removal and burning of all affected plants.

LEAF BLIGHT.

Leaf Blight attacks many plants, especially of the

mustard family, such as cabbages, turnips, radishes, etc. This disease causes the leaves to discolor and fall off. It may be controlled by spraying with Bordeaux mixture. Perhaps it is a different form of Leaf Blight that attacks celery than that which attacks the plants above referred to. Some claim that the form that attacks celery flourishes most in dry weather, while others claim that dry weather is death to it. It is treated in the same way that ordinary Leaf Blight, that is, with a fungicide, such as Bordeaux mixture.

DAMPING OFF.

This disease attacks many plants. The stem decays near the surface of the ground and the plant falls off. There is little that can be done for this disease, except to pick all diseased parts and burn them. See also that the land is well drained, and the soil about the plants kept stirred. A liberal application of lime will sometimes help.

POWDERY MILDEW.

Powdery Mildew affects plants that produce much vine. The fungus grows on the surface of the leaves forming a fine powder. It also affects the stem of plants. It may be checked by spraying with some fungicide such as Bordeaux mixture in a diluted form.

DOWNY MILDEW.

This disease appears on cucumbers, onion, pump-

kins, squash, watermelons, etc., and appears as yellow irregular spots on the leaves, which are soon entirely covered. The disease may be controlled by spraying with Bordeaux mixture every ten days.

TOMATO BLIGHT.

Tomato blight appears as sudden wilting of the vines. The small roots decay and the vine soon dies. Diseased plants should be dug up and destroyed. A wide rotation, never planting on the same land more than once in four years, and the liberal use of lime on land intended for tomatoes is the best remedy.

TOMATO BLACK ROT.

This black rot affects the fruit, a black spot appearing on the seed end before the tomato begins to ripen and gradually enlarging until nearly half the fruit is affected. The best remedy is to avoid the direct use of fresh stable manure on this crop and frequent spraying with Bordeaux mixture, which is made as follows: Into a 50 gallon barrel pour 30 gallons of water and suspend in it 6 pounds of bluestone in coarse sacking. Slack 4 pounds of fresh lime in another vessel, adding water slowly to obtain a creamy liquid free from grit. When the bluestone is dissolved add the lime milk slowly, with water enough to fill the barrel, stirring constantly. Apply this mixture with an ordinary sprinkling pot about once every two weeks until the blight has been gotten rid of.

QUANTITY OF SEED REQUIRED.

SEEDS NECESSARY TO PRODUCE A GIVEN NUMBER OF PLANTS AND SOW A GIVEN AMOUNT OF GROUND.

	Quantity per acre.
Artichoke, 1 oz. to 500 plants	4 lb.
Asparagus, 1 oz. to 200 plants	5 lbs.
Barley	2 1/2 bu.
Beans, dwarf, 1 quart to 150 feet of drill ..	1 1/4 bu.
Beans, pole, 1 quart to 200 hills	1/2 bu.
Beet, garden, 1 oz. to 100 feet of drill	10 lbs.

Beet, Mangel, 1 oz. to 150 feet of drill	6 lbs.
Broccoli, 1 oz. to 3,000 plants	5 ozs.
Broom Corn	10 lbs.
Brussels Sprouts, 1 oz. to 3,000 plants	5 oz.
Buckwheat	1/2 bu.
*Cabbage, 1 oz. to 3,000 plants	4 oz.
Carrots, 1 oz. to 250 feet of drill	2 1/2 lbs.
*Cauliflower, 1 oz. to 3,000 plants	5 oz.
*Celery, 1 oz. to 10,000 plants	4 oz.
Clover, Alsike and White Dutch	6 lbs.
“ Lucerne, Large Red and Crimson ...	15 lbs.
“ Medium	10 lbs.

*Colards, 1 oz. to 2,500 plants	6 oz.
Corn, sweet, 1 quart to 500 hills	8 qts.
Cress, 1 oz. to 150 feet of drill	8 lbs.
Cucumbers, 1 oz. to 80 hills	1½ lbs.
Egg Plant, 1 oz. to 1,500 plants	4 oz.
Endive, 1 oz. to 300 feet of drill	3 lbs.
Gourd, 1 oz. to 25 hills	2½ lbs.
Grass, Blue Kentucky (cleaned seed)	2 bu.
“ Hungarian and Millet	½ bu.
“ Mixed Lawn	3 bu.
“ Orchard, Perennial Rye, Red Top Fowl Meadow and Wood Meadow	2 bu.
Garlic, bulbs, 1 lb. to 10 feet of drill	2 bu.
Hemp	½ bu.
Kale, 1 oz. to 3,000 plants	6 oz.
Kohl-Rabi, 1 oz. to 200 feet of drill	1½ lbs.
Leek, 1 oz. to 250 feet of drill	4 lbs.
Lettuce, 1 oz. to 250 feet of drill	3 lbs.
Melon, Musk, 1 oz. to 100 hills	1¾ lbs.
Melon, Water, 1 oz. to 25 hills	1½ lbs.
Nasturtium, 1 oz. to 50 feet of drill	10 lbs.
Oats	2½ bu.
Okra, 1 oz. to 50 feet of drill	10 lbs.
Onion Seed, 1 oz. to 200 feet of drill	4 lbs.
“ “ for transplanting	2½ lbs.
“ “ for sets	60 lbs.
“ Sets 1 quart to 20 feet of drill	8 bu.
Parsnips, 1 oz. to 250 feet of drill	5 lbs.
Parsley, 1 oz. to 250 feet of drill	8 lbs.
Peas, garden, 1 quart to 160 feet of drill ..	1½ bu.
“ field or cowpeas, broadcasted	2 bu.
Pepper, 1 oz. to 1,500 plants	4 oz.
Potatoes	9 bu.
Pumpkins, 1 quart to 300 hills	4 qts.
Radish, 1 oz. to 150 feet of drill	8 lbs.
Rye	1½ bu.
Salsify, 1 oz. to 60 feet of drill	8 lbs.
Spinach, 1 oz. to 150 feet of drill	10 lbs.
Summer Savory, 1 oz. to 500 feet of drill	2 lbs.

Squash, summer, 1 oz. to 40 hills	2 lbs.
“ winter, 1 oz. to 10 hills	3 lbs.
Tomato, 1 oz. to 2,000 plants	4 oz.
Tobacco, 1 oz. to 5,000 plants	2 oz.
Turnip, 1 oz. to 250 feet of drill	1½ lbs.
Wheat	1 to 2 bu.

*The above calculations are made for sowing in the spring; during the summer it requires double the quantity of seed to give the same number of plants.

NUMBER OF PLANTS OR TREES TO THE ACRE AT GIVEN DISTANCES.

Dis. apart.	No. Plants.
½ foot	174,240
1 foot	43,560
1½ feet	19,360
2 feet	10,890
2½ feet	6,960
3 feet by 1 foot	14,520
3 feet by 2 feet	7,260
3 feet by 3 feet	4,840
4 feet by 1 foot	10,888
4 feet by 2 feet	5,444
4 feet by 3 feet	3,629
4 feet by 4 feet	2,722
5 feet by 5 feet	1,742
6 feet	1,210
7 feet	880
8 feet	680
9 feet	573
10 feet	435
11 feet	360
12 feet	302
15 feet	193
18 feet	134
20 feet	108
25 feet	69
30 feet	49

GATHERING PEACHES.

BOOK III.
FRUIT DEPARTMENT.

Edited and revised by

P. J. BERCKMANS,
AUGUSTA, GA.

FRUITS AND NUTS.

APPLES.

Apples are raised in most of the States. While apples are not raised so extensively in the Southern States as in some other States, still apple growing has been quite a profitable industry in the upper sections of the Southern States. Virginia, West Virginia, Tennessee, Georgia, Western North Carolina, and the Ozark section of Arkansas produce excellent apples.

set out in the fall, as more satisfactory results are obtained, than when trees are planted late in the spring. In the Southern sections, vegetation although inactive in winter for the formation of leaves and new wood, is never so, as to new roots. A tree transplanted during November or December, will by the ensuing spring have formed sufficient new roots to give it a firm hold in the ground and will grow more rapidly when active vegetation begins in the spring than trees planted in March or April. This

Fig. 1. Apple Trees in Smith Bros.' Nurseries, Concord, Ga.

The ideal location of an apple orchard is on a gentle eastern or northeastern slope which has full water drainage. Some varieties, like Shockley, succeed well in sandy loams. Low, flat meadow locations should not be used for an apple orchard. Hard wood timber lands, limestone soils and loamy clays are especially desirable for apples. Of course apples for home consumption can be grown almost anywhere in the United States where farming is carried on at all. Trees one and two years should be set out, rather than use older stock. They should be

rule holds good for all deciduous fruit trees. The trees should be planted from thirty to forty feet each way according to the quality of soil. For this climate, experience has taught us that one and two year old trees of thrifty growth are the most desirable. One should bear in mind that such trees can be removed from the nursery with all their roots; whereas a four or five year old tree can not be taken up without cutting away a large portion of them. Success in transplanting is increased according as attention is paid in selecting well-rooted trees, instead

of heavily-branched one. Give as many sound roots, and as little head to a tree as possible.

Preparation of the Tree.

Before planting, remove all broken roots, cut back one year peach or apple trees to a naked stem one and one-half or two and a half feet high, leaving no side branches. Two year old trees should have their branches cut back to one-half their length or more, the lower limb less than those above, cutting in shorter as you go upward, and leaving the leader the longer. Plant as deep as the tree was standing in the nursery row, excepting dwarf pears and cher-

Fig. 2.—One-year-old tree with Line to Show Where to Cut Back (U. S. Dept. Agr.)

ries, which should be planted sufficiently deep to cover the stock from 2 to 3 inches. It is best to allow the tree to form its head in its permanent place rather than in the nursery row.

To insure the earliest crop of fruit after transplanting, always select one or two year old trees. In planting the roots should be placed in their natural position, and the dirt trampled around them tightly. All plants and trees that are transplanted should be set a little deeper than they were originally in the nursery. Contrary to some people's belief, an apple orchard should be plowed deeply every year, beginning when the trees are first set out. Fall and winter plowing is as a rule advisable. For the first

four or five years crops such as potatoes, small fruits, cotton, corn, etc., may be grown between the rows of apples. Small grain crops should never be planted in an orchard unless it is desired to throw an overluxuriant orchard into bearing, or where the ground is not well drained, and this is the only plan of evaporating the water. Horticulturists advise cultivating the crop until June or July, and then seeding down the orchard with some leguminous crop, such as vetch, cowpeas, etc.

In fertilizing orchards, potash is the element mostly used. If you have a small farm, this can be best supplied with unleached wood ashes, using from 40 to 50 bushels per acre each season. If you have not enough wood ashes, you may use from 500 to 700 pounds of muriate of potash. Nitrogen in a great many cases is especially desirable, as it promotes the growth of wood, and it rejuvenates old worn-out orchards. It can safely be used in all old orchards, for they are always in need of nitrogen. If a mature or bearing tree does not make a foot or more growth upon all shoots per year, or when the tree matures in season and the leaves have a yellowish appearance, it is a sure sign that nitrogen is needed. But on the other hand, if the tree makes a vigorous growth each season, and has large leaves which are dark in color, this is a sign that the tree has plenty of nitrogen, and the use of any more nitrogen should cease, as this will be of damage rather than a benefit. When the trees have a sufficient amount of nitrogen the leguminous crops should not be used.

Apples should be gathered when they have at-

Fig. 3.—Two-year-old Tree with Lines to Show Where to Cut Back at Transplanting. (U. S. Dept. Agr.)

tained their largest size, and not wait until they mature on the trees, as they will keep much better, and develop a better flavor to gather early, than to wait for their maturing on the trees. Where apples are stored, they should be free from currents of air, and storeroom should be kept as cool as possible. Apples that are bruised should not be stored, as they not only soon decay, but cause others to decay also. Apples should be picked from the tree by hand, and not knocked down with a stick.

Apples that do not find a market as such, can be turned into profits by evaporating, preserving, apple butter, etc. The feature of by-products in apples is quite an important one, for the profits or loss comes in these small matters. Many farmers find it profitable to make apple cider and vinegar. Let the farmer see to it that nothing is wasted in the way of fruit. If it will not sell change its form and make it sell. For twig blight, see Pear Blight, for Brown Rot, see Brown Rot of Peach. All insects are treated under the Insect Department, such as moths, apple tree borers, etc.

BLACKBERRIES.

Blackberries grow wild, but the improved varieties have been cultivated to considerable extent throughout some sections of the South. There is money to be made in the cultivation of blackberries as well as other berries and fruits. The blackberry has grown wild for a long time, and are free as a rule to any one that will pick them, hence the public fails to recognize the value of cultivated blackberries. The value of the cultivated blackberries over those growing wild in fence corners, is recognized because of their commercial value. The public is realizing the superiority of the cultivated berries over the wild berry as the better market price fully attests.

They should be planted on a rich, deep loam soil, which is well drained. The land should be as thoroughly prepared as possible, and the fall is the proper time for this preparation. About the same fertilizer should be applied to blackberries as is applied to other garden crops. They are propagated by using root cuttings, or by tips for dewberries. These cuttings can easily be made by cutting the roots in two inch lengths. They should be set out in March or a little earlier. The rows should be six feet apart, and the plants put three to four feet apart in the row. The blackberry must be cultivated, if you

hope to have results. But you say that the blackberry grows wild without cultivation. Granting that this is true, yet we want to produce a superior berry, and this can only be done by cultivation, pruning, and fertilization, and by planting the best improved varieties. Cultivation should extend through the season, and should be sufficient to keep down the weeds, and keep the ground thoroughly stirred.

Pruning is quite important in raising blackberries. The object of pruning is to force the plant to assume a strong, stocky form that will be self-supporting, requiring no artificial assistance from trellises or stakes, and also to cause vigorous lateral shoots to put forth, on which the crop is mainly set. Therefore, as soon as the suckers have reached the proper height in early summer, after the fruit is off, it is the practice to top them back, but the proper height is still an unsettled question. Many growers top at one and a half feet, a large number at two feet and a half, some at three feet, and a few at a still greater

Fig. 4.—Rooted Tips of Blackcap Canes.

height. In this section it is probably advisable to top at two and a half feet. All shoots coming up in the proper position along the row should be topped as they reach this height, until an average of some five or six canes to the yard has been secured, after which all others should be treated as weeds and cut out unless required for propagation.

Where young shoots, however, are observed to be

affected with either Orange Rust or Anthracnose, they should be taken up bodily and burned, no matter how ugly a gap in the row such destruction may leave, and the grower would do well to thin his canes with an eye more to the eradication of these two maladies than to the production and maintenance of a symmetrical and sightly row.

Theoretically, a plat should be kept in stools of five or six canes each, some three feet apart in the row, but this will be found almost impossible to effect in practice, and hence the advice given here is to preserve a number of canes approximating five or six to the yard, as stated, located in the most convenient spots along the row, as they chance to present themselves. Thus the original site of each stool will soon be lost, and the row will take the form of a short, stocky hedge. This is the only practical method of treatment.

Trellising in various forms has been fully tested, and has proven superfluous and impractical with blackberries when properly pruned, though advisable with dewberries, as will be noticed under the proper head.

During the winter, the dead canes—those that have borne previous summer—should be removed. A piece of hoop iron, bent in the form of sugar tongs, and a pair of ordinary pruning shears are the best implements for this purpose.

Just before growth commences in the spring, the laterals that formed on the topped canes of the previous summer should be shortened in about one-third. This may be done with either pruning shears or ordinary hedge shears.

The yield varies, being anywhere from 20 to 100 bushels per acre. The first year a moderate crop will be produced and by the third year, they should be matured and producing full crops.

CHERRY.

Commercially, the cherry is not much grown throughout the South, but for home consumption, every family should have a few cherry trees. Cherries are divided into two groups or classes, the sweet and the sour cherry. The sour cherry is grown more than any other, because it is more resistant to summer heat.

The cherry should have a rather rich, warm soil. Perhaps a dry gravelly or sandy loam is about as good soil as can be secured. Cherries are propagated by budding and grafting. They should be set in the orchard when from two years old. The sour varieties should be planted 18 feet each way, and the sweet varieties 30 feet apart each way. Cherries begin to bear in two to three years. The tops should be started from three and a half to four feet from the ground. The cherry orchard should be cultivated clean until the fruit is ripe, after which it may be planed in cotton, potatoes, etc., but no grain. Do not use too much of nitrogenous manures.

As a rule, cherries are short lived throughout the middle sections of the South, and succeed there only occasionally. They, however, thrive in the upper or mountain sections, where several orchards have yielded good crops. The only cherry that may be called hardy in the middle sections is the common Mozello.

CHESTNUTS.

The growth of chestnuts for profit is a new industry. Native chestnuts grow in the limestone sections of the South, and find ready sale. The larger the nuts, the better the price paid for them. Chestnuts are propagated by planting the seed, and the seedling later grafted or budded with improved varieties. Nuts intended for seed should not be allowed to dry out, for they will not germinate. When kept over winter for spring planting, they should be preserved in a box buried about six inches deep in the open ground and alternating in single layers with moist sand. Chestnuts have a long tap root, which makes them difficult to transplant, therefore they should be planted where they are wanted if possible. Where you have native chestnuts, they can be cut down, and the sprouts when they grow to two or three inches in diameter can be grafted with new and improved varieties.

DEWBERRY.

The Dewberry is of the blackberry family, that has recently come into cultivation. Its fruit is from ten days to two weeks earlier than the blackberry. They ripen just between raspberries and blackber-

ries, and therefore there is a great demand for them. It is handled very much on the same plan and principle as the blackberry. Dewberries are propagated by what is known as tipping, i. e., by the end of the young canes, and can be grown on any clay soil, also light or sandy soils, if the land is well fertilized. They are usually planted six feet each way in checks, and are planted any time from December to March, provided the ground is not too wet. Prepare stakes during the early fall to stake all that you planted the previous winter, or spring. These should be seven feet long, and they should be driven in the earth about twelve or fourteen inches deep. As soon as the buds begin to swell, the canes of the dewberries should be tied to the stakes, using three strings to each one. Another method is to use stakes three feet out of the ground, nail a wire on top and train the canes over these. About sixty crates, each crate holding thirty-two quarts, may be produced per acre, and after deducting all expenses, crating, packing, freighting, and all such expenses, they average a net profit of \$1.00 per crate. As to the enemies of the Dewberry, see Insect Department in another part of this book.

CHINKAPIN.

This is a dwarf chestnut and grows wild. So far as has been learned there is only one improved variety under cultivation.

FIG.

The fig is grown in all of the Southern States, and usually thrives in good soil. It has not received the attention in the South that it should. This is due to three reasons: There has been until recently a very slight demand for figs, but now this is increasing. It can be cultivated as an orchard crop, but some difficulty is connected in shipping the fruit to distant markets. If shipped in refrigerating cars and carefully packed in pint cups, this difficulty is lessened and good prices are realized in East and Northern markets. However, if handled with care they will sell readily in our local markets. As a rule, figs will not last over twenty-four hours after they are gathered. To be good for eating purposes, it must ripen on the tree and can not be gathered prematurely like the peach or plum. A rainy season through the ripening season means ruin, for

the fig insists upon taking its moisture through the soil, and not have it poured on it. The fig throughout the South has never been planted in orchards to any extent, but every family, especially in the sections that can be cultivated away from the mountains, will gain much by having several trees in their backyard. They are very shallow feeders, and to disturb their root system in the orchard with the plow, means their destruction.

The best soil for figs is a well-drained loam well supplied with lime, potash and phosphoric acid. The figs are propagated from hard wood cuttings of the previous season's growth. The cuttings are made and handled like grape cuttings. Cuttings in the South may be set out in March. Bulletin No. 61 of Georgia Experiment Station, says: "The fig grows so readily from cuttings, and therefrom produces bearing wood in such a short time that it would be useless to consider here any other method. While it also responds tolerably to grafting, little is gained thereby, since the same scion, used as a cutting, would produce fruit on its own roots almost as soon, certainly bearing a small crop the second year, if a vigorous variety. Where this is not the case, grafting may be resorted to, but the fig does not take kindly to "stubbing back" and the probability of its advantageous employment is such a remote contingency that it may well be ignored.

"Cuttings may be taken either in late winter, just before the sap starts and after all danger from severe frost is past—in which case they may be at once set out in the nursery row, with the terminal bud even with the surface—or they may be cut earlier in the winter, bundled and buried, as with grape cuttings. In either event the cuttings should be long—ten inches or a foot—with several joints or buds, and in diameter from the size of a lead pencil to that of the little finger. The latter size generally making a thriftier growth. Long cuttings stand a better chance to strike root than do shorter ones, as they are most likely to reach permanently moist soil.

"Cuttings may be sometimes planted to advantage in the place the tree is to permanently occupy. If the conditions are favorable and the cuttings grow off promptly it should attain the height, the first season of from three to six feet. A few figs may be obtained the first year from Brown Turkey and Green Ischia, and the third season a good crop should result if the tree has not been cut back by

frost, as is frequently the case in our climate. In this event it is customary to remove the injured wood, cutting clear to the ground, if badly frost-bitten, and starting a new stool of canes from the root. It is not uncommon, with prolific varieties to find the cuttings covered with young figs in the fall of the first year, these are not "brebas," although the first and only crop of that season, because they are necessarily borne on the new wood, and they are sometimes cut off prematurely by frost.

"If either a cutting or a rooted plant from the nursery fails, when set out in its permanent place, to grow off well at the start, it is useless to leave it and endeavor to bring it out by subsequent attention, such as manuring or cultivation; it is unlikely to ever develop into a vigorous plant, something is radically wrong with its vitality, and it is better to grub it up and replant. In transplanting, only the most healthy and vigorous specimens from the nursery should be selected—and this is one advantage in using rooted plants. On the other hand, a year's time is frequently saved by employing cuttings. Only the less vigorous need be replaced. In orchard planting, however, it is somewhat difficult to protect the cuttings placed in situ during the earlier stages of their growth, and this consideration often induces the owner to select rooted and therefore larger and more conspicuous plants.

"In handling fig cuttings and rooted plants for both home use and shipment, neither the cuttings nor the roots should be permitted to dry out. If so, they are worthless, for they never recover their moisture like other plants."

The "Smyrna Fig" is the commercial fig of the countries east of the Mediterranean Sea, and is the dried fig of commerce of this country.

Bulletin No. 61 of Georgia Experiment Station says: "They are, as their name indicates, of Asiatic origin, and to Syria, Asia Minor, Northern Africa and Greece, their cultivation is to-day practically confined. The figs so widely distributed throughout Italy, France, Spain and Portugal are almost entirely the "Domesticated" or mule type.

"Smyrna figs" contain only pistillate or female flowers. These, if pollinated artificially swell and grow, developing into the finest figs known to commerce. Unpollinated, they shrivel and drop off. Pollinated 'Smyrna' figs dry readily in even a semi-humid climate like that of California, and present,

even in Florida and South Georgia, our only chance or hopes (albeit a slender one) of ever developing this branch of the fig industry. 'Mule' figs only dry successfully in a rainless season, and here their profitable manipulation would be impossible; that is to say, the product, as compared with Asiatic, European or even California dried figs, would be found so inferior that the attempt would have to be

Fig. 5.—Fruit and Foliage of Fig.

abandoned. This being the case, it is altogether unnecessary to enter into a detail of the process of drying in this Bulletin. Pollinated 'Smyrna' figs acquire a rich, aromatic, nutty flavor that is exquisite in the fresh product and extends to even the dried article. The finest grades of commercial dried figs are all of the 'Smyrna' class. Quite recently their culture has been successfully introduced, on a small scale, into California—the pioneer in this work being George C. Roeding, of the Fancher Creek Nursery, at Fresno. Yet without the close companionship of the next class—'Caprifigs' the 'Smyrna' fig would be absolutely valueless, as self-pollination is of course impossible.

"Caprifig," or Wild-figs' (literally 'Goat-figs') were evidently the prototype of the entire race. They rarely develop edible quality and their province in nature is apparently to serve as pollinators for the pistillate group. This they effect in a most peculiar manner. The 'Caprifig' with its first crop, or 'Profichi' (referred to more in detail further on) which is the one used in artificial pollination, bears three kinds of flowers. First, Staminate or Male, clustered in a compact mass around the interior rim of the 'eye' (sometimes termed the 'ostium' or 'little mouth') their anthers or pollen case blocking

the exit like a screen of brushwood. The rest of the interior of the receptacle bristles with 'Gall' flowers but there are no Pistillates. In the base or false ovary of the Gall flowers, which are merely degenerate pistillates, the egg of the *Blastophaga grossorum* or 'Fig Wasp'—a minute insect—is deposited, hatches and develops to maturity. The wingless males emerge first and with powerful mandibles cut into the flowers containing the female wasps partially release and impregnate them. The gravid females shortly complete the liberating, and being winged, at once seek to escape for the instinctive purpose of ovipositing. They emerge from the eye of the 'Caprifig' after squeezing through the mass of pollen covered anthers protecting the exit and seek other fruit in which to lay their eggs. Naturally they would enter the nearest 'Caprifig' in the proper stage of development. But meanwhile, if the 'Caprifig' containing the colony has been plucked from its stem and suspended from the branches of an adjacent 'Smyrna' tree, the female, on emerging, forces her way into a fruit of the latter class, losing her wings in the process, and at once begins a frantic scramble around the interior, searching for the anticipated Gall flowers, in which to oviposit. Failing, necessarily, to find them, and incapable of again taking flight, she finally curls up and dies heartbroken, but not until she and her companions between them pretty thoroughly pollinated every female flower in the cavity with the plentiful store of pollen conveyed from the 'Caprifig'—thereby insuring the development of the fruit.

"It is in this way that 'Smyrna' figs are artificially pollinated. The process is termed 'Caprification,' and required, of course, for its own conduct, the parallel cultivation of a sufficient number of 'Caprifig' trees to furnish the necessary quantity of *Blastophaga* to pollinate the crop of Pistillate 'Smyrna' figs. It is estimated that some 400 females, on an average, emerge from a normal 'Caprifig' and from 50 to 100 figs per tree are needed for the thorough pollination of the crop, while the proportion of 'Caprifig' trees to 'Smyrna' trees, should be for thorough work, according to Eisen, about 1 to 50.

"Seed of pollinated 'Smyrna' figs (even when dried) are capable of germination, and from their planting it is impossible to originate new varieties—a field of work that at no very distant day may offer an inviting opportunity to the patient experimenter

in this section of the South. Yet it should be noted that all 'Smyrna' seedlings are not 'Smyrna' figs, but true hybrids, with the hybrid tendency to revert more or less to the male parent—the 'Caprifig'—this greatly reducing the chance of obtaining a valuable product in the progeny."

The fig can be crowded more than it would seem possible. It is only necessary to give sufficient distance between the rows for passage between them, and the trees may be crowded in the rows so close that the top branches of the trees touch. It may be safe to say that the trees may be placed anywhere from 10 to 15 feet apart, up to 20 by 20 feet apart for orchards, depending, of course, upon the location, and the size the bush grows. Where they are placed close together, they should be fertilized accordingly.

The best fertilizer for figs, is barnyard manure, supplemented when the trees are bearing by an addition of phosphoric acid and potash, using five pounds of acid phosphate and two pounds muriate of potash broadcast will be of sufficient quantity.

Figs where they are to be shipped should be packed in 24 quart berry crates, (as shown in illustration) for nearby markets. There are many cities and towns in the South that will consume all that will be grown for many years.

GRAPE.

Fig. 6.—Planting the Grapevine.

The grape is one of the surest fruit crops grown anywhere in the country. A great deal of money has been made raising grapes, and as they are almost sure to bear, it is quite a safe crop. Vines of most varieties commence to bear the second year after planting in the vineyard. They are easily

grown and do well on almost any soil. There are upwards of three hundred varieties grown in the United States, but all varieties in cultivation that are of any importance as market sorts, may be reduced to fifteen or twenty.

The selection of the site of the vineyard is of great importance, and therefore should receive the greatest care and consideration. Nearly any soil will grow grapes at least to some extent. The best soil, however, is a light sandy or gravelly one, on high elevation and exposed to the south so that there will be little danger from frost in the early winter. The soil should be well drained, and wet lands are not desirable for grapes. Limestone soils are very desirable.

The best vines are strong, one year old plants from the cutting or layer, and with plenty of root. Before planting the top should be cut back to two buds, and the root to one foot in length. The grape is propagated by layers, or cuttings and grafting for a few growing sorts.

Fig. 7.—The Kniffin System of Grape Training.

The growing of grapes from seed has given us our best variety, but the practice is only intended for experimental purposes. If you desire to raise from seed, select the seed from some very good variety. Choose the very best bunches, and then the very best berries. Take the seed from these berries and sow in the early spring in well pulverized clay soils in rows about one foot apart, placing seed one inch apart in drill, and cover three-quarters of an inch deep. When the young plants appear, keep them clean and well cultivated through the summer. In the fall take them up carefully and transplant the most promising plants in rows 5 to 6 feet each way, in good soil, then stake them, and carefully prune back the following winter. Seedlings may begin to bear fruit in three years. Should any of them show signs of disease in the leaf, pull them up, as it is useless to keep them.

The easiest and most simple way of propagation of the grape is by cuttings planted in the ground. While this plan will not succeed with all varieties, yet it will with most, and prove quite successful. It is done by selecting the best ripened wood of medium size and cut in lengths of from 9 to 12 inches, cutting close below the lower bud, and about an inch above the upper. They should be kept in the cellar during the winter or bury them in finely pulverized soil, keeping the upper end downward. In the spring as soon as the ground is dry sufficiently, the bed should be prepared for the cuttings. The cuttings should be placed in this bed from one to two inches apart, and the rows from one to two feet apart. They will grow from one to two feet the first year. In the fall they should be taken up and set in the vineyard, as a good one year old vine is best. But a simple plan is to plant the cuttings in well prepared land in rows 3 to 4 feet apart and the cuttings four to six inches in the rows.

All varieties of the grape may be increased by layering. To layer a vine, shorten in the canes of last season's growth to about one-half their length, then early in the spring, thoroughly pulverize the ground around them. Make a small furrow about three inches deep, and bend down the canes, and fasten in it by the use of pegs. The canes may thus be left until the following winter and transplanted in permanent places. Layering is practiced with varieties that do not readily grow from cuttings.

When grapes are grafted, take a strong growing two or three years well established vine and use the cleft grafting method, inserting the graft four to six inches below the soil and hill up the graft with soil after having wrapped the cleft part with some thread that will decay in a month or two, do not use wax cloth, as this will eventually cut in the stock and injure it.

The land should be thoroughly prepared by plowing and harrowing, before setting out a vineyard. The vines are usually planted six feet one way and eight feet the other. Some varieties, like Delaware, may be planted closer than this. It is better to use rooted plants, as cuttings are unsatisfactory. You should see to it that the plants are first-class in every respect. The best are always the cheapest. Planting can be done in the fall and in the spring when-

ever the ground is in good shape for work. The crown of the vine should not be planted too deep, as the grape roots naturally run very near the surface. Three or four inches is deep enough for the crown, but the roots should be put down in the soil, as shown in illustration. (See Fig. No. 6.) It is sometimes the practice to put the roots on the sloping side of the furrows with the crown four inches deep.

The grape does not require a great amount of fertilizer. Phosphoric acid, and potash are the greatest need with the grape. The following is a very good general formulae for grapes:

500 pounds of Fine ground bone,
300 pounds of Sulphate of potash,
Or the following:
200 pounds of Nitrate of Soda,
200 pounds of sulphate of potash,
400 pounds acid phosphate,

Of course the fertilizer should be varied according to the particular ground that is used.

The first two years, some hoed crop, such as peas, beans, etc., may be grown in the vineyard, but clean cultivation is preferable. There are many methods of training grape vine, but perhaps the best is to train on a trellis made of two or three wires. The top wire should be about five feet from the ground, the bottom wire two feet from the ground, and the other wire midway between these two.

For enemies to grapes, see Insect Department, and Diseases of Trees and Vines in this chapter.

MULBERRY.

The improved varieties of the mulberry are grown quite considerably throughout the South, for feeding poultry and hogs, the fruit has no other commercial value. The best variety for these purposes are, first Hicks, and second Stubbs and Downing. The Hicks produces fruit during a period of six to eight weeks. The Stubbs is the best for fruit as a feeder for silk worms. At present the world's supply of silk is secured from Europe and Asia where they have cheap labor. Mulberry is propagated by cuttings of the ripe wood or of roots. Early spring grafting with entirely dormant scions is the most successful method of grafting the mulberry. When the fruit is ripe it drops from the trees, and may be gathered by shaking the trees, and allowing the mulberries to fall on a sheet. The mulberry has another value, in that

birds are very fond of them, and it frequently pays to have one or two mulberry trees to furnish food for the birds, for by doing so, you can protect your valuable fruit.

Fig. 8.—New American Mulberry.

Fig. 8½.—Downing Mulberry.

ORANGES.

Excepting the apple and peach, the orange is the most important fruit grown in the United States, but its area is confined to localities where heavy frosts do not prevail, therefore the citrus fruit belt may be considered to be only in the extreme Southern part of the United States.

As varieties are not certain to come true from seed, budding must be resorted to if one expects to have such fruit as the market demands. Good plump seed selected from home-grown fruit may be used for producing seedlings for budding or for growing in the orchard for fruit. Seed intended for propagation should never be allowed to dry out. If they are not planted immediately, the seed should be mixed with moist sand, and allowed to stay until warm weather comes in. The seed should be ready to be transplanted to the nursery the following spring. The trees should be planted in the nursery from a foot to a foot and a half apart. Then by the next spring the seedlings will be ready for budding. Budding, though sometimes practiced in the summer and fall, should be done when the trees are in full sap. After they are budded, the trees should remain in the nursery from one to two years. The trees should be set out any time from December to March 1st. The land should be prepared by thorough working. Some growers advise breaking the soil a foot deep, and then using a subsoil plow breaking it still deeper. As to the distance the trees should be apart, it

is a difficult matter to lay down any general rule. The distance varies according to the variety grown, the method of pruning and richness of soil. However, (although circumstances may call for different distances), seedling trees should be placed from thirty to forty feet apart each way, semi-dwarfs like the Mandarin eighteen to twenty-four feet apart each way and the dwarfs about 10 feet each way. When the trees are first set out it is the common practice to cut off a large part of the top, leaving only short stubs or branches. In growing oranges, the object is to produce a vigorous and healthy tree. If the soil is fertile, and is resistant to drouth, a great deal of cultivation will not be necessary. If on the other hand, the soil is thin, although well fertilized, it will be

The orange tree requires but little pruning after the removal of the undesirable and dead branches.

PEACH.

Commercial Peach orchards began to be planted to a limited extent in Georgia and South Carolina about 1854, but it can be said that the industry really began on an extensive scale immediately after the Civil War, until now millions of trees are in full bearing and yield fruit of a quality that commands the very best prices. On account of its importance, we go into the culture of peaches in detail, and especially for commercial orchards.

There are a great many kinds of soil where the

Fig. 9.—Budded Orange Grove. Erroll Farm, Plymouth, Fla.

quite necessary to give thorough and frequent cultivation. A good supply of vegetable matter, or humus, can be given by growing some leguminous crop, like a vetch or cowpea, when the trees are maturing their annual growth. An excellent fertilizer is a compost of muck and lime spread broadcast.

To protect the trees from frost some provision, which shall be ready for use at all times should be made. If the trees are grown close to the ground, coarse hay, reeds, brush or similar material can be quickly piled up around the trunks and in among the branches with but little expense. Other methods, such as smoking, by using piles of rubbish, are recommended and used with good results.

peach will grow successfully. Good orchards may be grown on stony and gravelly poor soil, as well as on fertile loams, and very light pine sands, on limestone soils; on stiff red clay lands, and even on beach sands so light as to be blown about by the winds. To lay down a general rule, it may be said that peaches prefer a light, well-drained sandy or loamy land with a clay subsoil, although some very fine orchards have been grown upon stiff clays, and deep sands. Muck lands, and soils that retain the moisture, and in fact, all wet lands should not be used to plant peaches. In selecting a place for an orchard one thing of importance is to select a place where you can reach the markets. There are thousands of

acres of land throughout the South that would grow fine peaches if transportation facilities were available, but it would be unprofitable to plant peaches if they cannot be shipped. A peach orchard should be close to a main line of a railroad, so that they can be readily shipped to the markets. Also select the best part of the farm for the orchard. Some parts of a farm are better suited for peach growing than others. As a rule higher lands are to be selected rather than the lower. A hillside with a Northern exposure is better than one with a Southern exposure, this being due to the fact that the Northern exposure will retard the opening of the blossoms, and in this way orchards will escape the late spring frosts. After the site of the orchard has been chosen; a selection of the varieties made, therefore, a proper preparation of the land should be the first point considered.

PREPARATION OF THE LAND.

If the land is fresh and has just been cleared, it should be cultivated at least two years in cotton or some other crop adapted to the locality. Should this new land be too rich for peaches, the fertility could be reduced by planting it in corn or some other exhaustive crop for a year, however, if it is old and worn out, it should be restored to a state of fertility before setting out the trees. The land should be broken up to the proper depth with a two-horse plow; followed with a sub-soil plow if necessary. Sow in crimson clover, cow peas, or plant potatoes, or some other crop which will require fertilization. In late winter turn under the cover crop. Excellent results have been derived from the following treatment:

After the land has received the proper plowing and sub-soiling broadcast or drill in peas in May, using one bushel to the acre, 150 to 200 pounds of good fertilizer per acre will materially increase the growth. In February or March break up the pea vines by running over the ground with a Cuttaway Harrow, then turn under with a good turn plow. As the depth of the top soil has been increased, the land can be plowed to a greater depth than at the previous plowing; subsoil again, if necessary, and in November your land is ready for the orchard.

Another excellent mode of preparation is to sow crimson clover in September, first broadcasting with

stable manure or applying good commercial fertilizer. Plow under the clover in May, subsoil, and sow in peas. All peach lands should be thoroughly and deeply plowed, because after the trees are planted, and are in growth, they can not be plowed deeply. All places in the orchard where the top soil has been washed away, should receive careful and special at-

Fig. 10.—Proper Method of Pruning Peach-trees When Set in the Orchard. Tree on the left ready for planting (after Taft.)

tention; such places are devoid of humus, and this must be supplied by a liberal application of stable manure or compost, and should be put in peas and clover, which must be plowed under in March. In two years' time, by treating as above mentioned, these depleted parts of the orchard can be made very fertile.

PLANTING.

Check off the land at the proper distances, using a good two-horse turn plow. At the intersections dig a hole two feet square, throwing the top soil to one side, use a liberal amount of well decomposed stable

manure to each hole, have this thoroughly incorporated with the soil; if stable manure is not available then use from 1 to 2 pounds of bone meal, or the same quantity of mixture of two parts acid phosphate to one part cotton-seed meal. When using chemical fertilizers the best results are attained by first setting the tree in the hole, fill up the hole one-half its depth, and then apply the fertilizer, but mixing it thoroughly with the soil, firm the earth well about the roots of the tree and level off.

CULTIVATION.

After the trees have put out a growth of 1 1-2 to 2 inches, rub off all but three growths, and these should be so distributed about the tree that it will be well balanced. The early rubbing off of the surplus growth can not be too thoroughly emphasized; it is a great saving of time to do this rubbing off before the young growth becomes tough. It is also not so severe a shock to the tree. The trees should be gone over once or twice during the growing season, and all superfluous growth rubbed out. If these growths are allowed to attain some length it is then necessary to use the pruning knife, which is necessarily a slow and more expensive operation. Keep the orchard thoroughly cultivated, and the trees free from grass and weeds, drill in 3 to 4 rows of peas in the orchard; leave at least 4 feet between the peas and trees. Cotton, melons, or other hoed crops should also be planted in the orchard, but if the land is poor, use peas. Let the vines remain on the ground and turn under in February or March with a one-horse turn plow. Great care must be exercised in plowing, especially the first strip near the trees, otherwise the roots will be injured. The depth of the plowing can be increased as the distance from the tree is increased. The Cutaway and Acme Harrows and weeders are the best and most economical tools for subsequent cultivation. The question has frequently been asked how often an orchard should be cultivated; the answer to this is, whenever needed, frequently an orchard is gone over with the harrow and weeder as many as 20 times during a season. The ground should never be allowed to bake or become hard. Frequently beating rains will harden the ground; in this case the Acme or Cutaway Harrow should be used to break the crust, but the cultivation should be shallow. During the fall and winter hogs could be pastured in the orchard, but under no circum-

stances should horses, mules or cows be allowed to run at large.

FERTILIZATION.

For the first two years the growth of the orchard should be stimulated as much as possible by an abundant supply of phosphoric acid and nitrogen, but care should be exercised not to give an excess of nitrogen. This is readily distinguishable by the vigorous growth, and the dark green color of the leaves. An excess of nitrogen will also produce an exudation of sap, and immature the ripening of the twigs, which are frequently winter killed. When the tree shows a pale color it indicates a lack of nitrogen. In such cases an application of stable manure is

Fig. 11.—Peach Yellows (U. S. Dept. Agr.)

beneficial. A most excellent chemical fertilizer to use at this period is a mixture of 1,200 pounds of acid phosphate, 400 pounds cotton-seed meal, and 400 pounds muriate or sulphate of potash; apply broadcast or in furrows on opposite sides of the tree at the proper distance from 2 to 4 pounds of this mixture according to the size of the tree. When the bearing period is reached, potash is needed; this can be supplied in the form of muriate or sulphate of potash. As the tree increases in age the quantity of this fertilizer per tree can be increased; it is best applied

in February or March, or just before active root growth commences. Hard wood ashes when obtainable is a most excellent and economical fertilizer. A bearing orchard should be given clean cultivation, which should be continued until the fruit is harvested; after that time, if practicable, drill in peas and continue the cultivation until middle of August or first of September. Many orchards do not require fertilization annually, but should be kept thoroughly and constantly in cultivation from spring until middle of August or 1st of September. If the trees receive too much phosphoric acid and nitrogen the growth will be excessive, the fruit will lack color, and it will be very susceptible to Brown Rot; in this case ashes or potash fertilizer should be liberally applied.

the fruit. Should the trees have a rank or vigorous growth the surplus wood should be removed. The pruning should be done annually. Great care must be exercised in leaving a proper quantity of fruiting wood. Frequently a peach crop is materially reduced by an ignorant cutting away of too many fruit buds.

BORERS.

In early winter the earth should be removed from about the body of the tree down to the crown, all gummy exudations scraped off; for this purpose use a tool somewhat like a farrier's knife. All borers should be carefully taken out, then apply the following wash, which is excellent to prevent the attack of the borer:

Fig. 12.—Orchard near Fort Valley, Ga.

PRUNING.

Upon proper and intelligent pruning will depend in a great measure the success of your orchard. In this section trees should be headed low when set out, 1 to 1 1-2 to 2 feet above ground being the best height. The tree having been set to three limbs so that it is well balanced, 1-2 to 1-3 of the previous year's growth of these limbs should be removed during the winter, and tree pruned so that it will have a broad open head, thus admitting light and air to

1 bushel of quick lime,
20 pounds of sulphur,
1 gallon coal tar,
50 gallons water.

Mix tar and sulphur in 10 gallons of water in barrel, add lime, keep well stirred. When entirely slackened dilute to 50 gallons. Apply with a brush to the body and large limbs of the tree. In February draw the soil up to the tree, forming a cone about 6 inches above the level. The above operation should be repeated annually.

THINNING.

This is a most deceptive occupation. It should be started when the fruit is about 1-2 inch in diameter, and at that time we do not realize that these little peaches will attain a diameter of 1 1-2 to 2 1-2 and frequently three inches, consequently the thinning process is not always sufficiently severe. Some varieties should be so thinned that when the fruit matures there should be at least 4 to 6 inches between each specimen; this may seem unduly severe, but it will give you better financial results, and at the same time add to the healthfulness and life of the tree. Your entire crop of fruit will be of a merchantable size, and you will not have a lot of undersize and worthless fruit. All peaches removed from the tree should be carried to the dump and burned, as in this manner you will destroy thousands of Curculio in the embryotic state. Thinning the fruit in connection with proper pruning and cultivation will keep the peach orchard up to its standard, and barring frost and storms there is no reason why the peach orchard should not produce a good crop annually and not have off years.

CURCULIO.

This pest is the cause of the loss of many car loads of fruit annually, and we should wage vigorous warfare against him. Wild plums, crab apples, and haws are excellent feeding for this insect, and the careful cultivator will see that such trees are removed from the vicinity of the orchard. It is well to remove all woods adjoining the orchard, but if this is not practicable you should burn off the woods in late winter, so as to kill all the undergrowth. The only practical mode of destroying the Curculio is to jar the trees, catching the insects on cloth covered frames especially made for this operation. The best time to jar the trees is early in the morning and late in the afternoon when the Curculio is dormant. The jarring should commence as soon as the fruit is set, and should be continued as long as necessary. Spraying for Curculio is not entirely successful, but if 2 lbs. of arsenite of lead added to 50 gallons of Bordeaux is used when spraying for Brown Rot many Curculio will be destroyed.

BROWN ROT.

The following treatment has given good results:

- 1st. Remove all mummified fruit, should there be any on the tree.
- 2nd. Before the buds open spray with Bordeaux 4-6-50.
- 3rd. When in full bloom prune out all twigs and blossoms affected with Rot.
- 4th. When fruit is well set, spray with Bordeaux 3-9-50.
- 5th. Ten days later Bordeaux 3-9-50.
- 6th. Ten days to two weeks later Bordeaux 3-9-50.

The same spray should be continued at intervals of ten days to two weeks until the fruit begins to ripen. If the Bordeaux is carefully applied there is no material injury to the foliage, but if milk or lime is used three days after an application of Bordeaux the shot-holding of the foliage will be greatly reduced.

Many orchardists do not believe in spraying, as the results obtained have been unsatisfactory, and in many instances the results have been fatal to the trees. Not infrequently the spraying is intrusted to the most trifling and most careless help on the farm, whereas, this should be done by the most careful and intelligent man. The spray should be thoroughly distributed over the tree, but not in such copious showers that the liquid will drip from the leaves, not run down the trunk of the tree in streams. Spray properly, or omit it altogether. Another most important feature in reducing the ravages of Brown Rot and visitations of Curculio is the removal of all fallen fruit. During the harvesting season the orchard should be gone over carefully at least twice a week and all fallen fruit gathered up and carried to the dump and burned. After the crop is harvested it is well to go over the orchard and cut out all twigs showing the effects of Brown Rot; these twigs like the fruit should be cremated. The above is taken from the transaction of the Georgia State Horticulture Society, prepared by Mr. P. J. Berckmans.

All preparation of the orchard should be done in advance of the arrival of the trees. The selection of the trees is quite important. It is not necessary that they be large, but the trunks should be smooth and well grown, and the roots abundant and as little injured as possible. Before you give your order for trees, have a written agreement with the agent nursery covering each of these points. Make him specify that they should come up to these requirements

and state them. Remember that a few stress that are poor in quality means more than the price you pay for them, for they mean the land, cultivation, and other expenses that are not touched by the amount you pay for the tree. Nearly every State has enacted laws which compel every nursery man to have his trees inspected annually by duly appointed State entomologists, who can not deliver a certificate if trees are infested with scale insects or fungous diseases of an injurious nature, and further that all trees must be properly fumigated in a thoroughly well constructed house, with hydrocyanic gas before shipping. Failure to receive a certificate of inspection forbids the sale of all nursery products and transportation companies can not accept any package unless a certificate of State Entomologist is attached thereto. This is a protection for tree buyers and prevents diseased trees to be sold under penalty of a misdemeanor. The greatest care should be observed that they be not infested with borers, scale insects, etc. It is better to pay two prices for a tree of assured character, than it is to accept trees as a gift of doubtful character.

In the selection of the variety, common sense should prevail. For instance in Georgia for the past few years, there has been more Elberta trees planted than of other varieties. As Elbertas ripen about the same time, there is often a glut of these in certain sections. Now the wise peach grower will plant some other varieties that will come in earlier or later than the Elberta. In order to get those that will pay commercially, the peach must have as many good points as possible. For instance, the trees must be productive, the fruit must be of good size, and fine color, and superior flavor, and must be firm enough to stand shipping.

Fifty to one hundred pounds of nitrate of soda or its equivalent in some other material per acre is as much nitrogenous fertilizer as any orchard should have, and some orchards do not need any nitrogen at all. Additional information can be had on the subject by reference to the chapter on Fertilizer found in another part of this book.

One great trouble with peaches in the South, is that they bloom during a warm spell in early spring, and then comes a frost and kills the fruit. For that reason the crop is not as safe and sure as some other crops. The Missouri Experiment Station found that if peach trees are thoroughly whitewashed, that the trees absorb less heat on sunny days, and that

the buds remain dormant, while the trees around them which were not whitewashed, bloomed. This is worth trying and may mean much to the peach grower.

Picking and packing peaches require the personal supervision of the grower. You can not trust these matters to hired help unless you are there to look after it yourself. A peach should be picked and packed with as much care as an orange. They should not be poured from basket to basket, as this will surely bruise them. More attention needs to be given to picking peaches. If you pick a day too early the peaches are too green, and if you are a day too late they are over-ripe. If growers would give more

Fig. 13.—Shipping Packages for Figs. (24 qt. crate.)

attention to the picking, packing and shipping of their fruit, they would certainly get better results. Some shippers make the mistake of shipping in too large crates or baskets. The best package is the six basket carrier crate. For the diseases of the peach see diseases of Fruit trees in this chapter.

PEAR.

The pear is one of the most delicious fruits grown. As a canning fruit, they are equally as desirable as peaches. On account of blight it is not grown so much as it otherwise would be. Pears, like most fruit, are propagated by budding upon seedlings during June and August. They will grow successfully on much heavier lands than either the peach or the apple, but succeed best on clay, or clay loams.

The pear orchard should be well-prepared by deep, thorough plowing. Standard trees are set 18 to 22 feet apart, and the Dwarf 12 to 16 feet apart. The pear orchard should be cultivated similar to the peach orchard. Before the crops commence bearing some crops can be planted in the orchard, such as potatoes, cabbages, peas and beans. The pear tree begins bearing from five to eight years after planting, and

should continue to bear for fifty years, unless disease attacks it. As to fertilizers, if the soil be good, pears do not require any fertilizer until they commence to bear, when phosphoric acid, and potash should be applied. Leguminous crops are better than an application of nitrogen. Wood ashes and ground bone are preferable to ammoniated manures.

The practice of thinning pears is quite important, and should be practiced as regularly as for peaches. Thinning prevents them from overbearing, also improves the quality and size, and tends to make the tree bear each year. This is especially required for the Keiffer. Where the tree overbears, there is a tendency towards the tree failing to fruit every year. Pears should be picked before they are ripe, and be allowed to ripen in a closed room. They should be picked when they reach their full size, and a very slight color begins to show, and be carefully picked by hand. Varieties like the Clapp, which rot at the core as soon as it is fully matured, should be picked one week before they would mature on the tree.

As to the variety which should be planted, this depends upon their prospective use. If needed for home consumption many varieties of known good quality will be desirable, but if for market few sorts, except Keiffer and LeConte will pay. The Keiffer is grown more than any other commercially, as it is very valuable for canning and produces large crops at an early age of the trees. For enemies to the pear, see diseases of trees found in another part of this work.

PECAN.

The Pecan is the most important native nut tree in the United States. The tree belongs to the Hickory genus and grows wild in the rich bottoms of Kentucky, Louisiana, Texas, and south-east to Georgia. The bulk of the pecans of commerce are gathered from seedling trees, but orchards of grafted sorts are being set out throughout the South, and are proving quite profitable. Pecans are propagated from seed, but only about fifteen per cent. come true to the parent form, so most growers are budding or grafting pecans, but with a smaller proportion of success than with other fruits. They are quite difficult to bud or graft, and hence are very expensive, but in the end it pays much better to have the grafted or budded

stock. You can then be sure to get what you want. After the pecan nut is planted it will take the tree two years to be ready to place in the permanent orchard, and if budded or grafted, it should remain in the ground a year longer before being transplanted to its permanent orchard. The trees may be transplanted any time after the leaves drop in the fall and before the buds swell in the spring. It does not injure the tree to cut the tap root, and some growers recommend the cutting off of the tap root so that the tree will bear earlier than it otherwise would do. In transplanting trees of any kind the top should be cut back so as to put the young tree in good shape, and the amount of cutting back should be made to balance the loss of roots. Few trees are injured by being cut back severely.

On very rich soils, pecan trees tend to grow wood rather than nuts. Sandy loam soils with a good clay subsoil has been found to give excellent results. Land that is suited to the cultivation of corn and cotton will grow good pecans. On poor soils, the trees should stand 40 feet apart each way, and on richer soils, and bottom lands they should be from 50 to 60 feet apart each way. The pecan orchard will require about the same care as other fruit orchards. The pecan seedlings do not begin to bear fruit until the trees are ten years old, but grafted trees usually give their first crop when four years old. Few trees respond more readily to heavy and regular fertilization. Trees 5 years old which were regularly supplied with washings of barnyard have been known to bear fruit. The nuts retail in the market from 5 to 50 cts. per pound. An extra large variety has been known to command \$1.00 per pound in New York City.

JAPANESE PERSIMMONS.

The Japan persimmon is thoroughly adapted to the Cotton Belt. It does especially well in the coast region. The tree is a vigorous grower, an early and prolific bearer. As it is apt to overbear the fruit should be thinned out, leaving only a number commensurate with the size of the tree. The fruit varies in color and shape. The dark-flesh varieties are never astringent, but the light-fleshed should never be eaten until soft. The flesh also varies in color; in the pointed varieties it is usually deep orange; in these it remains solid and quite astringent until

November, but become soft and edible after being house-ripened. In the round varieties, those having dark-brown flesh are edible while still solid, while most of these with orange flesh should be allowed to become soft before being eaten. The fruit of nearly every variety begins to color when half-grown, but should be allowed to hang on the tree until just before a frost is expected, or in case of early ripening varieties, when fully soft. If gathered before a frost, there is a slight astringency next to the skin, but this disappears after being kept in the house for a few days or weeks. If allowed to be slightly touched by frost the flavor is much improved, but the fruit will then not keep many days. Gather the fruit before frost, if intended for keeping; some va-

PINEAPPLE.

The pineapple and frost are bitter enemies. For this reason the commercial culture of pineapples is limited to Southern Florida where the temperature varies from 73 deg. to 76 deg. F. The pineapple is propagated from offsets from the parent plant. As a rule the suckers or offsets that grow near the base of the plant are most desirable to use in propagating. In using these suckers, you can secure fruit much earlier than when you use slips, or offsets that are produced at the base of the fruit, for these require eighteen months or two years to produce fruit.

In Florida the soils upon which the pineapple grows best is a fine sand which is exceedingly poor

Fig. 14.—Pineapples as Grown in Florida.

rieties will remain sound until January or February. The flesh is soft, rich and sweet, and of a slight apricot flavor. Some varieties will be perfectly seedless during one or more years, and again every specimen will contain more or less seeds the following season.

The best varieties are as follows in the order of maturity: Zengi, Migro-Tan, Maru-Gata, Aoong, Hi-yakume, Okame, Hachaya, and Tsum-no-ko. Trees of the early maturing sorts do not grow as tall as those of the late sorts.

in plant food. "Hickory Scrub" is considered the best land for pineapples and this will analyze from 94 per cent. to 99 per cent. pure sand, under which is a layer of yellowish sand. One of the most important matters is that the land be well drained. It is not so important as to what kind of soil you use, as it is how well that soil is drained. Pineapples will stand drouth considerable, but they cannot stand water. The Florida Experiment Station has conducted several experiments to determine the fertilization question in connection with pineapples. As a result of these experiments it is suggested that if the

pineapple plants are set in July or August a handful of fertilizer composed of three parts cotton-seed meal and one part fine unleached tobacco dust should be immediately dropped into the bud. This furnished plant food, and prevents them from filling with sand. Then later, say in October or November, 680 pounds of blood and bone and 500 pounds potassium magnesium carbonate should be applied. As soon as the danger of frost is over, this same application should be repeated, say in February. Then just before the beginning of the rainy season from 1000 to 2000 pounds of blood and bone and from 750 to 1500 of potassium magnesium carbonate should be applied. This same application should be repeated in October or November. The plants should be set in rows 30 inches wide and from 15 to 18 inches apart. Very little cultivation is necessary. It will be well enough to hoe them sufficiently to keep the weeds down.

In the past few years pineapples have been grown under sheds. The sheds are built seven or eight feet high, and are covered with laths three inches wide, leaving a space between them equal to the width of a lath. These sheds protect them from frost, also from the very hot sun. The cost of production is not so high as it used to be, and the value of the market fruit is much greater than it was a few years ago.

PLUMS.

There is no more delicious or nutritious fruit than the plum, of which numerous varieties grow in the U. S. The European varieties which have been domesticated, are represented by the blue, red and yellow plums and produce excellent fruit. The great objection to the European plum is that they are subject to the attack of insects and fungus pests, and cannot be grown unless they are given careful attention. This group grows best on a deep moist loam, but they will grow on many other soils. They should be so planted as to allow full exposure to the air and sunlight, which will do much to prevent the rotting of the fruit and the growth of black rot. Few varieties of this group succeed except in restricted localities.

The second group are the Japanese plums which have become quite popular in the last twenty years, and are planted quite extensively. They are nearly all of vigorous growth and are precocious bearers.

The fruit varies as to quality, some varieties being most excellent. Nearly all varieties are prolific bearers. They thrive in the same soil as the peach, and are subject to the same insects and fungus diseases. However, on account of their bearing so much younger and being more reliable than the European sort, they can be more profitably grown. They should be so planted as to get the full benefit of the sunlight and air, as they are subject to brown rot and black knot. The same method of pruning the peach applies to the Japanese plums.

The third group consists of American or native varieties of plums. Some varieties like the White Goose or the Chickasaw type are very prolific, productive and free from disease, and are well suited to the South.

In order to get the best results from plums, it is necessary to cultivate the orchard. They should also be fertilized, using the same fertilizers and the same cultivation that you would use in growing peaches. The soil that is best adapted to plum growing is a heavy clay soil. However, plums will grow in a wide range of soils. The trees should be set 15 feet apart each way and either in the fall or spring. Trees should be one and two years old when set out. The Wild Goose will be expected to produce some fruit when two years old. All broken and injured roots should be trimmed off before setting out, and the top trimmed to a whip about two or three feet long. The tree should be planted a little deeper than it stood in the nursery. Overbearing in the Japanese and American groups is quite a common fault, and therefore it is very important that they should be thinned. Fruit growers should realize the importance of thinning fruit. By doing so, much larger fruit will be produced, and also you will get much more regular crops by thinning early if much fruit is set.

QUINCE.

Commercially the quince is not much grown. It cannot be eaten without cooking, and has little value except for preserving purposes. It makes perhaps the best preserves of any fruit, and in this consists its value. It has very little value as a shipping fruit, for the slightest bruise or scratch injures it. A few quince bushes are usually planted in gardens, but very few orchards are in existence in the South. The

quince is propagated by hard wood cuttings taken in the fall or winter and placed in the sand. These cuttings should be a foot long. In the early spring, the cuttings after having been in the sand a couple of months, may be planted out, and remain in the

Fig. 15.—Outlines of Principal Varieties of Quinces.

nursery for two or three years before planting out in the orchard or garden. The best soil for the production of the quince is a deep, rich, moist loam. The trees should be planted 10 feet apart each way or perhaps 12 feet each way, depending of course upon the fertility of the soil. Nitrogenous manures should not be too freely used. The fruit should be gathered when it turns yellow, when the whole crop may be gathered. They must be handled with a great deal of care, as the slightest scratch will cause the skin to turn brown. The fruit may be kept for a month in a cool cellar.

RASPBERRY.

The raspberry is grown most everywhere in gardens, but it is not grown for the market as extensively in the South as in the North-eastern States and on the Pacific Coast. There are two classes of raspberry grown in this country, the black cap varieties and the red. The black is sometimes of more commercial importance than the red, as it stands shipping better, and bears heavier. The reds are relished more than the black.

The red raspberries are similar to the blackberry and are propagated in the same way, by root cuttings or from suckers thrown up from the roots. It delights in a cool, moist location, but grows in almost every kind of soil. The land should be fertile if you

expect large fruit. Barnyard manure should be used as a fertilizer and should be used liberally. There can be no definite rule laid down concerning the distance the red raspberry should be planted. Different growers, and different varieties and different methods cause a wide variation in the distance between the bushes. In very rich soils, it is perhaps best to have them in six feet rows and the bushes placed four or five feet apart, but in poorer soils three by five feet would not be too close. Raspberries will stand our coldest winters, but unless kept well cultivated during summer, excessive heat will injure them. The raspberry should be cultivated shallow, as it is a shallow feeder and working too deep is liable to injure the plants. It is best to pick the fruit in pint baskets every day. They should not be picked while wet if possible to avoid it. As soon as they are picked they should be sent to the market at once, as they quickly spoil.

The black raspberries are much better shippers than the red, and therefore are grown a great deal more commercially than the red berries. They are propagated by burying the tips of growing canes shallow, late in the summer, as shown in the illustration, late in the summer. The habits and growth of the blackcaps differ widely from the red berries. The black raspberries grow in hills, and do not throw up suckers. They mature a little earlier than the red raspberries and are planted either 4 feet apart in rows, rows 5 feet apart, or 5 feet apart in rows, rows 6 feet apart. The end bud should not be planted more than two inches under the surface, but the roots should be planted down in the moist soil. The culture is about the same as for blackberries.

STRAWBERRY.

The strawberry is quite an important berry throughout the South. Over 200 bulletins from the different experiment stations have been issued, thus showing the importance of this fruit. Perhaps there is more money made out of strawberries than any other crop. It is a crop that requires more skill in growing and more shrewdness in marketing than any other, but when it is carried on as it should be, you need have no fear as to results. In exceptional instances \$200.00 to \$300.00 per acre have been realized. It is better for strawberry growers, that grow

for the market to get together, so that they can co-operate in buying boxes, crates, fertilizers and the securing of the best shipping rates, etc. Before beginning to raise strawberries there are several questions that you must answer. For what purpose are you going to raise strawberries? Do you want them for your family, or do you want to raise them for the market? And then when you have decided these questions, there are others to be considered. In the next place, if you are going to raise them for market, are you to raise them for the local market, or to ship? This question is important, for if you raise them for the local market you will want to get a variety that will do well in your locality, one that will ripen at a time to command the best prices and a quality that will be in demand by your customers. It takes more time and money to produce a berry of the best quality than it does to produce a berry of poor quality. If you desire to ship your berries, you will have to select in many cases, an altogether different variety. It must bear shipping well, be of best quality, large size, and good appearance. So you can readily see that there are several things that are to be determined before you are to go into the strawberry business.

As to the soil upon which to raise strawberries, it is quite difficult to lay down a general rule. In Florida the best strawberry soil is a good flat wood soil. Next best is a hammock or "Bay-head." The soil must hold moisture well but not be soggy. Light sandy soils well fertilized good for an early crop, yield well, if you are in position to irrigate. Any land that will grow good corn will grow strawberries.

The soil for strawberries should be well prepared. In fact, you cannot overdo the matter of preparation of your strawberry ground. It should be broken deeply and plowed in the fall, before the plants are set out. After the ground has been thoroughly broken, heavily manured with barnyard manure (from ten to twenty loads per acre should be put on,) the plants may be set in rows from three and a half to four feet apart. The plants may be set out in the fall or spring, (but fall planting is recommended for the middle South) and should be from eighteen to twenty inches apart. They should be carefully planted so that the crown is just above the surface level. The same bed should not be used to produce plants and fruits. Let the energy of one bed be

devoted to one purpose. You can secure much larger berries if you grow berries and not plants in the same bed. Never take up the plants and reset them, that is, after taking up plants, never reset the ones that have been bearing, but use the plants that are made from the runners. One plot of ground should not be used longer than three years for strawberries, and to secure the best results, it should not be used that long. After the plants bear two or three crops, they lose their vitality, and cease to bear. The plant soon after it is planted in the spring should be mulched with straw as it keeps the weeds down, also retains the moisture.

Fig. 16.—Planted Too Deep. Fig. 17.—Planted Too High

Fig. 18.—Planted Just Right.

There are several Systems of Planting Strawberries.

The Hill System. This consists in setting the plants in rows three feet apart and placing the plants one foot apart and keeping the runners cut off. The runners, of course, should be cut off as soon as they start out, and makes them easier cultivated, mulched and harvested. There is a modification of this sys-

tem called the Hedgerow system in which the plants are placed two and a half feet by two feet and the plants treated in the same way, except the plants are allowed to fill in the space at eight to ten inches apart.

Wide Matted Row. This system consists in planting the rows from three to five feet apart varying according to the fertility of the soil, and letting the runners grow over the space between the rows.

The following cultural directions will apply to nearly all sections of the South: The strawberry adapts itself to almost any soil which is not too wet or arid, but it will do best on a deep, rich, sandy

tender, and more susceptible to being burned out during the hot, dry summers. Plants set out after the fall rains will yield a fair crop of fruit during the following spring, but a large crop cannot be expected until the second year. It is undesirable to let the plants remain after the second year, and more profitable to plant every year, so that one field may take the place, as the other is plowed up. Set the plants in rows, three by one foot, thus one acre will require, 14,520 plants: For the South we advise matted rows in preference to stool cultivation, as the former is more resistant to long drouths. After the crop is gathered, keep the soil well stirred and always free from weeds. Remove all runners as fast as they appear; this will increase the size of the plant and also

Strawberries grown by J. W. Goree, Whitewright, Texas.

am. The land should be thoroughly prepared by being broken up with a two-horse turn plow, first applying from fifteen to twenty-five two-horse loads of well decomposed manure to the acre; a top dressing of hard-wood ashes, (thirty to fifty bushels,) muriate of potash (300 to 400 pounds,) or bone meal (500 pounds,) should be applied per acre during February. Avoid nitrogenous fertilizers just before the blooming period, as these will induce a strong vine at the expense of the fruit; the plant is also forced into a very sappy growth, which will make it

the quantity of the berries produced. We have tested hundred of varieties of strawberries and find few that will give general satisfaction. Locality has a great influence upon the success of this fruit and therefore we cannot depend upon the same variety thriving equally as well in different soils and localities.

Mulching. After a thorough working of the soil in the early spring, a thin covering of straw or leaves should be placed around, but not over the plants.

Let this mulching remain during the fruiting period, then remove. Keep the beds well cultivated and free from weeds, during the balance of the year.

Sex of blossoms. The blossoms of most varieties are perfect, or bi-sexual, and are termed staminate, but some varieties, destitute of stamens are imperfect and are termed, pistillate. The latter are, as a rule the most productive if planted near perfect flowering sorts; otherwise they will not produce fruit. Plant three rows of a good pistillate variety, and then three rows of a perfect or staminate sort, etc. Hoffman, Lady Thompson, Michel and Tennessee Prolific are good pollenizers, but care must be taken to keep the runners of each variety from encroaching upon others.

The strawberry is a very perishable fruit, and therefore requires the greatest care in handling. The picking should be done early in the morning or late in the day when possible. The fruit should be removed to some cool place immediately, but should not be placed on ice, if possible to avoid it. They are almost universally marketed in quart baskets. Picking strawberries is one of the greatest problems that confronts the grower. Some growers employ men, some boys, and some women. Perhaps the best results are obtained where women are employed to pick. One of the greatest, if not the greatest thing, in handling strawberries is to present them on the market in the very finest condition. When that is done, little trouble will be experienced to find a sale. It is much better, if you can get the pickers that will do so, to assort the fruit as it is picked. Great care must be exercised not to bruise the berry in picking or packing. By having large and small berries in the same box, the price realized will be less than if the fruit is properly graded. Put the large berries in one box and the smaller in another, and let the fruit at the bottom of the box be of the same size as that which is on top. Mix sizes bring only the price of the smaller ones. The smaller size rules.

As to varieties, not all be as equally successful in every section, but the following have given the best results, as a rule, Lady Thompson, Brandywine, Wilson's Albany, Hoffman, Haverland, Sampler.

FUNGIOUS DISEASES.

Diseases commonly known as rusts, blights, rots,

mildews, etc., are known to botanists as fungous diseases. These fungous diseases are parasitic plant growths, that grow on other plants, thus weakening the host plant, upon or in which they grow, and causes them to cast their leaves, the fruit to become spotted or decayed, or the trunk or branches to become injured. These plants that cause so much trouble are very minute, and are frequently invisible to the eye. Most of these plants are more prevalent during moist and heat periods, although some, like the apple scab, grow in rather cold weather.

Anything that will destroy a fungous plant is called a fungicide. In growing fruits or vegetables it becomes absolutely necessary to use fungicides according to formulas given hereafter.

THE APPLE SCAB.

The apple scab attacks the fruit and leaves of the apple and pear trees. It is an olive green spot fungous that grows during moist, cool weather. It feeds only on the skin of the leaves or fruit, often causing the leaves to fall off during the summer. It does not disfigure the fruit unless it attacks it early in the season, when it will cause the fruit to fall off also. Its main effect on the fruit is to disfigure it, and destroy its keeping qualities. The spores in this disease are very minute and can only be seen by very close observation, and are often carried long distances by the wind.

Remedy. Spray with Bordeaux mixture when the buds are swelling, and copper sulphate solution after the fruit is nearly grown.

CEDAR APPLE FUNGOUS OR RUST.

This disease is caused by a fungous which spends part of its life on the cedar. The disease causes small yellow spots on the under sides of the leaves, and sometimes on the fruit. Sometimes the leaves and fruit fall off. The disease attacks apples, pears, and quince.

Remedy. Where it is impossible to gather the cedar apples, and destroy them, the best thing to do is to cut down all cedars growing near apple trees. Bordeaux mixture used as a spray in early spring before vegetation starts is advisable.

BLACK ROT.

Blackrot is a disease that attacks the apple, pear and quince. The dying of the end branches, the dead patches of bark found on the branches and trunk are caused by this disease. It also attacks the fruit, and will be known by discolored patch and spots on the fruit. The injured parts are nearly black in color and studded over with pistules or bead-like projections in which the spores are produced. If it attacks the fruit, it finally cracks open and hangs on the tree over winter.

Remedy. The tree should be sprayed with a solution of copper carbonate beginning soon after the fruit sets, and repeating if necessary two or three times.

If trees are sprayed with Bordeaux mixture there will be less trouble with black rot as it acts as a preventative.

LEAF BLIGHT OR LEAF SPOT.

This disease attacks the pear and quince, affecting the fruit, stems and leaves. The disease appears as soon as the leaves appear, and sometimes later, if the season is dry. It first appears as minute red dots about one-sixteenth of an inch in diameter which afterwards grows to an eighth of an inch in diameter. These cause the leaves to fall off frequently in the summer, it also attacks the fruit, causing it to crack. At first the spots are red and then turn black. On the quince the leaves may turn yellow before they fall off. Sometimes a second crop of leaves appear and even blossoms, but the wood, (at the end of year.) that year's growth becomes hard and is considered dead, fails to ripen, in which case the tree is liable to injury during the following winter, or to an attack of fire blight during the following summer.

Remedy. By using several applications of Bordeaux mixture, the disease can be controlled in a great measure.

FIRE BLIGHT.

This disease attacks apples, pears and quinces, although the pear is more subject to it than either of the other two. The disease is bacterial, and is something similar to the yeast plant in habit of growth, and develops very rapidly in moist, warm weather. It is a one-cell plant, this cell enters the tree in some

soft part, perhaps the pistils of the flower, or some broken place on the bark. The disease is frequently transmitted from one part of the tree or flower to another by bees and other insects. The disease may not be noticed until the leaves are seen to wither on the branch or branches attacked. Sometimes it only attacks a small branch, while at other times, the whole tree will be affected.

Remedy. The diseased part should be cut off as soon as the disease appears, as far back as the wood seems to be affected, and the part cut off burned. This is about the only thing that can be done. Everything possible to give the tree a vigorous growth should be done.

PEACH SCAB OR BLACK SPOT.

This disease is caused by excessive moisture especially in close weather. It is more prevalent on low lands than on high lands, for the trees on high land are exposed to sunlight and air. When the fruit is attacked early in the season the growth is checked, the fruit falls off and sometimes cracks. If it spots the fruit, the sale of the fruit is injured.

Remedy. Spray with a solution of Bordeaux mixture just before the leaves appear in the spring, using strong Bordeaux, (4-4-50) and when the leaves have opened, with a weaker solution, (4-4-200) will prevent the attack. It is a good idea to spray again after the leaves have unfolded and then once or twice in the latter part of July and the first of August. Paris green should not be used on peach foliage, but arsenate of lead may be safely used.

BROWN ROT.

This disease attacks peaches, and plums and is one of the most serious affecting these fruits. It causes the fruit to rot and quite frequently attacks the twigs, doing serious harm. The diseased fruit turns brown, dries up and becomes covered with a gray fungous covering. The peaches that are dried up on account of this disease frequently remain on the trees all the winter, and should be removed and burned to prevent the disease being held over.

Remedy. Spray with copper sulphate before buds swell, and with Bordeaux mixture before flowers open and again with Bordeaux when fruit is set. Repeat this at intervals of 10 to 14 days. Dusting the flowers

with sulphur when fruit is half grown, and repeated every 10 to 14 days is advisable if Bordeaux mixture is not used.

PEACH CURL.

In seasons when the weather is warm and is followed by a very low temperature, the growth of the leaves is so checked, that this fungous finds the right conditions within which to grow. The leaves become short, thickened, and finally drop off, to be followed by another set of leaves a little later on. The disease is not very serious if the trees are healthy and in a good vigorous condition.

Remedy. Spray with Bordeaux at least two weeks before the fruit buds open; only one application is necessary to prevent this disease. If spraying has not been done and the disease appears, continuous cultivation and the application of nitrogenous manures will throw off the diseased leaves and save the fruit crop. In case of San Jose scale in the same orchard the lime, salt and sulphur wash may be used effectively against both scale and leaf curl at one spraying.

PEACH YELLOWS.

The exact nature of this disease is not fully understood, for no specific fungous or bacterial germs or growth have been discovered. The disease will be recognized by the premature ripening and high coloration of the fruit, which is spotted with red in the flesh. New buds develop on the trunk and branches and the winter buds sometimes unfold in the fall. Sometimes only one branch will be affected, but unless it is remedied, the whole tree will be killed. The disease is very contagious and its spread should be prevented by the immediate removal and burning of all affected trees. On account of its cause being unknown there is little use of trying to doctor up the sick trees. It will be cheaper in the long run to remove and burn the trees, for you run the risk of losing many by trying to save one. Fortunately this disease is seldom found in the South.

PEACH ROSETTE.

This disease is very similar to yellows. Small leaves are produced in small bunches of a yellow

cast. It should be treated in the same way as yellows.

BLACK KNOT, BLACK WART, ETC.

Black Knot attacks plums and cherries. Many plum trees of European varieties are destroyed by this fungous. Affected branches swell on each side until the bark bursts, exposing a brown spongy mass. The spores which cause the trouble, enter the tree at some soft place and grow very rapidly, and soon cause the death of the trees. Old knots are black and dry.

Remedy.—If the trees are badly affected by the disease, the trees should be dug up and burned, as the disease rapidly spreads. Spraying with Bordeaux mixture (4-4-50) will help to hold the disease in check.

SHOT-HOLE FUNGOUS.

This disease appears as red circular spots that come on the nearly grown leaves. It attacks all plums, and will prove very destructive unless stopped by spraying. After a while the red or brown part of the leaf drops out, leaving a hole there, from which it gets its name.

Remedy. Spraying as you would for Black Knot.

PLUM POCKETS, PLUM BLADDERS.

This disease attacks the fruit while it is young. It is death to plums, causing them to swell to their natural size within a few days. They are first green or yellow and then as the spores develop on the outside they turn a grayish color and then a dark brown. The interior of such diseased plums is hollow. All leaves and fruit from diseased trees should be removed and burned as soon as they fall, as the disease is very contagious. It is also recommended that the ground under the trees be sprinkled with air-slacked lime to prevent the disease from spreading.

Remedy. Spray the tree with standard Bordeaux mixture before the buds swell.

ANTHRACNOSE, SCAB, BIRD'S EYE ROT.

This is a disease of the grape vine and attacks the

green parts of the vine during the growing season. Black or brown spots often appear on the leaves and the diseased tissue often cracks, leaving ragged holes. The disease appears on the fruit as brown spots with a narrow darker margin. Some varieties are more liable to attack than others, those containing European blood, that is, those originating from crosses of European and American varieties, being more likely to be attacked than some of the native types.

Remedy. The vines should be sprayed with Bordeaux mixture before the leaves unfold, and two or three times during May or June will do much to keep the disease under control.

Another Remedy. Wash the vines with a solution of copperas in winter and spring. In addition to this in the summer regular sprays of Bordeaux may be used. Dusting with flowers of sulphur so soon as fruit is set, and repeated every ten days until fruit is coloring is advisable.

BLACK ROT.

This disease attacks grapes and first makes its appearance known by brown or black spots on the leaves or shoots. Then the berries are attacked, and become black. In the center of the diseased spot may be found numerous black pistules which contain the spores of the fungus.

Remedy. Thorough spraying must be done to keep the disease in check, using the standard Bordeaux mixture.

DOWNY MILDEW OR BROWN ROT.

This is a disease of the grape and affects the leaves, young wood, blooms and the berry. In moist, hot weather the disease is likely to do serious harm unless the vines are sprayed. On the leaves it appears as green-yellow spots on the upper surface and with white spots on the under surface. Then the white surface disappears and the leaves turn brown and dry up. In the gray rot the berry is covered with white powder. Such varieties containing foreign blood, such as Delaware, Brighton, Rogers, Hybrids, etc., are especially subject to this disease.

Remedy. Spray with a solution of copper carbonate before flowering and after flowering, then at intervals of from two to four weeks. It is quite impor-

tant that everything be done to secure a vigorous growth of the vine.

Another Remedy. Spray with Bordeaux mixture, just before, and after flowering.

POWDERY MILDEW.

This disease attacks the leaves, new growth and berries of the grapes in the midsummer. The affected parts are covered with white threads, by which the disease may be distinguished from Downy Mildew. This disease is a little similar to Downy Mildew, but it does not appear until after Downy Mildew.

Remedy. The same treatment as for Downy Mildew.

ANTHRACNOSE, CANE RUST.

This disease is similar to Anthracnose, and attacks the raspberry. It appears on the young canes of the raspberry as small, round, light spots, with a purple ring. It appears in June or July and attacks the leaves sometimes. It is more damaging on old plantations than on those just settled.

Remedy. Spray with copper sulphate solution before buds break, then with Bordeaux mixture just before the leaves unfold, and once or twice after the leaves have opened, but before the fruit has set. The affected parts should be cut off and burned.

CANE BLIGHT.

This disease usually appears late in the summer, say in August. It appears in the form of a light brown spot attacking the lower leaves and working upward. If this loss of leaves occurs early in August, the damage is quite serious.

Remedy. Use the same treatment as for Anthracnose.

This disease affects the raspberry and the blackberry, and appears in the spring, attacking the leaves and canes. The attack is followed by large masses of yellow or golden spores, and finally the part attacked dries up. The spores, it is supposed, germinate in the summer and fall and grow in the tissues near the ground in the spring.

Remedy. This disease is on the inside of the plant,

consequently spraying does little towards killing it after it has appeared. The best thing to do is to gather and burn all the affected parts, and after the fruit has been gathered in the summer, spray two or three times with Bordeaux mixture to prevent new spores from forming, and doing damage for the next year. There is another modification of this disease called the Fall Orange Rust that appears in the fall instead of the spring. The same treatment as for this disease is recommended.

Fig. 19.—Bud Stick with Bud Prepared for Insertion.

STRAWBERRY LEAF BLIGHT.

This disease attacks the strawberry, and makes itself known by the reddish or brown spots that come so abundantly on the leaves in the spring or summer. This fungous grows very abundantly in warm, moist weather.

Remedy. The best method or remedy is to dip the leaves of the plant in Bordeaux mixture before they are set in the spring, and then spray the plants afterwards several times. It is a good idea to spray in the spring just before the plants bloom.

MILDEW

This fungous attacks the strawberry plants and is a light grayish growth of the plant. It injures the berries.

Remedy. The disease may be controlled by using Bordeaux mixture, or by dusting them with sulphur.

BUDDING AND GRAFTING TREES.

The practice of budding and grafting trees is that of changing the variety of a plant, or in some cases changing the plant altogether. For instance, if a fruit grower has a certain variety of peaches, of which he wishes more of the same variety, he cannot plant the seed of that variety and get it at all, but the small seedling tree must be budded or grafted. Grafting and budding are practiced for the same reason, but are different processes. Nearly all fruit trees that are planted are grafted or budded trees. The plant on which the grafting is done is called the stock, and the part inserted in the stock is called the scion or bud. The scion as used for grafting refers to a twig consisting of one or more buds, the detached

Fig. 20.—The Bud Inserted and Secured.

bud is used for budding. The fundamental principle in grafting is to bring the cambium layer, (which is the growing tissue between the bark and the wood) of the scion and the stock in contact with each other, and to keep them in contact until they unite and grow together. There are several methods of grafting which will be discussed here; budding, scion grafting, and grafting by approach, etc.

Budding is practiced with peaches, cherries, plums, and most stone fruits, apples, pears, etc. It consists in slipping a single bud under the bark of the stock. Budding may be done almost any time during the summer from June to September. June budding is done during June or early July. The work has to be done whenever there is a good flow of sap in the stock, and the bark can be separated easily. The stocks on which the buds are inserted should be as large as an ordinary lead pencil or a little larger. Peach stock as a rule are large enough the summer after they are planted, but stocks of all the other classes of fruit must be grown one year before. The buds are taken from twigs of the present season's growth, from a variety which it is desired to propagate. Select thrifty, vigorous twigs on which the buds are well developed and immediately trim off all the leaves except about a quarter of an inch of the stem of each. These leaf stems are a great convenience in handling the buds. If the twigs must be kept more than a short time they should be wrapped in a wet cloth to prevent them from becoming dry and wilted.

The only tool needed for the work is a sharp knife, and the knife must be very sharp so that it will make a perfectly smooth cut. Almost any good knife will do, but the most convenient form is one in which the edge makes a straight slope to the back at the point. When much work is to be done it will pay to buy a regular "budding knife," which will cost about fifty cents. One also needs a supply of the material, Rafia sold by all seedsmen and nurserymen, which is the best for peaches. A soft cotton yarn is very satisfactory and is used quite frequently.

When ready for work wipe the sand and dirt from the stock at a place near the surface of the ground where a smooth, straight place can be found. The cut for the bud is made T-shaped, the cross cut being made first, and from one-half to three-fourths of an inch in length. Then make the perpendicular cut about an inch in length, and with a slight twist of the knife loosen the bark at the top of the cut. These cuts should barely go through the bark, and not into the wood. Fig. 19 shows the cut at a and the loosened bark at b.

Then cut a bud from the twig, beginning the cut about a half inch below the bud and continuing it

half an inch above, as shown in Fig 20. This cut should be made so deep as to take a thin slice of wood with the bud, but too much wood should be avoided. Handle the bud by the short piece of leaf stem, and slip it gently under the loosened bark, bring the top of the bark above the bud down so that it will just fit the cross cut in the stock.

The tying should be snug but not so tight as to cut the bark. Begin at the bottom of the bud, bringing the first turn over the end of yarn to hold it from slipping, and then make three or four turns below,

Fig. 21.—Cleft Grafting.

and as many above the bud, being careful that the string does not come exactly over the bud, and that the loosened bark at the top of the cut is brought back into place. Fasten by making a loop, or by putting the upper part of the string into a slight cut made an inch or two above the bud. In two or three weeks the buds will have "taken" or died, and the tie should be removed. Nothing more needs to be done to September buds until the next spring, when the tops of the stocks should be cut off just above the bud. If the budding is done in June, the tops should be removed as soon as the buds begin to grow.

GRAFTING.

Grafting is practiced in many ways, but the more common ways are cleft, and whip or tongue grafting. Cleft grafting is done early in the spring, and is practiced with large bunches. The scions are taken from the previous year's growth. Perhaps it will be well to explain what is meant by cleft grafting. This term is applied when the branch is sawed off, the

stock made smooth with a knife, and split a little way with the chisel, and the scion, after having been cut wedge-shaped inserted in the cleft, carefully adjusting the inner bark of the scion to that of the stock. As a rule a scion is placed in each cleft, and if the stock is too large two scions are placed in each. Sometimes it happens that the pinch of the cleft is too strong for the scions, which can be remedied by inserting a short wedge. After the scion is inserted, the whole wound is coated over with grafting wax, which must entirely exclude the air and moisture. The secret of success lies in making the inner bark of the

Fig. 22.—Side Grafting.

scion fit exactly against the inner bark of the stock and holding it there tightly, and excluding all air and moisture until there is complete union and the wound healed up.

The following method which is termed side bark grafting is recommended. All the tools necessary are a fine sharp saw, and a keen cutting knife. Saw off the stock wherever desired, and with a knife, split the bark about three quarters of an inch on opposite sides, as shown in Fig. 22, prepare scion by making a straight clean cut on one side only, as shown in Fig. 22. Then scrape the outside bark from the point of the scion as far up as the scion is set in the stock. Slip the scion down between the bark and wood of stock and cover well with wax. This method makes a better contact with the inner bark than cleft grafting does. The scion starts quicker and makes a stronger union and is less liable to split down.

WHIP OR TONGUE GRAFTING.

Whip or tongue grafting is employed in grafting

seedling apples. The stock, and the scion should be the same size in whip grafting. The different steps in the progress are shown in illustrations: See Fig. 23. The parts are held in place by a piece of cotton yarn or thread.

In grafting by approach or inarching two branches from the different trees are brought together and united without detaching either branch from the original plant. This is done by cutting a piece of bark in the branches and bringing them together so that the cambium layer of one will come into close contact with the cambium layer of the other. The branches are then bound together at the place of contact and waxed. After the union of the two is complete, the branch from the stock or mother plant is cut off below and above the place of union. This method is but little used except for such plants (especially evergreens) as do not succeed by the former processes of grafting.

Fig. 23.—Tongue or Whip Grafting.

In all this work, wax must be used. The following receipt for making wax is given, and has been highly recommended: To four pounds resin and to one pound of beeswax add one pint of linseed oil. Put it in an iron pot and heat slowly, thoroughly mixing the same. Pour out into cold water and pull by hand until it assumes a light color, work into sticks, and place in a cool place until wanted. In using this wax, oil the hands, work the wax until

soft and press it tightly around the graft and thoroughly cover the cracks. If the day be very warm when using, it is frequently better to wet the hands in cold water.

TREE PRUNING.

There is no subject of more importance to fruit growers than tree pruning. In order to do this judiciously, there are some general principles that are necessary to be understood.

When a branch is cut off from a tree a wound is made. If the tree be in good health efforts will be made by the tree to heal that wound immediately. The bark, which is the protective covering of the tree, is gone, and the wood is exposed to decay. After a few years the wound will be frequently healed over. There are certain conditions that must be complied with before the wound will heal. Small wounds, other things being equal, heal more rapidly than large wounds. It is a well established fact that some parts of the tree grow more rapidly than other parts. Those branches directly in contact with the main food supply, receive more food than other branches not as favorably located. Bent and twisted branches do not grow so rapidly as straight branches, either in length or thickness. So these things being true, we can lay down the principle that those parts of the tree receiving the most food supply will heal the quickest. It is also noteworthy that a branch of any size cut off a few inches or more from the trunk of the tree does not usually heal over as rapidly as it would were the wound right at the trunk of the tree. Wounds on young trees or those growing vigorously heal more rapidly than wounds on a mature tree. Wounds heal very rapidly on apple, pear and most of our shade trees. Wounds made on peach, plum, cherry and on the pine and other cone bearing trees are very slow to heal. Wounds heal more rapidly when the trees are abundantly supplied with food.

The stub, which is a piece of limb cut a few inches from the trunk of the tree, should never be left, for it is impossible for the wound to heal. Not only does it fail to heal, but decay sets up. Perhaps an illustration will help to understand the matter. Fig. 24, line 3, shows where the cut should be made to remove the branch. It is true a larger wound is made, but it will heal faster and better than it would

if made away from the trunk or large branch. In other words, make the cut close to the part that is to remain and in making the cut hold the saw parallel to the branch or trunk from which the branch is removed. The cut should be made as smooth as possible. No ragged or rough edges should be left. Never use an ax in pruning trees. It is far better never to cut off a branch, if it must be done with an ax. In removing a branch sometimes the weight of the branch causes the wood to split. If the branch be heavy saw it off a foot or two from the trunk of the tree, and then saw it off at the proper place. This will take more time but it will be far better than splitting it, and causing an ugly wound that may never heal.

Fig. 24.—Where to cut and How to Prevent Splitting. Cut in order of Numbers.

A great many people do not know how to hold the shears to prevent them from bruising the tree. In making the cut, the cutting blade of the shears should work against the part of the tree or vine that is to remain, while the bruise is made on the part that drops off when the cut is finished. See illustration. Fig. 25.

When a wound is made by cutting off a branch, it

leaves a part of the surface unprotected and bacteria enter and cause the wound to rot. The knot rots out and this leaves the heartwood exposed and it also is apt to rot out, leaving the tree hollow. But all this can be prevented by placing something over the wound when it is first made that will prevent decay from taking place. Many things have been suggested and used to protect such wounds, such as tar, grafting wax, shellac and paint. Tar does well in most cases, but it sometimes prevents the healing of the wound. It should never be used on peach, plum, cherry or other stone fruit trees. Grafting wax is a good covering, but it frequently curls up around the edges and drops off. And then again grafting wax is often removed by the bees, leaving the surface exposed. Shellac often cracks and splits off. Of all substances that have been used from time to time, no material so nearly fills the bill of a good dressing for tree wounds as a pure lead paint made up with oil. It sticks well, does not crack or chip off and is easily secured. The wound should be painted as soon as it is made. This applies to any wound where the cambium layer, which is the part between the bark and the wood, is exposed. While the paint does some good, remember that it is inefficient when the wound is made five or six inches from the trunk of the tree. It is desirable that the wound be covered over as quickly as possible.

When to Prune.

One of the Bulletins recently issued contained the following, and we reproduce it: "The pruning should be done at a time when the healing process may begin at once, or soon after the cut is made. For this reason alone the autumn and early winter months must be excluded. Growth will not begin until spring and in consequence five or six months might pass before the formation of callus starts. But there is another reason. The bark and wood in cold regions freeze, and the cambium layer may be injured and the wood will dry out and check.

"It is not advisable to prune trees during the time when growth is just starting in spring and the sap is in active motion. For at this time it will be well nigh impossible to protect the wound. The necessary coat of paint will not stick to the surface wet with sap that has bled from the tree.

"Then the best time to prune is in the early spring before growth starts. There is usually less to be done

on the farm and in the orchard and garden at this season and time is available for work. Wounds made at this time heal well. If it cannot be done then, the trees should be pruned in spring, just after they are well out in leaf, but in all cases preference is given to the early spring period. Pruning should be a part of the regular care of shade and fruit trees. A regular time each year should be set aside for this work, and the latter part of February or early March would suit most sections of the middle South.

What to do With the Wood Removed.

"Usually the branches which are cut from trees and vines are hauled into an old field, the edge of a wood or some similar place, thrown into a heap and left. This should not be done. Frequently the branches are infested by insects and diseases. These may again find their way back to the growing trees. They are a menace to the health of the trees from which they come, as well as to all other trees in the vicinity. Instead of disposing of the trimmings as indicated, they should be piled and burned in some place convenient for the purpose. Then the insects and fungous spores will be destroyed completely."

Special directions are needed in the pruning of each class of fruit trees. We give such directions as are within the scope of this book.

Apples.

When planting one year old apple trees, cut the stems back to 2 or 2 1-2 feet and remove all side branches. The object of this is to give the trees a permanent low body in order that the body being shaded by the head will prevent sun scale to which high bodied trees are very liable to in the South.

Two year old trees as received from nurseries have usually been cut back the first year and their branches should be cut back to half their length. It is advisable that the heads should allow light and air by not being too crowded. After the third or fourth year all that is necessary is to cut back all branches that grow too tall, to one-half, so as to keep all the heads in uniform shape. Do not let one branch overweigh the others.

Peach.

Directions for pruning peaches are given under the

head of Peaches, in the main part of this chapter.

Pear.

The same directions for the apple tree apply to the pear.

Plums.

Same directions for pruning peaches apply to plums.

Spraying.

The subject of spraying is thoroughly treated and considered under the head of Insects. We refer you to the Insect Department for information concerning this subject.

FRUIT ON THE FARM.

Every farmer should have a fruit orchard on his farm. Many farmers wonder why it is that their children do not like the farm. If the farm is made as attractive as it should be, and as it can be, this question will be solved. Where a farmer makes the effort to make his farm attractive, the children will be attached to it. Every farmer in the South can grow some kind of fruit, and should grow more than one class, but include apples, pears, peaches, plums and small fruits. It is of the utmost importance that farmers look after this department. It is the only way that the farm can be made attractive to the children. And then we must also consider the expense account. When we have fruit on the farm, a great deal is saved in actual living expenses. With a good vegetable garden, fruit orchard and a poultry yard, no farmer can be starved. How often is it the case that the entire meal is made from these three sources. Yet how often do we hear men say that they have not time to look after the fruit. Now, we do not believe, as some people do, that fruit does not need attention, for we know that it does, but at the same time, it is claimed and justly so, that no time or money pays better than that which is expended in planting and looking after the fruit trees. A great deal of the canned fruit that is placed upon the market has preserving solutions added to it. But if one does not grow the fruit, he must either buy it and can it, or he must buy it ready canned. Now if he would devote a little time and money to the growing of a fruit orchard himself, he would save the neces-

sity of buying canned fruit, which will cost him much less. The lack of suitable land need not deter anyone from planting trees, for you can always find a suitable place on some spot of the farm. It may be that you have nothing but an old hill-side, but you can get fruit from that place. Dig a large hole, say three feet in diameter and three feet deep, then take your wagon and haul from some bottom or some low place some good earth, mix this well with barnyard manure well decayed and use a liberal proportion in each hole. You can grow an orchard if you will try. And this work can be done when you would not do any work otherwise. One acre is enough to grow a great deal of fruit on, and can have some to sell as a rule. The following list and number of trees may be placed on one acre of ground. Now this list is not suitable for all sections of the South, for some fruit will not grow in some sections, while it will grow in other sections. If any of the fruit that is placed in this list will not grow in your section, substitute a fruit that will grow.

One or two vines of Muscadine grapes should be planted in the coast and Piedmont sections.

16 Plum—One row, 15 feet for the row, 13 feet apart in the row.

32 Peach—Two rows, 15 feet for the row, 13 feet apart in the row.

16 Cherry (sour)—Two rows, 20 feet for the row, 26 feet apart in the row.

16 Apple—Two rows, 20 feet for the row, 26 feet apart in the row.

16 Pear—Two rows, 20 feet for the row, 26 feet apart in the row.

20 Fig—One row, 12 feet for the row, 10 feet apart in the row.

45 Blackberry—One row, 4 feet for the row, 4 feet apart in the row.

45 Dewberry—One row, 4 feet for the row, 4 feet apart in the row.

20 Grape—One row, 10 feet for the row, 10 feet apart in the row.

1050 Strawberry—Five rows, 3 feet for the row, 4 feet apart in the row.

INCREASING THE SIZE OF THE FRUIT.

Good size and large fruit bring the better price and sell more readily in the market than small size fruit. In fact, small size fruit is most always sold at far below its real value. There are three chief things, says "Farmer's Review," that the orchardist can do to help his trees to produce large fruit.

One of these things is to give good cultivation. The system of cultivation should be thorough and should be continued year after year, and as often each season as it is necessary to keep the weeds down. It is surprising how quickly the weeds will take possession of the young orchard after the cultivator has stopped its work. In an old orchard the weeds do not bother so much, as the shade of the trees does not encourage their growth.

The best method is to plow the land in the spring, if the orchard is young. Then put in the cultivator and later the harrow, keeping up the cultivation 'till the middle of the summer at least. During this time the fruit is increasing in size, and so are the buds for the fruit crop of next year. The land being kept free from weeds will be in shape to receive the air and the moisture, and the roots will get the benefit of both. The fruit on the tree will, therefore, have supplied to it the plant food in the soil to the extent that the roots can take it up, with the assistance of the water. Later in the season, cow peas or even field peas, or soy beans, should be planted and used for winter covering. If vetches can be grown so much the better, but the seed of the vetch is expensive. In the spring this winter covering should be plowed under and the old regime recommended. Unless the land is very rich, stable manure should be used, as this will help keep up the supply of plant food in the soil, which must go into the fruit.

The second great means of increasing the size of the fruit is pruning. This is a matter that is too much neglected. Nearly all orchardists prune, but a good deal of the work is done in a very unscientific manner. The work can be done at a time when there is little else to be done.

The third great means of improving the fruit is thinning. This is coming extensively into use with our tree fruits where it is desired to produce fruit of

a good size and appearance. The thinning of plums and apples has been practiced to some extent by the horticulturists in our agricultural colleges, and has given good results. The practice has not, however, become common with the people. It is otherwise with peaches. They have been thinned more extensively than have other fruits and with greater returns. The peach is largely water anyway and the taking away of half of the crop on the tree results in a very pronounced development of the remaining part.

FRUIT NOTES.

Neither the doctor nor the sheriff will have any professional errand on the farm where there is plenty of fruit raised.

No one has failed as a fruit grower as long as he was willing to keep trying.

No man was ever so poor that he could not set a few trees, and prune them, nor so poor that he could not plant a few seed and cultivate them.

There are few kinds of fruit that poultry will injure when it is growing. Therefore they make good scavengers, and insect gatherers among all kinds of berries, grapes and plums.

Every farm porch should have some climbing vines, roses, crimson Rambler, red, yellow Rambler, jasmine, purple flowers; red or white honeysuckles.

Close-netted woven wire, the right width is the best protection for trees from mice and rabbits. The right length may be measured and cut, and then it can be bent around a roller for the right shape.

Nearly all orchard trees that are thrifty put out more branches than should be permitted to grow. An orchard should be gone over once a month during the early part of the season, and all of the sprouts rubbed off while it may be done with the fingers. Large sprouts and limbs sap the vitality of the tree.

It pays to have wood ashes and spread them by the wagon load in the orchard.

It is important with everything that is set that it

should have a good start while it is growing. Every condition possible should be given to make it start off promptly.

In the spring is the best time to give the orchard a shallow plowing. It loosens the soil, destroys the insects, and makes the trees grow.

Very frequently it pays to undertake to grow undesirable fruits and vegetables almost entirely unknown in the vicinity in which one lives. In this way, a good trade may be built up.

Some orchardists claim that at least six things are necessary for a good orchard—climate, soil, location, well prepared setting, the right kind of fertilizer, and proper care.

To have a good market is one of the most impor-

tant items. Fruit is worth double the money, if it is within easy wagon reach of the customer. This should always be considered when seeking a location.

The cultivator is worth more in the young orchard than guano.

Better plant some crop like cotton or potatoes among your peach trees, which will require clean culture, and not be exhausting to the soil. Then fertilize it well. This will pay on the crop and help the land and the trees.

To prevent borers, whitewash the trunks of your peach trees with coal tar and lime; three gallons coal tar and one bushel of lime to fifty gallons of water. The odor of the tar prevents the fly from laying the eggs on the trees which produces the borer.

Fig. 25. Showing How to Hold the Shears in Pruning.

Dutch Hyacinth.

BOOK IV.
FLORAL DEPARTMENT.

... EDITED BY ...

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ATLANTA, GEORGIA.

FLOWERS AROUND THE HOME.

A PLEA FOR MORE OF THEM.—BEST VARIETIES AND BEST METHODS OF CULTURE.

We believe the time has come to make a plea for beautifying the surroundings of Southern homes, especially the surroundings of the farm homes.

It has been the writer's good fortune to travel over our broad land from Maine to California during the past dozen years, and he must confess that what has surprised and pained him most was the absence of flowers and shrubbery around the farm homes in the South, as compared with other sections.

We live in a part of our country that for ease of growing flowers cannot be equaled, yet the ones we have are few. In the years following the Civil War, yes, up to a few years ago, there was the excuse of poverty, the grinding poverty following the devastation of war and the attempts at re-adjustment following. All that has passed. The South has come into her own again and is growing in wealth by leaps and bounds, a wealth that finds its way into the hands of those who produce it.

In many places are flowers and shrubbery unexcelled, and they grow to perfection. Why not all places? The time has come when we owe it to our families and to our own self-respect to beautify our homes and surroundings. It's well to spend fifteen to twenty dollars or more for a new plow or cultivator to do better work, and it is also well to spend a dollar or two or more a year for flower seed and plants to beautify the home surroundings. It is due to the wife and the daughters to give them attractive surroundings, and having a home with such surroundings, will go a long ways towards keeping those boys and girls on the farm when the attractions of town and city life pull them away. A yard full of roses, flowers and shrubbery, and neatly bordered walks and green grass, make you proud to be known as its owner. The possession of such a place satisfies the desire that every woman has for the beautiful. It gives employment to her in the care of the flowers that is a welcome break in the regular duties of the home and makes her happier and more contented. The possession of a "beauti-

fied" place gives its owner standing in the community, and last, but not least, it adds to the actual cash value of the place many times the cost.

Do not think that we are advocating the expenditure of large amounts of money. We are not. It don't take much. The selling price of ten to twenty pounds of cotton every year invested in flower seed, plants or shrubbery will work wonders in the appearance of half of the Southern farm homes, and who among the readers of this book is so poor that he cannot afford to turn over to the wife or daughter the small amount necessary to make a start towards making your home surroundings such as you will be proud of?

FLOWERS FROM SEEDS.

It is not our intention to give a long and confusing list, but rather to give one of the more easily cultivated, yet satisfactory kinds. The directions given as to time of planting, varieties and methods of culture are based on seasons and soil such as are generally found in the middle South. Planting north or south of that section must be varied according to your location. If your soil is a peculiar one, you may have to do a little experimenting with varieties to find out just what will do the best for you.

Flowers from seed are divided into two general classes, the annuals, such as Petunias, Balsams, Nasturtiums, etc., blooming the first season and the biennials and perennials, which usually do not bloom until the second year after planting, but are of more permanent nature, lasting two or more years. Of this latter class the Carnations and Dahlias are an example. Based on northern conditions, these do not bloom the first year, but in the middle or lower South they will almost always show more or less bloom in late summer and fall of the first year, but do not reach perfection until the second year. The annual varieties are the most generally planted, as they show results quickly, still the real lover of flowers will not neglect the biennials and perennials.

HOW TO SOW FLOWER SEED.

With few exceptions, flower seed are small, and

sowing them by the inexperienced often results in failure, either partial or complete, because a few simple rules are not followed out. There is nothing mysterious about success with flowers. It requires care and a little common sense. With these, failure is almost impossible. It is work that cannot be left to a negro farm hand or laborer. It must receive careful attention. By observing closely the following rules for sowing flower seed you will have little cause for complaint or failure.

The Soil.—A mellow loam, which is a medium earth between the extremes of clay and sand, enriched with a compost of rotten manure and leaf mold, is adapted to the generality of flowering plants. Previous to planting flower beds or borders, care must be taken that they are so arranged that the ground may be a little elevated in the middle; that the water may run off, and that the plants may show off to better advantage.

Planting the Seed.—Make the surface as fine and smooth as possible. Cover each sort of seed to a depth proportionate to its size; the finest, like Petunias, etc., should be merely sprinkled on the surface of the ground, and barely covered with finely sifted, light, mellow soil; press the soil down firmly over the seed with a brick or a short piece of board. For larger seed the depth should be regulated according to the size of the seed, those of the size of a pin head one-half inch deep, and those the size of a pea three-fourths of an inch or more. Procure a bit of lath (it would be better if planed smooth) about two feet long, press the edge down into the soil evenly, so as to make a groove as deep as the seed is to be planted, scatter the seed along this, allowing 4 or 5 of the larger to 1 or 20 of the smaller seed to the space one plant is to occupy when grown. Cover the seed by pressing the earth over it, then turn your lath flatwise and press the soil down firmly. On light, sandy soils flower seed should be covered twice the depth that they should be in stiff or heavy clay soils.

Sowing in Boxes.—Almost all flowers will stand transplanting. Many of them grow better for having been transplanted. In sections liable to late spring frosts, or where drouth comes in spring, it is advisable to sow seed in shallow boxes which can

be placed in a warm sunny window or on a porch. This is always advisable with the expensive seed and those of a tropical nature, such as Coleus, Salvia, etc. These need a warm soil to start the seed. Sow the same as in open ground, and keep the soil moist, but not soaking wet. If surface of soil shows tendency to cake or crust, scratch it lightly to break the crust. Small seed cannot force their way through a crusted surface. As soon as the plants reach a height of 2 or 3 inches they may be transplanted to open ground, taking as much earth from the box as possible with each plant so as not to disturb the roots more than is necessary.

AGERATUM.

A favorite garden flower for the South. It is a native of Mexico and easily stands long, hot summers. Can be grown anywhere in the South successfully, and stays in bloom all summer and fall. Sow seed in open ground beds early in April or earlier in boxes. Plants grow 1 to 1 1-2 feet high with light green foliage, surmounted by clusters of tassel-like flowers. Very quick growth and profuse bloomers. It comes in two colors, blue and white. —Annual.

ALYSSUM.

Very free flowering annual beginning to bloom in earliest spring and continuing until hot weather. Seed may be sown in open ground January to March. Makes an excellent border plant, growing 8 to 10 inches high. The most commonly used variety is what is catalogued as "Sweet Alyssum." The variety known as "Little Gem" is a very dwarf one, growing only 3 or 4 inches high and when in full bloom the plants are literally covered. The "Little Gem" is especially desirable for border work. All the varieties are pure white.

ABRONIA.

More commonly known as the "California" or "Land Verbena" and especially well adapted to the sandy and lighter soils of the lower South, as it is a trailing plant that grows well in rather dry open soil. Seeds should be sown in open ground where plants are to stand, about April 1st. There are nu-

merous varieties of *Abronia*, but they are usually of yellow and pink shades.

Fig. 1.—*Abronia*, or Sand Verbena.

AMARANTHUS.

A class of annual plants grown both for the foliage and showy flower clusters. They grow quickly and may be sown in open ground in March or April. There are four varieties in common use; *Amaranthus Candatus*, or "Love Lies Bleeding," has plants of stiff, erect growth, 2 to 3 feet high with sprays of rich, crimson flowers. *Amaranthus Tricolor*, or "Joseph's Coat," has a single erect stalk and brilliantly colored leaves when full grown. The rich, yellow and red markings are very distinct, contrasted with the deep green foliage. *Amaranthus Cruentus*, or "Prince's Feather," comes from Asia. Tall growing with purplish green leaves. Heavy feathery heads which droop, giving a beautiful effect. *Amaranthus Salicifolius*, or "Fountain Plant," grows 2 to 3 feet high, branching freely and of pyramidal shape. The slender branches grow with a drooping habit, producing a graceful effect like the spray of a fountain. We do not recommend planting any of the *Amaranthus* in the lower South.

ASTERS.

These are favorites everywhere, a sort of early summer substitute for the *Chrysanthemum*. In the middle and lower South every effort should be made, if perfection is to be had, to start them early so that the blooming stage may be reached before the extreme heat of midsummer arrives. Seed should be sown in shallow boxes in the house in February or first of March. By time danger from frost is past, usually the middle of April, the plants will be 2 or

3 inches high and may be transplanted into beds in the open. In this way they can be brought into bloom in early June. They are also good fall bloomers and with this in view seed can be sown in May and June. The Aster grows luxuriantly in any good garden soil and the quantity of bloom from even a small bed will well repay you. Extra large flowers can be made by disbudding and only leaving a few blossoms on each plant.

Fig. 2.—Asters.

The varieties of Asters are almost innumerable and it is usually the most satisfactory to buy general mixtures sold by the different seedsmen. The principal and most highly improved types are the *Chrysanthemum* and *Paeony Flowered*, *Victoria*, *Comet*, *Triumph* and *Branching*. All of these can be had in various colors.

ANTERRHINUM OR SNAP DRAGON.

Fig. 3.—Antirrhinum, or Snapdragon.

An old-fashion flower that has been greatly improved in recent years. Seed sown in early spring will produce some flowers the following fall and will reach perfection the following year. Comes in various colors. Sow seed in open ground in March and April.

BALSAM, (Touch-Me-Not, or Lady Slipper.)

An interesting flower furnishing plenty of flowers in the bed and when the seed pods form are a source

Fig. 4.—Camellia Flowered Balsam, or Lady Slipper.

of almost endless amusement to the children. These seed pods burst, when fully ripe, at the slightest touch, scattering the seeds in all directions. A few plants of these, at least, ought to be in every garden. Most easily grown and the wax-like flowers produced so abundantly show elegant shades of color and markings. There are numerous varieties, the best of which are the Camellia Flowered, Rose Flowered and Double Spotted.

Seed should be sown in open ground as soon as danger of frost is past or earlier in protected boxes. For best results and full development the plants should stand about a foot apart in the beds.

BELLIS PERENNIS, (or Double English Daisy.)

Fig. 5.—Bellis Perennis, or Double Daisy.

Suited best to cool, moist locations and is not recommended for the lower half of the South. Seeds sown in October will bloom the following spring; spring sown seed the next fall. After once established they bloom in both fall and spring for many years and in general should have the same treatment as violets.

CARNATIONS.

A famous florist's flower and a favorite everywhere, easily grown from seed, if sown in either boxes or carefully protected beds. Transplant to open ground when the young plants are 4 to 5 inches high. The Double German (comes in mixed colors) and the French Grenadin (scarlet) do not reach perfection until the second season. During the past few years three distinct new varieties have been introduced which bloom in 4 to 5 months from seed. These are the Marguerite, the Grant Marguerite and Chaband. For quick results in bloom

use these latter varieties although they are neither as double or sweetly scented as the German.

Fig. 6.—Carnation Pinks.

CACALIA, (Tassel Flower.)

Curious flowering plants growing 14 to 18 inches high and producing little red and yellow tassel-like flowers. Seed should be sown in beds in open ground as soon as danger of frost is past.

CANNAS.

A splendid plant for decorative effect in all parts of the South. A quick grower with large tropical looking leaves, and among the later introductions are many fine flowered varieties. The canna in its earlier days was known as "Indian Shot" and at that time had no value except for its foliage, but with use of large flowering French varieties it furnishes both the decorative effect as well as being worthy of cultivation for its various colored orchid-like bloom.

Cannas can be grown from seed, but the quickest and most satisfactory way is to obtain the roots of the best varieties (obtainable from florists and many seedsmen) and plant them in well manured soil in March and April. These roots should be placed 12 to 15 inches apart each way and covered about three inches deep. After the plants appear above ground keep the surface of the soil worked and free from grass and weeds. The different varieties grow from

3 to 7 feet tall and will continue to bloom until killed by frost. If the roots are protected from freezing they will last for years. A covering of leaves several inches deep or coarse stable manure or litter will carry them through any ordinary winter in the central South.

If you wish to grow cannas from seed you should sow seed in boxes of finely sifted garden soil in February and March and keep the box in a warm sunny place. The seeds have an exceedingly hard outer covering which should be filed through before planting. If not cut or filed through canna seeds will frequently remain dormant in the ground for several years without sprouting.

Large Flowering French Cannas.

As soon as the young plants show 4 or 5 leaves they may be transplanted to open ground and treated the same as plants from the roots.

If a fine tropical effect is wanted there is nothing that will give it so quickly and at such little expense as the canna.

COLEUS.

The coleus can almost be called nature's paint box.

Grown only for their various colored leaves which make a splendid display. Millions of coleus plants are used each year in bedding in city parks and as it is so easily and quickly grown there is no reason why the dwellers in the country should not enjoy them. The coleus is a plant of tropical nature and

Fig. 8.—Bybrid Colens.

cannot well be carried through the winter except in green-houses. The plants can be obtained of any florist in the spring or can be grown from seed which should be sown in boxes in February or March and kept in a warm sunny window. Seeds should not be covered more than one-eighth of an inch with very finely worked soil. The young plants when once up should never be exposed to cold. As soon as danger of frost is past transplant to open ground. The Coleus, like the canna, delights in warm, sunny situations and usually the warmer the sun the more highly colored will the leaves be.

CHRYSANTHEMUMS.

Another specially good plant for the South, and while it can be grown from seed, yet it is almost always advisable to purchase named varieties from florists. There are something like 3,000 varieties, of all sizes, shapes and colors and the lover of flowers can choose their own varieties in color and style. The young plants should be set in the open ground where they are to stand as soon as danger of frost is past. Left to themselves they will produce large numbers of flowers from one to three inches in diameter. Most of us have seen the fancy "exhibition" blooms of the chrysanthemum, six to eight inches in diameter. These are easily obtained by high cultivation and the practice of "disbudding" by which means the whole strength of the plant is thrown in-

to one or two blooms. For general yard culture this is not advisable and is only used to produce extra large flowers.

In growing chrysanthemums from seed the same care should be taken as with coleus. Usually the plants will not bloom until the second season.

The chrysanthemum is perfectly hardy in the central South and the roots will stand through the winter without protection. The clumps of roots should be taken up and divided every two or three years, however, if the plant is to be kept up to the standard in quality of the bloom.

Fig. 9.—Japanese and Chinese Chrysanthemums.

COSMOS.

Very handsome, free flowering, annual plant, thoroughly adapted to all parts of the South. Usually grow 4 to 5 feet high with finely cut foliage. Flowers are borne freely from August until frost and show various shades of color ranging from crimson to white. Sow seed broadcast in open ground as soon as danger of frost is past. Keep free from weeds and grass. Beyond this they need no special treatment and if the flowers are left uncut they can

usually be depended on to re-seed themselves for the next year.

Fig. 10.—Single Flower of Cosmos.

DAHLIAS.

No flower in recent years has shown greater improvement than has the Dahlia and it is adapted to all parts of the central South.

The introductions of the last seven or eight years produce flowers of the largest size and striking brilliancy of coloring and the more we see of the im-

Fig. 11.—Double Dahlia.

proved strains the more pleased we are with the Dahlia and are confirmed in our belief that it will rival the Chrysanthemum. Dahlias are generally grown from roots, which can be purchased from florists under name or color so that you know what you are getting both in form and color.

They are easily grown from seed, usually blooming in the fall of the first season. Seed should be sown in shallow boxes in the house in February or March and kept in a warm, sunny window. When plants are 3 to 4 inches high and danger from frost is past, transplant to open ground, two to three feet apart. Plant in rich or well manured soil and keep free from weeds and grass.

When frost kills the tops, cut them off near the ground and cover with 6 to 8 inches of coarse manure, leaves or grass. This mulch should be weighted down with a little dirt to keep from blowing away during windy weather in winter.

Such protection is ample to protect them in any ordinary winter in the central South.

The most satisfactory varieties are the double sorts, although some prefer the single ones on account of their greater freedom of blooming. No collection of flowers in the South is complete without at least a few dahlias of the best varieties and they will well repay the small expense and trouble.

DIANTHUS OR GARDEN PINKS.

Popular everywhere and with everybody and can be grown successfully anywhere South. They bloom freely from early spring sown seed the first season, but larger and better blooms come the second year.

Fig. 12.—Mixed Dianthus or Garden Pinks.

No trouble, as they need no protection in winter. Seed should be sown as soon as the trees start to bud in the spring, covering the seed not over 1-2 inch. When well up, say 4 inches high, transplant to the borders or beds where they are to remain. There are dozens of varieties, all of them pretty and many of them showing most beautiful markings. Most seedsmen make up mixtures containing a dozen or more of the best varieties and unless you want some special color it is usually best to buy seed in these mixtures. If a double white pink only is wanted, purchase *Dianthus Chinensis Alba*, as listed in most catalogues. There is hardly a flower that will give more lasting and satisfactory results than the *Dianthus* or Garden Pink.

DELPHINIUM, (Larkspur.)

For the central South only, as it does not do well toward the Gulf. This is a quick growing, very free flowering plant in various colors, which come in both doubles and singles. Seed should be sown in earliest spring in open ground beds and when well up should be thinned out to about 10 inches apart for best results. They make a pleasing display and are very satisfactory.

ESCHSCHOLTZIA, (or California Poppy.)

A most popular bedding plant, as it stands hot sun well. Sow seed in spring as early as ground can be worked, scattering seed thinly over the surface and raking in very lightly. They grow quickly and are fairly covered with large showy flowers and make a most brilliant display in open ground beds.

GAILLARDIA.

Well adapted to our section and often called "Blanket Flower." It thrives on poor and rather dry soils and the plants are covered with large, showy flowers of many colors all through the season. Sow seed in early spring, broadcast in beds, covering seed lightly by raking in.

FORGET-ME-NOTS.

Favorites all through the central South for either borders or beds. Sow in open ground as early as it is possible to work it. When well up thin out to 5

inches apart. Comes in two colors, blue and white.

HELIOTROPE.

A garden favorite, easily grown from seed, but not adapted to open ground bedding except in partly shaded locations. Heliotrope is better adapted to pot or box culture to be kept on porches. Seed should be planted in boxes in February or March and kept in warm, sunny situations. Seed should not be covered over 1-4 inch. Flowers are exceedingly fragrant, a single spray often perfuming an entire room with a most delicate perfume.

HOLLYHOCK.

Fig. 13.—Double Hollyhocks.

Adapted to central South, but not to the Gulf Coast section. Easily grown from seed, but does not bloom much until the second season. When once well established they will last for years. Seed should be sown in early spring in boxes or protected beds and when 6 to 8 inches high they should be

transplanted to where they are to stand permanently, placing them 1 1-2 to 2 feet apart in the row. They grow 5 to 6 feet tall and are fairly covered with blooms of various colors, ranging from white to deepest crimson. We do not consider the old single varieties of much value, but the double varieties introduced in recent years are well worth the attention of every lover of flowers.

IBERIS OR CANDYTUFT.

A well-known favorite North, but only adapted to the hill and mountain sections of the South. Seed should be sown as soon as ground can be worked in spring and thinned out to 4 or 5 inches apart when well up. Hot, dry weather destroys the beauty of the bloom and unless it can be planted early it is best to let it alone.

LANTANA.

Easily grown from seed and good for all parts of the South. It is a strong growing plant, almost a shrub in Florida and Gulf Coast sections. Sow seed in boxes, in warm, sunny window in March, transplanting to open ground as soon as danger from frost is past. They will begin putting on verbenalike bloom in June and July, which will continue until frost.

MARVEL OF PERU.

Also known as "Mirabilis," and "Four O'Clocks." It is a very showy, free flowering annual, which gets its name from its peculiar manner of remaining open only during the hottest part of the day, the flowers closing tightly about four o'clock in the afternoon. Flowers all the way in color from white to carmine. Sow seed in open ground when danger of frost is past and ground is warm, thinning out when well up to one foot apart. They grow 2 to 3 feet tall and branch out freely.

MARIGOLDS.

An easily grown favorite for those liking yellow and orange colored flowers in abundance. They do splendidly anywhere in the South. All the culture necessary is to sow seed in any good garden soil as soon as danger of frost is past; keep clear of weeds

and grass and you will have a mass of flowers. The tall African varieties are best, growing 1 1-2 to 2 feet tall with finely cut foliage. The French varieties have smaller flowers of deeper color and frequently do not grow over 6 inches high and are generally not considered so desirable as the African.

Fig. 14.—African Marigold.

NASTURTIIUMS.

These might well be termed "Everybody's Flower," for there is nothing of easier culture or that will reward the sower in the South with such a wealth of bloom of brilliant and gorgeous shades of color from early summer until frost. No flower garden is complete without them and no one hardly is so poor that a nickle or a dime can not be invested in a packet of seed. We don't know of a flower listed in any seedsman's catalogue that will give so great results for the little time and money spent as Nasturtiums.

Sow seed thinly in any good garden soil when leaves are well out on the trees, covering seed 1-2 to 3-4 of an inch. When well up, thin out the Dwarf varieties to 10 inches apart and tall varieties to 6 inches. The Dwarf varieties are of rather low growing, bushy form, the tall varieties are essentially climbers and should be placed where they can have a chance to climb or at least be supported. It is usually best to buy the "Mixed" nasturtiums, which can be had of any of the larger seedsmen in both the Dwarf and Tall varieties. If you are only going to plant one kind of flowers let that be Nasturtiums.

PANSIES.

These are always favorites, but for best results in size of flowers and richness of coloring the seed should be sown in September or October and the young plants covered during severe winter weather with leaves or litter which should be removed when warm spring days come. The plants make little growth during winter, but attain size quickly in early spring and are soon covered with flowers which continue until hot weather. The advantage of fall

Fig. 15.—Extra Large Pansy.

sowing is that the plants get to full size and perfection during the cooler weather, which the spring sown seed do not have a chance to do.

There is a great difference in quality of pansy seed, ranging as it does in price from 5 to 50 cents per packet. The difference usually lies in the size of the flowers and richness of coloring. These high priced varieties should only be bought by experts or those wishing to produce specially large flowers. Our experience has been that the average person can get just about as much satisfaction out of such strains as "French Mixed" and the "English Face" pansies selling at 10 and 15 cents per packet as from the more expensive kinds. The so-called "Fine Mixed" pansy usually sold at 5 cents are almost invariably small flowered, lacking both large size and good colors.

PETUNIAS.

Another splendid plant for outdoor beds, something that will last all summer and most easily grow. Seed should be sown in good garden soil when leaves start on the trees in spring. Scatter seed very thinly in the beds and barely cover with earth, as seed is almost like fine dust. They can also be started earlier in boxes in the house and transplanted. Many prefer what are known as "solid colors," which are found in the best mixed strains. With us, we have always preferred the so-called "Striped and Blotched," as this gives much greater variety in the markings and beauty of the flowers. The "Giant Fringed" introduced in recent years, are most beautiful, but have none of the vigor and hardiness of the more common sorts. These above mentioned are all single varieties. The Double Petunia is most beautiful, but not over 50 to 60 per cent. come double from seed, and as the seed of the double is very expensive and also delicate, we consider it best to buy plants of the double varieties from florists rather than attempting to grow from seed.

Fig. 16.—Single Petunias.

PHLOX DRUMMONDII.

Easiest grown of all annual flowers in the South and one of the best. Seed should be sown as early as soil can be worked in spring, sowing broadcast, thinly in the beds and covering by raking in lightly. No flower grown gives so wide a range of colors or variations nor is so good for early display bedding. Beds of phlox, if left unpicked will usually re-seed themselves and come up next year. It is fully adapt-

ed to any part of the South and all varieties are good. What is known as "Phlox Grandiflora" gives flowers nearly twice the size of the other varieties.

Fig. 17.—Phlox Grandiflora.

RICINUS OR CASTOR BEAN.

While not properly a flower, the ornamental varieties are very useful for planting for decorative purposes with their tropical appearance and quick growth from seed. A plentiful supply of these grown near a house is said to keep away mosquitoes. Although we can not vouch for the truth of this mosquito statement, we do know that it makes a splendid decorative plant in yards or on lawns.

POPPIES.

We like poppies with all their gorgeous display of color in late spring and early summer. We must confess our inability to make a success of them from seed sown in late spring. Best results have been obtained by sowing seed November to February. The seed sown at that time does not come up until spring, but that early sown seed gives good bloom where the others don't. The poppy finishes blooming in June with us. Seed is fine as dust and should be sown thinly broadcast and raked in very lightly.

SALVIA SPLENDEUS, (Scarlet Sage.)

Universally popular in the South for a bedding plant to furnish a blaze of brilliant scarlet in the

hottest part of summer, continuing until killed by frost. It delights in the warmest and sunniest situations. Sow seed in open ground when leaves on the trees are in full leaf and the soil becomes warm, or may be started earlier in boxes and transplanted when danger of frost is past. For full development plants should be set 18 to 20 inches apart each way.

Fig. 18.—Double Poppies.

SWEET PEAS.

Not generally successful in Florida and the sandy soils along the Gulf Coast. In the central South they are a perfect success when rightly planted. Our methods here near Atlanta are as follows: In January or February, dig out trenches or rows to a depth of 15 to 18 inches. Fill this up to within 6 or 7 inches of the surface with a mixture of thoroughly rotted manure and top soil. Never use fresh manure. If you do your sweet peas will be a failure. Sow the seed at the rate of 1 ounce of seed to every 8 or 10 feet of row and cover about 2 inches. You need not be afraid of freezing, as they have always proved hardy and resistant to cold here. As the plants grow, fill in the trench until even with the surface. Support must be given, as they grow 4 to 5 feet high. For this we have never found anything better than the ordinary wire netting used for

fencing in poultry yards. As the plants grow, keep the soil near them cultivated and by the end of May the flowers will begin to appear. If kept closely picked, the blooming period will last 6 or 7 weeks and you will be well repaid for any trouble you have taken. The worst enemy to success with sweet peas is the short period of hot, dry weather that usually comes in May or June. If seed is planted in trenches, as described above, the roots are down below the reach of any ordinary drouth and will not be affected and you will have an abundance of bloom. If seed is planted within 2 or 3 inches of the surface the vines usually "fire" and die before blooming size is reached, from late spring drouth. Now, as to varieties. It is usually best to buy the "Mixed Sweet Peas." The largest seedsmen make up blended mixtures giving a great variety of colors. These

Fig. 19.—Sweet Peas.

mixtures are usually sold at prices of 10 cents per ounce, or 60 to 75 cents per pound and you can usually depend on these to be good. Don't buy the cheap mixtures sold at from 30 to 50 cents per lb. They are usually made up of the poorer colors and discarded varieties.

SWEET WILLIAM.

A member of the "Pink" family and requires sim-

ilar culture to "Dianthus" described on a preceding page. Very few flowers appear the first season, but they are in their prime the second season. They come in various colors and in double and single varieties. We prefer the single varieties as showing the most perfect development and greatest beauty. Very satisfactory in the central South.

VIOLETS.

A favorite Southern plant blooming in late fall, winter and early spring. Makes a splendid border plant and is most easily propagated by dividing the roots of well grown plants. Easily grown from seeds, however, and should be sowed and grown according to directions given for pansies.

VINCA.

An almost unknown flower, yet for bedding in the South, especially the lower South, it has few equals. Seed should be sown as soon as danger from frost is past. They will begin blooming in early summer and continue until frost. The bloom is shaped like phlox, but is two or three times as large. Comes in several colors.

VERBENA.

Fig. 20.—Mammoth Flowered Verbena.

Seed should be sown in early spring in boxes, or later in open ground. Is very easily grown, but seems to do best in partly shady situations. Planting of this is not advised for the sandy soils of the

Gulf Coast. They begin blooming early and continue until midsummer.

ZINNIAS.

We don't like Zinnias as an individual flower, but for massing in beds to produce a brilliant display there are few flowers that equal it. Seed should be sown thinly broadcast as soon as frost is over, in a well worked up garden soil. Should be kept weeded until plants are 6 or 7 inches high, after which they need little attention. The rather coarse, but brilliant flowers are produced in the greatest profusion from early summer until frost. Zinnias come in two classes, each with mixed colors. These are the Tall and Half Dwarf. The Tall have always given best results with us.

CLIMBERS FOR PORCHES AND TRELLIS.

In the preceding list only such flowers as are used in bedding or borders have been mentioned, with the possible exception of the Tall Nasturtium which will, if properly trained and given support, grow 7 or 8 feet high. The writer has frequently seen Tall Nasturtiums in California reaching up above the second story of houses, but conditions are not right for such growth with us.

Here in the South we live in a "sun" country and during the summer months that sun is both glaring and hot. Scores of houses will be found in every community where not a trace of a green vine is found to protect the house or porch from the heat and glare of the sun. Two hours' work, a few cents' worth of seed of almost any of the numerous climbers mean shade, a relief from glaring sun, a cooler and more comfortable home for yourself and family. In general, almost all seeds of climbing plants should be sown where plants are to stand. Ground should be deeply spaded or broken up as early as possible and seed planted as soon as danger from frost is over. As they begin to run, support should be furnished either with wires or strings. We have vines on our porches each year and have permanent supports of poultry fencing, commonly called "chicken wire." This makes a good support for any of the climbers, is inexpensive and lasts for years.

ARISTOLOCHIA OF DUTCHMAN'S PIPE.

A good climber of tropical origin, well adapted to

porches and trellises. Grows rapidly and has large, dark green leaves. Needs rich or well manured loamy soil, also plenty of sunshine. Flowers are 3 to 4 inches across, white and purple blotched, and the shape of a pipe. In buying seed of this get the variety known as "Elegans." Flowers of the other varieties have a disagreeable odor.

BALLOON VINE.

An interesting climbing annual from India where it is a general favorite. Foliage is rather open, has small white flowers which are followed by small fruits resembling miniature balloons. Sow seed where plants are to stand in April or May.

BALSAM APPLE.

A quick growing climber with finely cut ornamental foliage and interesting and valuable fruits that are highly prized in many sections for their medicinal qualities. It also furnishes considerable amusement for the children, for the bright orange colored fruits when fully ripe only need the slightest touch to cause them to burst, throwing the seeds in every direction.

CYPRESS VINE.

Fig. 21.—Cypress Vine (Climber.)

The most graceful of all vines and easily grown anywhere South. For trellises or covering trunks of dead trees it is unexcelled. It has finely cut, almost fernlike foliage, perfectly adapted to ornamental work and it is always covered with the small star-like scarlet and white blossoms. If planted thickly in good soil it will make a fairly dense growth.

JAPANESE MORNING GLORIES.

The writer knows he is apt to run up against a snag when he mentions morning glories in some parts of the South where the common Morning Glory or *Convolvulus Major* has escaped from cultivation and becomes a pest in the fields. This is not apt to happen with the Japanese, as it does not seem to "run wild." Certainly it is well worth cultivating. With anything like a chance in good soil the Japanese will grow 20 to 25 feet high, furnishing a dense

Fig. 22.—Imperial Japanese Morning Glories.

shade that will protect your porches perfectly from the sun. In addition to the shade, the flowers are double the size of the common morning glory and nowhere will one find so great a variety of colors, shade and markings as in the flowers that are borne so freely. Some 30 distinct shades and markings have been noticed in recent years in the Japanese. Of the easiest possible culture, they stay with you until frost, furnishing an abundance of bloom and perfect shade for any porch, arbor or trellis. Seed should be sown in April where plants are to stand, allowing one plant to every 6 or 8 inches. Cover seed about one-half inch and as soon as plants begin to run give proper support.

CORBEA SCANDENS.

A favorite climber from Mexico, well adapted to

all parts of the South. A rapid grower, quickly attaining a height of 1 to 20 feet, if planted in good soil, and is covered profusely with reddish, violet purple bell-shaped flowers.

Fig. 23.—A Single Flower of *Corbea Scandens*.

This is a delicate plant that will not stand cold and seed should not be planted until the native trees are in full leaf. Seeds are thin and flat and in planting should be set on edge and covered not more than a half inch. Can also be sown in pots or boxes earlier if care is taken not to disturb the roots in transplanting.

JAPANESE HOP, (*Humulus Japonicus*.)

A very rapid growing, very satisfactory annual climber that is beautiful in appearance and furnishes good shape. Fine for covering porches, trellises or unsightly fences. Sow in early spring.

MOONFLOWERS, (*Ipomea*.)

The Moonflowers are popular everywhere South both for bloom and the dense shade that they form. They are of quick enough growth to shade any two-story porch and the immense flowers are always a source of enjoyment. There are many varieties of Moonflowers, but in our opinion there are only two worthy of general planting, the *Ipomea Grandiflora* Alba or White Mexican Moonflower and the *Ipomea*, Heavenly Blue. They are both strong growers, fur-

nishing dense shade. The *Grandiflora Alba* produces immense pure white flowers; the *Heavenly Blue* has large, intensely deep, sky-blue flowers. They are both essentially night blooming plants, the flowers opening about sunset on clear days and remaining open until 8 or 9 o'clock the next morning. In cloudy days they remain open most of the day. No one who has not seen the moonflowers in full bloom can appreciate fully their beauty. They are very sensitive to cold and seed should not be planted in open ground until danger of frost is past. Seeds of the *Grandiflora Alba* are large and very hard and to get a successful germination this hard outer covering should be cut or filed through before

Fig. 24.—White Moonflower.

planting. Can be planted earlier in pots in the house and when 5 or 6 inches high can be transplanted to open ground. The *Ipomea Setosa* or Brazilian Morning Glory is another of this family, easily grown from seed and which will grow 40 to 50 feet high in a season with any chance. The flowers of this are often 5 inches in diameter and of a bright shade of lavender pink. All moonflowers or *Ipomeas* make dense shade and are good for that purpose as well as for flowers.

ALL EASILY OBTAINED.

It has not been our purpose to furnish a complete list of flowers grown from seed or their culture.

Such, if anywhere near complete, would fill two or three books of this size. It has been our purpose to give the reader briefly a list of the best and easiest grown varieties that are suitable for planting in our section and such only that can be easily obtained. We do not know of a single variety named that can not be obtained of any of the leading reliable seedsmen of the country. In flower seed buying, as well as vegetable seed or field seed buying, our advice to you is to buy only of reliable seed dealers. There are many of them in our country and you have only to choose which one you will buy from.

ABOUT SEED BUYING.

The writer of this chapter on flowers is a seedsman and has been engaged exclusively in that business, together with the growing of plants and fruit trees, for the last 20 years and it may not be out of place in a book of this kind to say a few words to you about buying seed, plants, bulbs and fruit trees.

During the last ten or twelve years there has arisen in this country a class of dealers in this line of goods that are a disgrace to this particular line of business and whose business success depends entirely on their ability to cheat the intending buyer, or as they term it, "catching suckers." For instance, they will advertise broadcast in certain papers something like this: "200 kinds of Flower Seeds for 15 cents." The impression they seek to give is that you will get 200 different packets of different kinds for that price. What you really get is one packet of mixed flower seed that may contain 200 different kinds, or it may contain 20, for all you know. You will also see advertisements of 50 bulbs for 25 cents and other things equally as enticing. Now, these men are not in business for their health only, nor are they doing business at a loss, and you may rest assured that you are going to be the loser and not they when you send your good money for something that looks very cheap. The same thing holds true all through the list of seed, plants or bulbs. Good, honest goods are only sold at about a certain standard of price. If lower than that something is the matter with the seeds. If you see a seed catalogue with pictures in it showing pumpkins or watermelons as big as a barn, an ear of corn that it takes a double team to haul or other things in like proportion, any firm making such representations either in word or by picture is a good firm not to send orders to. A good

honest article, both as to quality and quantity, is worth an honest and fair price and you can't buy it for less.

Such practices hurt both ways. The seed-buyer, be it man or woman, sees one of these alluring advertisements in some of the cheap "mail order monthly" story papers that are scattered broadcast through the country, more especially to farmers' families or they get hold of some of these highly sensational catalogues. They send off their good money for some of these wonderful bargains. When the seed come they usually are disappointed and at once jump at the conclusion that all seedsmen, florists or nurserymen are swindlers and that they will get the same outrageous treatment from all of them. No one condemns these undefendable practices in the seed trade as strongly as do the best seedsmen of the country, but we all recognize that these swindling concerns are going to keep on doing business just as long as they find victims that will "bite at their bait;" just so long as victims will continue to send the 10, 25 or 50 cents to them. There are swindlers in the seed, plant and tree business as in other lines. The buyer is the one who must use his judgment in buying. The best guide is common sense and when you see unreasonably low bargains advertised or representations by pictures that are lies on the face of them, its time for you to send your money to some one else for supplies of this kind.

FLOWERS FROM BULBS.

The flowering bulbs and roots represent a distinct class of plants and these may again be divided into two classes; first, those to be planted in late fall and early winter for earliest spring blooming and, second, the ones to be planted in spring for summer blooming. The bulbs for fall planting are the most important, almost all of them blooming in early spring. There are hundreds of varieties of these, but the most important are the Dutch and Roman Hyacinths, Tulips, Narcissus and Crocus.

Tulips are not very satisfactory south of middle Georgia, but all of the others can be planted with reasonable expectation of success as far down as the north line of Florida.

OUT DOOR CULTURE.

With Hyacinths, Tulips, Crocus and Narcissus we

have always had best success in this latitude (Atlanta) by planting in open ground during December. Earlier planted bulbs are too apt to start up above ground during the warm spells that come so frequently during our winters and then get cut down with a March freeze, weakening the plant to the detriment of the bloom.

All bulbs should have a good rich garden soil for best results and before planting, unless soil is very rich, well rotted stable manure or bone meal should be thoroughly mixed with the soil. Never use fresh manure in the soil with any kind of bulbs. It will almost always destroy the bulbs if brought in direct contact with fresh manure.

It is well, when preparing soil for these bulbs, to remove the top soil to a depth of about 5 inches, then apply the manure or whatever fertilizer is to be used, mixing it thoroughly with the soil. Level this bed evenly, then cover with about an inch of top soil. Be careful to have the soil well firmed down and level. Set the bulbs firmly on this layer of top soil and then fill in the bed with good garden soil, covering the bulbs some 4 inches. Firm the soil well over them and they are then ready to form roots, ready for spring blooming. In our climate the great danger with Hyacinths and, in fact, all fall planted bulbs, is that they are apt to start up above ground during warm spells that come during winter. This too early starting can be largely prevented by covering the bed with either leaves or coarse stable straw.

In the purchase of Dutch Hyacinths the average flower grower can get just as good results from bulbs costing 50 to 60 cents per dozen as from the fancy named varieties sold at 10 to 25 cents each. Also avoid buying so-called "Dutch Hyacinths" selling at from 30 to 40 cents per dozen. These are usually the small "Dutch Romans" that are almost worthless in the hands of any but experienced florists in greenhouses.

The Roman Hyacinth is largely a variety for indoor pot culture and for that purpose it is one of the best, and in the lower parts of the South does well for out-door planting for February and March blooming. For open ground culture plant in same manure as described for the Dutch Hyacinths. We would advise the use of the White Romans only. There are pink and blue varieties but the colors are not distinct or well marked. The White Roman

Hyacinth is a most delicate and beautiful flower with a delicate fragrance.

Tulips are not well adapted to either pot or indoor culture and should only be used for out-door bedding, where beautiful designs can be produced by the use of the various colors. Soil for beds should be prepared in a similar manner to Hyacinths, but the bulbs should only be covered from 2 1-2 to 3

Fig. 25.—Single Early Tulip.

Daffodils and what are commonly called Jonquils in this section.

They are almost all suitable for out-door culture and should be planted in open ground during November and December, giving the same general treat-

Fig. 26.—Narcissus Grandiflora or Paper White Narcissus.

inches. This means that the top of the bulb is to be covered that much. The best varieties in single tulips are Cardinal's Hot for scarlet; Chrysolora for yellow; L'Immaculee for white; Duchess of Parma for orange red; Cottage Maid for pink. In the doubles, greater variations of color are found, but we cannot advise extensive plantings of same, as so many of them do not open perfectly.

THE NARCISSUS FAMILY

is a most extensive one and covers the Narcissus Grandiflora or Paper White Narcissus, the Chinese Sacred Lilies and all the hundreds of varieties of

ment as for hyacinths. Any of these can be brought into bloom almost any time during the winter with pot or water culture, which will be treated a little further on. Any of the Narcissus family of bulbs can be left in the ground anywhere in the middle South and will multiply freely. For keeping up the size and quality of the flowers, however, the clumps of bulbs that form should be dug up and separated every two or three years.

CROCUS.

This is the earliest spring bloomer with us. They can be planted in rows for border work any time

during the fall, but the most charming effects are obtained by planting clusters of from four to six of them all over the lawn. They bloom in March with us, maturing quickly and then disappearing to be seen no more until the following spring. They can be had in four separate colors: white, purple, yellow and blue together with striped ones. In buying these get the so-called Mammoth Crocus, as the blooms are about double the size of the old sorts. Bulbs should be covered about 2 inches and do not need to be as carefully planted as other bulbs. A blunt stick driven down a couple of inches in the lawn is sufficient to drop a bulb into and cover.

BULBS—POT AND WATER CULTURE.

One great advantage with the use of bulbs is that you can have the flowers almost any time during the winter with a little care. For this purpose the kinds best adapted are the Dutch and Roman Hyacinths, Narcissus Grandiflora, Chinese Sacred Lilies and Freesias. All of these can be grown to perfection in flower pots filled with any good garden soil mixed with about one-third sand. Bulbs like Dutch Hyacinths, Narcissus and Chinese Lily can be planted at the rate of 3 bulbs in a 6-inch flower pot; Roman Hyacinths 4 or 5 to a 6-inch pot and Freesias from 8 to 12 bulbs. Dutch Hyacinths (pot culture) will bloom in about 3 months; Romans in 8 or 9 weeks; Narcissus and Chinese Lilies in 5 to 7 weeks from time of potting.

Fill the pots about two-thirds full of soil, place the bulbs in and then finish filling in with soil to within 1-2 inch of top of pot. After planting, thoroughly water until the soil is wet, then put the pots away in a closet or some other place that is dark. Examine every few days and give sufficient water when necessary to keep the soil moist, but not too wet. In two or three weeks usually a shoot will show at the surface of the soil in the pot. When this shows they can be brought out and kept in any room in the house where there is light most of the day, but it is not well to keep them in direct sunlight in windows until they show signs of blooming. Two things will have to be watched closely; first, to see that the soil is kept moist but not soaking wet; second, that they are kept from freezing during cold winter nights. With a little trouble and starting a few pots every two or three weeks you can keep up a succession of flowers all during the winter when

there are no flowers out-of-doors. If color is wanted, this can be obtained with the various colors of the Dutch Hyacinths, such as pink, dark red, light blue, dark blue or purple. The single Dutch hyacinths usually give better results in pot culture than the double. Yellow color can be had by the use of the Von Lion Narcissus. Then there are the White Dutch Hyacinths, White Roman Hyacinths, Paper White Narcissus and Chinese Lily.

The Freesia is one of the most delicate and fragrant of all flowers, but for successful growth it should be potted in September or October in a soil containing at least one-half sand and grown very slowly. Once in bloom it lasts for weeks and well repays one for the extra trouble.

In recent years the water culture of bulbs has been developed and it is certainly a most interesting and satisfactory method for growing the Chinese

Fig. 27.—Chinese Sacred Lily (Water Culture.)

Sacred Lily and the Narcissus Grandiflora or Paper White Narcissus. It can be done by any one successfully. Take any ordinary glass fruit dish anywhere near 6 inches across and fill the bottom of it with small rocks or pebbles. The only object of the use of rocks is to hold the bulbs in an upright position and give the roots something to twine around.

In the size dish or bowl described place 3 Chinese Lilies or 5 or 6 Paper White Narcissus in an upright position among the rocks and then fill up part way with water. The bulbs should not be more than half covered with water at any time. Set the dish away in a dark place until the roots begin to make a good growth. When these start bring out into the light and as soon as they show signs of blooming, place where they can get plenty of sunlight. The water should be changed every three or four days by pouring off the old and putting in fresh. Keep them rather cool so as not to force too rapid a growth. The two most important things in water culture is to keep them from freezing and keep the water fresh. It is a most interesting process and the bulbs will produce as good flowers in water as in soil. Paper White Narcissus cost about 40 cents a dozen; good Chinese Lily bulbs about \$1.25 per dozen so that the trial is not an expensive one and you will be more than pleased with the result.

BULBS FOR SPRING PLANTING.

Under this head properly comes Tuberoses, Gladioli, Dahlias, Cannas and Caladiums. There are many other bulbs and roots that could be named, but as it is the purpose of this work to cover only such as are sure to be satisfactory and are easily obtainable; we will omit all except these.

TUBEROSES.

These will grow to perfection in any good garden soil in any Southern State. Use only what florists call No. 1 bulbs which usually cost from 30 to 40 cents per dozen. These larger size bulbs will almost invariably bloom the first year, while the smaller, cheaper bulbs will seldom bloom until the second year. These bulbs should be planted any time from February up to June in open ground, our preference being March in this section. The large bulbs are from 3 to 4 inches long and should be placed in an upright position so that the top of the bulb is from 1 to 1 1-2 inches below the surface of the ground. The young shoots will appear above ground shortly after warm weather sets in and by mid-summer will throw up a tall stalk bearing from 10 to 20 perfect flowers of the most exquisite fragrance. As these flowers open they can be picked off one or two at a time leaving the full strength of

the plant to go into the production of the others. It is a most popular flower here around Atlanta and from 40,000 to 50,000 bulbs are planted each year in private gardens. The bulbs hold in perfect condition through the winter in the lower South, but are rather uncertain as to bloom the second year, hence it is better to obtain new bulbs every year if you wish to be sure of flowers.

Figure 28.

GLADIOLI.

Comparatively little known South but a perfect success anywhere in our climate and worthy of planting by any one. In hardly any flower can be had such a splendid display of fine color with so little trouble as with this. All shades and colors can be found from pure white to deepest scarlet, many of the varieties being most beautifully shaded and blotched.

Gladioli do best in rather sandy soil but any, loose garden soil will produce them satisfactorily, the only thing to be avoided is planting them in stiff clay. The bulbs are from 1 1-2 to 2 inches in diameter and are flattened. The top of the bulb should be

about 2 inches below the surface. The growth is rapid after the roots once put out and each stalk produces 10 to 15 perfect, almost lily shaped flowers. They require nothing after once being started, except to keep the surface of the soil stirred and free from grass and weeds. New bulbs should be planted each season as they, like the Tuberose, are uncertain as to blooming the second year.

As to varieties, there are hundreds of distinct, named kinds selling from 5 cents to \$1.00 each, but unless you are a specialist in growing them you can get just about as much enjoyment and satisfaction out of the "Mixed Gladioli" sold at 25 to 35 cents per dozen by reliable seedsmen and florists as from the fancy named kinds at much higher prices. Any sold at less than above prices are apt to be small, inferior bulbs and mostly of solid scarlet color, the scarlet being the most common. You will find the gladioli very satisfactory and there should be thousands of them planted where there is only a dozen or so now.

CALADIUMS.

More commonly known as "Elephants' Ears." Not a flowering bulb but a splendid plant for making a tropical effect. Bulbs should be planted any time after danger of freezing is past in either naturally moist soil or else where an abundance of water can be given all during the summer. Bulbs should be placed so that the top of bulb is about 3 inches below the surface. The bulbs can be had in several sizes, ranging in price from 10 to 15 cents each. The richer the soil and larger the bulbs the larger will be the leaves and the larger the leaves the finer the appearance of the plant. One of the best ways is to make a circular bed about 3 feet in diameter. Plant 5 medium sized bulbs around the edges, equally distant from each other, then one rather large bulb in the center.

These bulbs can be carried safely in the ground through winter in the middle and lower South providing the dead leaves are cut off after frost kills them, then a coating of 5 or 6 inches of fresh stable manure and leaves is put over them and left undisturbed until the ground stops freezing in the spring. The bulbs are very susceptible to freezing and once the crown of the bulb freezes it rots. Protected during each winter the bulbs if left, continue to increase in size for years.

CANNAS AND DAHLIAS.

The right methods of cultivation of both of these will be found under their respective heads earlier in this chapter in that part devoted to the growing of flowers from seed.

THE ROSE, THE QUEEN OF FLOWERS.

The South is the home of the rose and nowhere in the world can they be grown to so great perfection as here, especially so in the clay soils of the middle South. In making this statement we refer more especially to what are generally termed the

Fig. 29.—Everblooming Rose.—Kaiserin Augusta Victoria.

monthly or "Everblooming" Roses. The everbloomingers, broadly speaking cover the Tea and Hybrid Tea Roses. Most of the climbing varieties are satisfactory also, being used to cover porches, trellises, etc. We cannot advise the use of the "Hybrid Perpetual" varieties, as very few of them are adapted to our climate. Paul Neyron is an exception to this rule and does well. The value of the Hybrid Perpetual class is largely its ability to stand Northern winters without being killed and we do not have to meet those conditions, hence it is better to confine our plantings to varieties that give an abundance of bloom almost from frost to frost.

Rose growing in the South is not the difficult matter that many lovers of flowers consider it. No-

where on earth will roses grow more profusely nor to greater perfection than in our section.

Successful rose growing is entirely a matter of following a few simple rules. The first of these is to get varieties adapted to this section; two-year-old, open ground, Southern grown plants being preferable. The second is thorough preparation of the soil before planting. The third is frequent cultivation and close pruning to keep the plants in blooming condition.

Fig. 30.—White Everblooming Rose—The Bride.

We advise the use of the open ground grown plants because they are better and stronger than the small pot grown stock. The plants are a year older, are 'hardier, having been fully acclimated to outdoor conditions, and if planted out during the fall and early winter, will give plenty of bloom the following spring and summer, thus saving a year in obtaining results from your plantings. The use of these open ground grown plants relieves you of the necessity of the close care that has to be given the small, pot grown stock from greenhouses. We have had many years' experience in rose growing and planting in the South, and each year's work confirms us in the opinion that open ground grown roses are by far the best for the South. If you are willing to or prefer to use the small pot grown plants you should plant them out in early spring, watching them closely to see they do not die from lack of

water before the roots start well. These pot grown small roses are, of course, much cheaper than the open ground grown ones and can be had at 75 cents to \$1.00 per dozen, while the latter cost \$2.50 to \$3.00 per dozen. Another point. Don't buy roses, fruit trees or in fact, anything of this class from traveling agents. There are some honest agents of this kind, but they are so few that it is hardly worth while to consider. With few exceptions the best and most reliable nurseries will not sell trees or plants to traveling agents. In buying this class of goods buy direct from the growers.

TIME OF PLANTING.

Open ground plants usually become dormant between October 15th and November 1st and stay in that condition until March 1st. They can be transplanted any time while the plants are dormant. The earlier they are transplanted after they become dormant the better. Our soils remain warm enough all through the winter to promote root growth while the tops remain dormant, thus giving a root system by the time the spring growing season comes in and enabling the plants to make a vigorous growth at the start. The earlier the transplanting is done the greater the growth of roots during the winter. For this reason we advise planting at the earliest possible date after heavy frosts. Pot grown plants should all be transplanted in spring, except in Florida and near the Gulf where fall planting is best.

SOIL PREPARATION.

Many failures are the result of lack of preparation of the soil before planting. In the clay soils which are present in most parts of the Central South, the subsoil is stiff and hard and in no condition for the tender new roots to penetrate it. This must be thoroughly dug up and pulverized to the depth of 18 inches. A supply of well rotted stable manure should be used, mixing it thoroughly with the soil below where the roots of the new plants rest. If the rotted stable manure is not obtainable, bone meal worked into the soil at the rate of 2 to 2 1-2 pounds for each plant is the best substitute. Which ever is used mix thoroughly with the soil. It will also be found advisable to dig out the subsoil below where the plant is to stand and fill it in with woods earth, or if that is not obtainable, use the surface

soil from your own yard. Woods earth, which is largely decayed vegetable matter, or the surface soil is more fertile and looser than the subsoil and easier for the roots to penetrate, and for these reasons it is advisable to use either one or the other. Never use fresh manure beneath the surface in a rose bed. It makes the soil "thirsty" and easily affected by drouth. If fresh manure is used at all use it as a surface mulch, putting it on several inches thick up around the plants after they have been set. The winter rains will carry much of the fertilizing value of the manure down to the roots, and by spring the manure will usually be decomposed enough so that it can be spaded or worked into the soil and be beneficial instead of injurious.

is done after heavy frosts have come and rendered the plant dormant, the better growth they will make the following spring.

The plants, as they come from the grower, usually have most of the top left on. Before transplanting,

Fig. 31.—Shape and Form of Cochet Roses.

Have your soil worked down fine, free from lumps and trash of all kinds, so that it will pack easily and closely around the roots.

TRANSPLANTING.

As stated previously, the earlier in the season this

Fig. 32.—Everblooming Rose.—Helen Gould.

about one-half of this should be trimmed off. It is hard for many to cut the plants back, but it practically insures their living and making a good growth the following season. We do not favor pruning the roots except in cases where they become bruised or broken in handling. Where this has occurred cut off the injured or bruised parts with a sharp knife.

Plants should be set so that the crown of the roots will come just below the surface after the soil has been pressed down until it is firm. Roots should be placed as near the position they formerly grew in as possible and the soil pressed closely and firmly around the roots, preferably by hand. Then fill in the hole until even or slightly above the surrounding surface and then firm all the soil around the plant by tamping. Do not transplant in clay soils when the soil is wet enough to be sticky or muddy. The firming of the soil necessary to get it close enough to the roots would be injurious when the soil

is too wet. In the sandy soils in Florida and along the Gulf, it is advisable to plant when the soil is wet, directly after rains, but in any of the stiff clay soil sections drier conditions must be had. Whenever roses have been planted it is advisable to pour on one bucket of water to each plant. No matter how carefully the soil has been pressed down, the water will carry the particles of earth more closely against the roots than can be done any other way. After watering scatter a little dry earth over the wet soil. This dry earth mulch will prevent the baking and crusting of the wet soil beneath.

CULTIVATION.

If roses are to be kept in good condition, they must be cultivated frequently; the surface of the soil kept from baking or getting hard and crusted, and the bed kept free from weeds and grass. This is best done by frequent rakings, deep enough to break any crust that may be formed by heavy rains. Keep the surface of the soil loose. It promotes growth and prevents drying out of the moisture below. The use of stable manure is good during the winter months as a mulch on the surface. For fertilizing with commercial fertilizers there is nothing better than ground bone or bone meal, as it is usually called. This is not a quick acting fertilizer, but it furnishes a continuous supply of plant food during the season. If a quick acting fertilizer is wanted, any good vegetable fertilizer will produce the results. We prefer, for clay soils, one containing about 8 per cent. phosphoric acid, 4 per cent. nitrogen and 4 per cent. potash. This is a complete plant food and should be sprinkled lightly around the plants on the surface and raked in. This should be done every two or three months during the growing season.

TRIMMING AND PRUNING.

If the bloom is kept cut off closely and long stems cut with the bloom the plants will be kept in good condition for almost continuous blooming. Early in spring it is advisable to cut out any dead wood that may be on the plants or any wood that looks old and hide-bound. The object of close trimming and pruning is to encourage the growth of the new wood and new shoots from the roots. Old wood does not produce good bloom.

In cutting bloom cut in bud. It takes too much

of the strength of the plant to carry the flower to full maturity.

If you want to keep plants in good condition give them personal attention. Don't leave it to servants, or if you have them do the actual work, stand over them and see that it is done right. It is not safe to trust the majority of them without directly supervising the work.

WATERING.

All sections have dry times and drouths when it is advisable to water the plants. Many people do more harm than good by giving a light surface wetting daily. Once or twice a week is better. An inch or so of the dry surface should be drawn away from the plant leaving a basin-like depression into which should be poured from a half to a bucketful of water. After this has soaked in cover the wet spot with the loose earth previously drawn away. This prevents baking and crusting of the soil. In cities where water works are in use the whole surface of the rose bed should be thoroughly saturated once a week, the watering being done late in the afternoon. The following morning rake the bed thoroughly to prevent crusting and running together of the soil in the hot sunshine usually present during times of drouth.

If these few simple instructions are followed there will be little or no difficulty experienced in growing roses to perfection; in fact, you will be surprised to see how little effort will produce splendid results in rose growing.

It is not advisable in a book of this character to give a list of varieties that should be planted always, for there are new introductions every year and a list of this kind is always changing, new and better varieties superseding the old. The writer's stand-bys in the rose garden at this time, among the ever-bloomers is as follows. All these have been grown three to four years or more and have given us entire satisfaction:

In white varieties, Bride, Kaiserin Augusta Victoria, Snowflake or Marie Lambert, White Mamon Cochet; in pink varieties, Duchess de Brabant or Countess Le Barthe, Bon Silene, Catherine Mermet, Bridesmaid, Pink Mamon Cochet, Pink La France; in yellow, Mlle. Franciska Kruger, Perle des Jardins, Eloile de Lyon, Safrano, Marie Van Houtte, Souv. De Pierre Notting; in red; Meteor, Papa Gautier,

Triomphe de Pernet Pere, Helen Gould or Baldwin, Andre Schwartz and Gruss an Teplitz. All of the above are Teas or Hybrid Tea varieties and are "everblooming." In Hybrid Perpetuals the "Paul Neyron," an immense, free blooming rose is desirable. In climbers the yellow Marechal Neil is the best, followed by Chromatella or Cloth of Gold, Jas. Sprunt (cherry red), Lamarque (white with lemon centre), Reine Marie Henrietta (bright red), Solfa-terre (deep sulphur yellow) and Mrs. Robt. Peary (pure white).

The Crimson Rambler is a good porch or pillar

rose, covered with a mass of crimson flowers early in spring only. The other Rambler roses have little value in the South. At least a dozen roses ought to be a fixture with every home. There should be more if you can afford to buy them. They are fairly permanent, for with fair treatment they last for years, getting larger and better every season. You can't have too many of them and when times are prosperous the small amount necessary to buy the necessary plants and seed can be taken without any one feeling it. The time to begin beautifying our home surroundings is now.

Fig. 33.—The Giant Rose—Paul Neyron.

COW PEAS.—UNFERTILIZED ON RIGHT: FERTILIZED
ON LEFT. EXPERIMENT FARM, SOUTHERN
PINES, N. C.

BOOK V.

FERTILIZER DEPARTMENT.

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INTRODUCTION.

The use of commercial fertilizers has become a necessity in modern agriculture with the depletion of the natural store of plant food in the soil. This is especially the case in the South, where the careless cultivation of cotton year after year on the same land has so reduced the fertility of the soil that the application of fertilizer has been deemed essential for every crop grown.

But there is a wise and a wasteful way in which fertilizers are used. The prosperity of any country depends largely upon the productivity of the soil, and that country which produces the largest crops in excess of its home need will always take the lead of one which merely supplies its home consumption.

What is especially needed in the South is the increased production per acre rather than a continuation of the practice of going over a large area for the crop that should be grown on one-tenth the area.

Long and exhaustive tillage will reduce the productivity of any soil and the problem before the Southern farmers to-day is how most economically to increase the yield of the staple crops per acre. The old practice of planting cotton after cotton continuously with the aid of a little dribble of fertilizer in the furrows must give place to a wiser system and a more liberal use of the fertilizers in the proper place. The fact is that no soil originally fertile and of a good mechanical composition ever is entirely worn out. Nature all over the South has restored old fields by a growth of broomsedge and old field pines, so that when cleared of pines the land is found to be fertile again through a pumping up of plant food from the subsoil by the long tap-roots of the pine trees and the restoration to the surface of the organic matter that the careless cultivation has deprived the soil of. The soil was not worn out, but simply made unproductive through the shallow scratching of the surface with the one-mule plow, while right below was an unexhausted subsoil from which the pine tree brought fertility again to the surface.

We can learn hence from the old field pines lessons regarding the restoration of our soils. Of course we cannot afford to wait for nature to do this

work for us through the agency of the broomsedge and the pine. The farmer must learn that his soil is a great store of plant food entirely inexhaustible if properly treated, and the proper use of fertilizers is one of the most efficient aids in its improvement, while the improper use of these plant foods has been the means of reducing its productiveness till it is common to say that the soil is worn out when it still has an abundant supply of plant food if properly aided in bringing it out. If one simply draws on the land without restoring any plant food that may have been taken out by the crops, or not using any means for getting at its reserve store of plant food the available store of plant food will become exhausted, at least that which is available by the methods employed. A man having a deposit in bank can draw checks on it so long as he keeps his deposit good, but if he draws without renewing his deposit he will soon reach the time when his drafts are dishonored. It is the same way with the soil. The soil is the farmer's bank and if he wisely treats it he can continue to draw increasing drafts without exhaustion of the deposit. All crops grown take from the soil in different amounts the various materials that are needed for their perfection. In some soils, especially such as are derived from the decomposition of potassic rocks like our granite, some of these materials seem to be in inexhaustible quantity and it is said that these soils do not need applications of mineral matters except phosphorus. While it is true that in such soils potash does exist in very large amounts, it is in the form of an insoluble silicate or sand which becomes soluble very slowly through action of the carbonic acid that is brought to it in the rain water, and it is often wiser to use an application of potash in the fertilizer than to depend on that in the soil. The plant foods that are most commonly deficient in our old cultivated soils are phosphorus, nitrogen and potassium. These are pure elements, and we cannot use a pure element as a fertilizer. Nitrogen is a gas that is mixed in the air, and we must get it in combination with something else before we can get it in the soil in such a shape that the plants can get it. Just how this can be done we will explain later. Phosphorus in a pure state burns up as soon as exposed to the air, and

hence we cannot use pure phosphorus. But we can get it in combination with lime in the form of phosphoric acid in our phosphoric rocks, and it is phosphoric acid that we use as a fertilizer. Potash, as I have said, exists in all clay soils, and is found in hard wood ashes in very available shape. The most readily available source for potash, which is the oxide of the metal potassium is in the potash salts that are imported from the salt mines in Germany. These are all readily dissolved in the soil. Nearly all of our soils are the result of the decomposition or breaking down of the rocks and the transportation by water of the pulverized material and spreading them over the old rocks to form our soils of to-day. In some instances the soil is not formed from the rocks that lie below it. In Northern sections of the country where the ancient glaciers moved over the surface for untold ages, the soil is made up of materials transported by the ice from distant regions. And in the South here and there there are so-called limestone soils which lie on top of the old limestone that was formed under water of lakes, and on top of this rock an accumulation of vegetable decay has taken place, and a deep and fertile soil has taken the place of the ancient lake. This soil has not any connection with the rock below in its composition and is apt to be more deficient in lime than a soil made up of the rock decomposition, and it has been found that lime has a very great and beneficial action on such soils. Lime is one of the essential matters for plant growth, but in most soils there is an abundance of lime for all purposes of plant food. And yet it has been found that lime, even on such soils has a special value in sweetening the soil and in rendering plant food that is in an unavailable state available to the plants. Lime renders a heavy clay soil lighter by gathering the fine particles together in small lumps, and in a similar manner it makes a very sandy soil closer by gathering the sand together after the manner of mortar. Lime also acts on the vegetable matter in the soil and releases the ammonia so that the minute plant forms called bacteria can carry on their work and bring the ammonia into the form of a nitrate, which is the only form in which the plants use nitrogen.

We have said that soils of a good mechanical make-up do not become worn out. But to get at and keep up their productivity we must thoroughly plow and pulverize them. A mass of phosphate rock may lie for ages on the soil and have little if any effect on its productiveness. But if we pulverize that rock to a

fine powder and mix it with the soil the action of the carbonic acid of the rain water, which is the greatest decomposer of nature, has an opportunity to act on each small particle and it is dissolved so that plants can use it and get the phosphoric acid it contains. In manner a hard lump of clayey soil will not give up its plant food till pulverized by the implements of cultivation so the water and air can act upon it and make its plant food available. Plants take food from the soil by the very fine hairs on the extremity of their roots just back of the root cap that forces its way through the soil. If you will take a few garden beans and place them in a saucer on a few thicknesses of blotting paper made wet with water, and then cover the saucer with a pane of glass and put it in a warm place, the beans will soon sprout and throw out white rootlets on the paper. By examining these roots you can see that the extreme tip is bare and pointed and is called the root cap. This root cap is continually renewed so that as the outer part is worn in pushing through the soil it is continually renewed from behind. Just back of this root cap you will see that a portion of the rootlet is covered with a velvety coat of very fine hairs. As the root pushes forward through the soil new hairs are continually formed just back of the root cap, and the old ones die off. These root hairs are the only part of the root engaged in taking food from the soil, and as they are all of microscopic size it is evident that all the food used by the plants must be completely dissolved, since the root hairs cannot take in any solid substance. It is also easy to see that on the perfection of these root hairs the ability of the plant to get foods depends. Hence if we tear off the tips of the roots with the absorbing root hairs by running a plow through our corn, we are depriving the corn of the power to get the food it needs till it makes new fibres and new hairs, for the corn and the cotton plant send their roots far and wide through the spaces between the rows.

Deep breaking and thorough pulverization of the soil are essential to the dissolving of the plant food in the soil, but shallow and frequent cultivation afterwards is needed for the perfection of the crop. One piece of land may have just as much plant food in it as another right alongside of it, and yet through imperfect preparation and improper cultivation it may be far less productive than the other piece that is well plowed and properly cultivated. No matter how much

plant food a soil may contain, if it is not made available it will not be a productive soil.

COMPOSITION OF SOILS.

Soils vary chiefly in their mechanical composition, and different terms are used to describe them. When sand predominates the soil is called sandy. When more clay is mixed with it it becomes a sandy loam, and when still more clay, a clay loam, and when there is a small proportion of sand to clay it becomes a heavy clay soil. In sections where the limestone comes to the surface and its decomposition affects the soil, the soil will contain a great deal of lime in the form of carbonate of lime. The mineral matters other than clay and sand consist of various compounds of lime, potash, phosphorus and other things with sulphuric acid, phosphoric acid, carbonic acid and nitric acid, with oxides of iron and potassium and chloride of sodium or common salt.

when the soil is but a few degrees above the freezing point, while Indian corn under the same conditions will rot. Aside from the clay, sand and mineral matters the soil must contain a portion of decayed organic matter, that is, matter that has once formed the organs of plants and animals. This decayed organic matter when reduced to a black mass is called humus, and it is of great importance in the cultivation of the soil and in the supplying of moisture to the plants. A soil that abounds in this humus is made darker in color, and hence absorbs and retains heat better, and is therefore a warmer soil. It has been found, too, that humus retains moisture longer than any other matter in the soil, and that a soil abounding in humus dries out more slowly than one which is destitute of it. A soil newly cleared from the forest has a large percentage of humus, and we all know that such a soil stands a drouth better than an old soil that has become depleted of humus. It does not wash into gullies like the old soil either, and not 'till

Fig. 1.—Unfertilized. (Eight weeks old.) Fertilized.

Fig. 2.—Unfertilized. (Twelve weeks old.) Fertilized.

Water exists in soils in two forms. First, that which in any soil adheres to each particle of the soil in the form of a film of moisture, and also in the form of permanent water. The need for drainage is to get the permanent water table in the soil lower down from the surface so as to admit the air and the film water, for standing water shuts out the air and renders the soil cold, and to have plants thrive their roots must have the oxygen of the air, moisture in the form of films and a proper degree of heat suited to the plant growth, since some plants need less heat than others. A garden pea will germinate and grow

long cultivation and a failure to keep up the supply of humus has caused the soil to run together does the washing begin. This decayed organic matter also contains the plant food that the plants that made it took from the soil, and hence a new soil is always a more fertile soil. The humus also forms certain humic acids which act on other matters in the soil and render them available to crops. We see then the great importance of keeping up by systematic rotation of crops the organic matter that makes this valuable humus, and thus retaining the character that made the new ground more productive.

The retention of film moisture in the soil by this humus is one of its most valuable characteristics. In a soil abounding in humus we can use the commercial fertilizers in much larger quantities than in a soil that dries out quickly, simply because the fertilizer will be dissolved, while in the old dry soil a similar amount of fertilizer applied would really damage the crop in dry weather, burning the roots instead of being dissolved. The uniform supply of moisture then during the long dry spells we are apt to have in the South is one of the greatest arguments in favor of a systematic rotation of crops that will keep up the supply of humus in the soil. Having lightly touched on the various forms of plant food we will now take up each of the most important which are apt to be deficient in our old cultivated soils.

NITROGEN.

As we have said, nitrogen is in its elemental form a gas, and in order that plants may get it in the soil it is necessary that it be put into combination with other matters. The air is four-fifths nitrogen in its gaseous form. It is mixed in the air, but not combined with oxygen so that we can breathe it, for we could not breathe pure oxygen, as that would cause every thing to burn up at once. Nitrogen then is to dilute the air for animal and plant life. Green plants use nitrogen only when it has been brought into combination in the soil with lime, potash or sodium, through first being brought into the form of nitric acid, which at once seeks one of these bases to form a neutral salt. All the decayed organic matter in the soil contains nitrogen in the form of organic matter. Certain minute and invisible forms of plant life (to the naked eye) attack all vegetable matter buried in the soil and cause it to decay. These release the ammonia that the plants contained. Then another form of these myriads of microscopic plants called bacteria, which swarm in a soil having an abundance of humus live on the ammonia and they change the ammonia into a nitrite. Then a third form lives on the nitrite and its work results in the formation of nitric acid, and this acid at once combines with lime, potash or other mineral base that may be present in the soil, and the result is a nitrate which is at once available to plants. The immediate effect of nitrogen in the form of nitrate of soda when used as a fertilizer, is due to the fact that it is already in this nitrate form and can be used at once, and must be used at once

or it will be washed from the soil. Plants use nitrogen in varying percentages according to the crop grown. The value of nitrogen in plants is due to its effect in promoting rapid growth. If there is an excess of nitrogen in the soil over the due amount of phosphorus and potash needed, there will be a rank growth but small fruitage, for the mineral elements are essential to the ripening of fruit and the perfection of grain and seed.

GETTING NITROGEN FROM THE AIR.

It has long been known to farmers that clover, cow peas and other members of the family known as legumes or pod-bearers did in some way increase the fertility of the soil. But just how they did it was long a matter of conjecture. More recent study of these

Fig. 3.—Tubercles on Clover Roots.

plants by scientists has demonstrated the way in which they do this. On the roots of these legume plants were found certain little knots or nodules. It was found that when these nodules were on the roots that the plants did acquire nitrogen more than they could get from the soil, and that when there were no nodules the plants did not acquire any surplus nitrogen. It was evident then that in some way these nodules were the means for the acquisition of nitro-

gen by the plants. Further study in the microscopic laboratory revealed the fact that these nodules were formed by certain of these soil bacteria that lived as parasites on the roots of the legumes. These minute plants were of the nature of nitric ferments and they oxidize the nitrogen of the air that penetrates the soil and nitric acid is the result. This at once seeks a base such as lime or potash in the soil and the plants take up the nitrate formed just as they take the nitrate formed by the other nitrifying bacteria that live on organic decay. We, therefore, can easily see the importance of the legumes, especially our cow peas, to the farmer, for they not only get for him free from the air the nitrogen that costs so much in fertilizer, but furnish the organic decay for the other soil bacteria to go to work on and render available to other crops the following season. It also shows that these legume crops do not need an application of nitrogen in a fertilizer, since they can get all they need and more from the air. In fact, it is worse than useless to apply a nitrogenous fertilizer to them, since when this is done they will use the fertilizer and will not get from the air what they would get if compelled to do so. None of our cereal crops nor cotton belong to this family of plants and hence the importance of putting some of the legumes into our rotation to avoid the purchase of nitrogen for the sale crops. Much has been said of late about inoculating the soil for the various bacteria that live on the roots of legumes, and artificial cultures have been sent out dried in cotton. It has been found, however, that these artificial cultures do not readily grow in the soil. The Department of Agriculture at Washington is now making and sending out these cultures in sealed glass tubes with directions for use, and these will probably be more effective than the dried bacteria. But it is useless to try to inoculate a sour soil, for the bacteria nor the legumes will thrive on such a soil 'till sweetened by an application of lime. Nor is it of any use to inoculate a soil that is already rich in nitrogen, for in such a soil the legumes will use the soil nitrogen and will not make nodules on their roots. By far the best way to inoculate a soil for alfalfa or other legumes is to get soil from a field where the plants have already been successful and have made nodules. Scatter 200 pounds per acre of such a soil over the field and the results will usually be better than with the artificial cultures. It is useless to inoculate a soil in which phosphoric acid and potash are wanting, for these are very necessary to any plant, but especially

to the legumes, which, while they get nitrogen from the air must be abundantly supplied with the mineral matters, since they are greedy consumers of these.

The cereal crops are not nitrogen collectors and in this respect differ from the legumes. An experiment made at the Georgia Station showed that wheat, barley, beans and luzerne (alfalfa) were planted on the same field without an application of nitrogen, with nitrogen at rate of 18 pounds per acre and with 31.5 pounds and 45 pounds with the following results, phosphoric acid and potash being furnished in all cases in like quantities.

	No Nitrogen	18 lbs. N.	31.5 lbs. N.	45 lbs. N.
Barley	100	161	220	272
Wheat	138	212	270	316
Beans	935	938	961	883
Luzerne	976	983	1000	994

Showing that when the legumes, beans and alfalfa, received heavy applications of nitrogen they did not acquire an extra amount as they did when no nitrogen was applied.

While it is believed that there is little specific difference in the various bacteria that live on the roots of legumes, some of them have become so altered in their habits that they prefer certain plants to others and the bacteria that inoculate one form of legume will usually fail to affect another species. Hence it is important to have the forms that live on the special plant to be grown. But it must be remembered that these bacteria themselves have no nitrogen and do not add nitrogen directly to the soil, and are hence not to be considered in the form of fertilizers, but as plants which through their ability to oxidize the free nitrogen of the air enable the legumes to get it in a form in which they can use it.

PHOSPHORUS.

The element phosphorus is one of the most vitally important elements in plant life. While, as we have said, phosphorus cannot be used as a pure element, we can get it in the form of phosphoric acid associated with lime, forming a phosphate of lime. In its natural form in the rocks it is in a form not soluble in water. But when finely pulverized and mixed with the soil it does finally become, through the action of the carbonic acid in the rain water, available to plants. Soils will hold on to phosphoric acid 'till called for by plants, and it does not leach away from

soil like the nitrates do. But as all our cereal crops use it in large amounts in the ripening of the grain, it has been found that our old cultivated soils are more deficient in phosphates than in any other form of plant food except nitrogen.

We get phosphoric acid from animal bones and from the phosphatic rocks. Some manufacturers try to make the farmer believe that the phosphoric acid from animal bones is a better article than that from the rock. But this is a mistake. Phosphoric acid is the same and the same thing, no matter from what source, and the only thing to consider is its availability. In bone meal it is insoluble, but owing to the speedy decay of the bone meal in the soil it becomes available more quickly than that in the pulverized rock or

sulphuric acid, which at once unites with the lime carbonate in the soil and forms plaster or the sulphate of lime, which does not sweeten the soil as the carbonate does, and this robbing of the soil of lime brings about acid conditions and a need for fresh applications of lime. Practical men are rapidly coming to the conclusion that for the permanent benefit of the land it is better to use the pulverized rock in liberal amounts. Experiments made at the Maryland Station show that the pulverized rock gave better and more permanent results than the acid phosphate. The average super phosphate or acid phosphate contains about 14 per cent. of phosphoric acid, but some rock makes an article as high as 16 per cent. It has been found too that on a soil deficient in phosphoric

Fig. 4.—Yield from 1-10 acre. No Fertilizer.
From farm of T. J. Adams, Edgefield, S. C.

Fig. 5.—Yield from 1-10 acre, from Fertilizer containing 8 per cent. Phosphoric Acid, 3 per cent. Nitrogen, 6 per cent. Potash.

From farm of T. J. Adams, Edgefield, S. C.

phosphates" as it is called. The phosphatic rock found in South Carolina, Florida and Tennessee furnishes the cheapest source of phosphoric acid on the market. To render the phosphoric acid immediately available the pulverized rock is dissolved in sulphuric acid, making what is known on the market as acid phosphate. For immediate effect on the crops this is considered best. But it has been found that long continued use of acid phosphate brings about an acid condition in the soil that is detrimental to the growth of clover and other legumes. Not that the acid does so directly, for a well made phosphate has no free acid, and manufacturers avoid an excess of acid, as it makes the article sticky and hard to drill. But it has been found that when the acid phosphate is applied the crops take up the phosphoric acid and set free the

acid and potash an application of either alone will have little result, and that for the best results both are needed. The office of potash in the plant seems to be to encourage and promote the formation of starch, while phosphorus is engaged in the transfer of the starch to the points where it is needed.

POTASH.

Starch is formed in plants through the assimilation of carbon from the carbon dioxide in the air by the green matter in the leaves. But it has been found that this process is checked and little starch is formed if potash is deficient, and no growth whatever is made if it is entirely absent. Hence, though

potash contains no starch, it is essential to the formation of starch and to plant life, and starch is the primary form in which all the structure of plants is made up, the starch being transformed into various other substances to make up the tissues of the plant. Starch is also a storage form of food for the future use of the plant. It is stored by phosphoric acid in the tubers of the potato, and there keeps unchanged 'till the potato sprouts. As soon as sprouting takes place there is a ferment formed that changes the starch into a sort of sugar that the plant can use as food. Starch as starch is not digestible by plants or animals. We have in our saliva the same ferment that changes the starch in food to glucose and enables us to digest it. Now as starch is so important a matter in the plant economy it is important to understand the means for making and using it in the perfection of the crop. If the soil is rich in nitrogen but deficient in phosphoric acid and potash, potatoes will make rank tops and very small and few tubers. Grain will grow rank and have weak straw that will fall and lodge. Hence we see the importance of having a due percentage of phosphoric acid and potash in the soil, and if they are deficient to apply them in the fertilizer. An excess of nitrogen makes the cotton plant long limbed and "weedy" and a small fruitage in proportion to growth. But when this rank growth is supplemented with a due percentage of phosphoric acid and potash, the rank growth is no disadvantage and the plants will fruit heavily.

Potash is the oxide of the metal potassium. It is one of the component parts of all vegetable matter, and in burning wood we find in the ashes a large percentage of potash associated with a still larger percentage of lime and a small percentage of phosphoric acid. Hence ashes, particularly those from hard woods, are a valuable source of potash. The ashes of corn cobs are still more valuable, and those made from cotton-seed hulls are the most valuable of all. Potash exists more plentifully in clay soils than any other of the important elements of plant food. But it is in the form of an insoluble silicate, which is slowly made available to plants by the carbonic acid in rain water. Applications of lime will release potash more rapidly, and in some cases it may be found cheaper to get at it in this way than to apply potash in the fertilizer. But as a rule, even on soils that have an abundance of potash in the insoluble form it will pay to use some potash in the fertilizer, especially for those crops like potatoes, legumes and tobacco

need large percentages of available potash in the soil. The most readily available source for potash is the potash salts imported from Germany under the names of kainit, sylvanite, etc. But since in the crude salts there is but a small percentage of potash in proportion to the salt associated with it, the German companies have concentrated the potash in the form of muriate and sulphate in which there is 50 per cent. of actual potash, while in kainit there is but 12 per cent. Hence the more concentrated article is usually the cheaper since the farmer has to freight but one-fourth as much to get what potash he needs. It has been found, however, that kainit, by reason of the large amount of common salt it contains, has a special value on some soils in the South in preventing rust in cotton, and it is, therefore, largely used in cotton fertilizers. Bottom soils and reclaimed swamp lands usually need no application of nitrogen, but are apt to be very deficient in potash. Light sandy soils are also deficient in potash, and even on the heavy clay loams it will usually pay for some crops to use a liberal application of potash.

Potash and phosphoric acid are essential to the success of the legume crops, and the deficiency of these in the soil is the common cause of the failure of peas, clover and other legumes. If well supplied with phosphoric acid and potash the legumes will get all the nitrogen they need from the air, and will leave the soil richer in nitrogen for the following crop. Prof. Wagner, one of the best authorities on potash, says:

"On the strength of what is known up to to-day on that subject, I can lay down the following general principles:

"I consider it as suited to the purpose to fertilize with potash (kali) not only all plants intended to be used on the farm as food for animals, but also all cereals, which furnish straw, in quantities not merely sufficient for the production of a maximum crop, but with enough to induce the plants to take up an excess of potash (kali). Animal food rich in potash (kali) gives manure rich in potash (kali) and the potash (kali) of the manure is for some plants most advantageous.

For potatoes and sugar beets, give the potash (kali) in form of stable manure, and apply potash (kali) to the crop preceding or else fertilize with muriate of potash in the fall.

On loamy soils potatoes stand direct potash (kali) fertilization better than on sandy soils.

Among the cereals oats require the least, barley the largest quantity of potash (kali.)

To tobacco apply the potash (kali) only in form of sulphate.

1. All leguminous plants such as peas, beans, lupins, clover, seradella, lentils, esparsette should be rendered nitrogen-hungry, so that they may draw to the utmost extent upon the nitrogen supply of the atmosphere, and this is effected by potash (kali) phosphate fertilization.

2. For the nitrogen consumers the requisite amount of nitrogen should be secured from the cheapest possible source, the atmosphere. Extensive cultivation of leguminous plants, fertilized by potash (kali) phosphates, and their use as nitrogen-fertilizers effects this.

3. As far as nitrogen, procured without cost from the air does not suffice, the nitrogen-consumers should be supplied with the requisite amount of nitrogen, sufficient for the production of a maximum crop.

4. Whatever nitrogen has been secured from the air by green cattle food, and passes on into their manure, should be preserved from losses. This is effected by spreading potash (kali) salts, containing magnesia, either in the stable or the dunghill.

5. Whatever nitrogen has been secured by the soil by way of stubbles, roots, etc., of leguminous plants, should also be protected from loss, which is done by ploughing after fruits, or leguminosae, for fertilization alone, properly fertilized with potash (kali) phosphates.

6. All nitrogen furnished to the crop by the soil, by the stable manure, or by commercial fertilizers, should be induced to produce the highest effect, which gain is affected by liberal fertilization with potash (kali) phosphates.

7. Wherever lime is deficient, the soil should be supplied with it, so that the potash (kali) salts may develop their whole efficacy."

It has been found that certain forms of potash are better suited to certain crops than other forms. Tobacco grown by the use of the muriate of potash (chloride) is of inferior quality, and only the highest grade of the sulphate should be used on tobacco. Irish potatoes too are dryer and more starchy when the sulphate is used. But in the growing of the early potato crop in the South for the Northern market, the muriate is commonly used, since this crop is not expected to be particularly dry and mealy. Crops in which sugar is an important ingredient, are better

from the use of the sulphate, such as strawberries, sweet potatoes and other things of like nature. Every farmer should carefully save and apply all the wood ashes of the farm, for they are not only a valuable source of potash, but, as we have said, contain a very large percentage of lime, which will act in releasing potash in a clay soil. For the plant food they contain hard wood ashes are worth from \$8 to \$10 per ton if they have been kept dry.

What we have said in regard to the various forms of plant food in fertilizers shows the importance of having a well balanced fertilizer in the soil. It is essential that the crops shall be supplied with nitrogen, phosphoric acid and potash in due proportions for the best success. A fertilizer containing these is called a complete fertilizer and the proportions of each in the fertilizer will depend on the nature of the soil and its needs and also on the character of the crop grown. But we have found that in all general farming with grain or cotton, where a proper rotation of crops is used and the legumes are brought in frequently, the farmer never needs to buy an ounce of nitrogen, for he can get all that he needs through the growth of the legumes, and by applying the mineral elements, potash and phosphoric acid, liberally to the legumes, peas or clover, he can not only get his nitrogen without cost, but can make a profit in the feeding of stock on the legume hay. Since nitrogen is the most costly part of a fertilizer, it is evident that by adopting this practice the farmer can use the cheaper forms more liberally, and when they are applied to the crops that feed the soil in nitrogen and feed the stock at the same time he is making the best possible use of this fertilizer outlay. Neglecting this rotation and the growing of legumes he is compelled to use a complete fertilizer and to buy the costly nitrogen that he could get without money and without price.

Few farmers realize that by far the larger part of every plant does not come from the soil at all, but from the air. Take a large green stalk of corn and cut it up and weigh it. Then dry it thoroughly, driving off all the water by heat as a chemist would in his dry bath. Weigh it again, and you will find that it has lost a great deal. It has lost water. Now burn this dried plant 'till every particle is changed to a white ash, and you can hold what is left of the corn stalk in your hand. These ashes represent what the plant got from the soil, except the nitrogen you have driven off and the water, and these came originally

from the air. You say that you have destroyed the stalk. No, you have simply resolved it into its original elements. The lime, potash and phosphoric acid are in the ashes, and the structure of the plant, the carbon di oxide and water have gone back to the air from which they came.

HOW PLANTS GET FOOD FROM THE AIR.

Sprout a potato in a dark cellar after weighing it, it will make long white sprouts, but will gain nothing, for the sprouting is only the transfer of matter already formed in the potato. But sprout it in the sunshine and you will see that the sprout turns green and the potato gains weight. This green color in vegetation is one of the most important matters in plant growth. The leaf of every plant has especially on the under side myriads of little openings invisible to the naked eye. These openings have the power to open and close like a pair of lips and are the mouths or breathing pores of the plant. When the sun shines, and at no other time, these mouths open. The air can then enter into the interior loosely arranged cells of the leaf. There is always in the air a minute percentage of carbon di oxide or carbonic acid gas. This is composed of two parts oxygen and one part carbon. The green matter of the leaf has the wonderful power to break up this combination and the plant takes the carbon and throws off the oxygen and thus purifies the air and gets at the same time the carbon it needs. Then with this carbon and the water that comes from the soil, the plant makes starch and all the compounds known as carbohydrates, which are used by the living matter of the plant to build up its structure. Nitrogen is an essential element of the living matter itself, and this it gets from the soil except in the case of the legumes when by the aid of the bacteria on the roots they get it from the air. Plants get from the soil through the fine root hairs we have mentioned the mineral elements or ash elements as they are called, dissolved in the soil water, and these are taken to the leaves and there all the material for growth is formed and transported to where it is needed to make new growth. Tops and roots and stem are all formed of materials elaborated in the leaves, and whatever the leaves are that will every other part of the plant be. The roots of plants have a power to select what they want from the soil and in the proportion they want it if it is

available. The oak tree and the pine will grow in the forest with their roots interlacing in the soil, but manufacture oak material and the pine pine material. The so-called sap that rushes up in spring through the trees is not sap but merely soil water with plant food dissolved in it. Growth comes entirely from the leaves in every direction. As all plant food in the soil must be dissolved before plants can use it, the im-

Fig. 6.—Illustrating the formation of starch.

portance of a due supply of film moisture is evident. Plants get all their carbon from the air and never from the soil. They never use ammonia or any other form of nitrogen 'till it has been transformed into a nitrate through the action of the soil bacteria. While all the higher forms of plant life get carbon solely from the air, the bacteria that carry on the work of changing ammonia into a nitrate have the power to get carbon in another way. It is found that in a soil abounding in organic matter containing nitrogen that an application of lime carbonate promoted the activity of the bacteria, and it was finally discovered that they have the power to get their carbon from the lime carbonate, which the higher plants can not do. The following table will be of interest and value.

	Potash (Kali) K ₂ O.	Phosphoric Acid P ₂ O ₅	Nitrogen. N.
Wheat	58	45	111
Rye	76	44	87
Barley	62	35	78
Oats	96	35	89
Corn	174	69	146
Rice	45	24	39
Sorghum	71	68	129
Buckwheat	17	40	63
Pea (pisum sativum)	69	39	153
Horsepea (Vicia faba)	169	64	254
Soja bean (Soja hispida)	87	62	297
Lupine, green, for fodder	63	46	219
Lupine, yellow (Lupinus luteus)	80	37	155
Potatoes	192	55	119
Sugar beet, beet-root	200	44	95
Cattle turnips	426	74	187
Carrots	190	65	166
Meadow hay	201	53	166
Corn, fodder, green	236	66	122
Clover, (trifolium pratense)	29	18	37
Clover, green (trifolium pratense)	154	46	171
Lucerne (medicago sativa)	181	65	289
Clover (trifolium repens)	58	29	89
Red Clover (trifolium incarnatum)	57	17	95
Esparssette	103	36	239
Seradella	196	57	128
Vetch (Vicia sativa)	113	35	149
Rape	124	79	154
Poppy	92	30	87
Hemp (cannabivs sativa)	54	34	..
Cotton	35	32	110
Hops	127	54	200
Tobacco	148	32	127
Sugar cane	107	37	518
Sorghum (Sorghum saccha- ratum)	561	90	446
White cabbage	514	125	213
Cauliflower	265	76	202
Lettuce (lactuca sativa)	72	17	41
Cucumbers	193	94	142
Onions	96	49	96

THE SPECIAL VALUE OF BARN-YARD MANURE.

While the commercial fertilizers furnish the essential elements of plant food in a more readily available form than barnyard manure and in larger amounts per ton, we have found that barnyard manure has a quality that commercial fertilizers lack. The manure carries with it a large amount of organic matter. This

organic matter tends to increase the humus in the soil, and to render it more retentive of moisture, and hence better able to withstand drouths. It also serves to make the soil more mellow and more easily worked, and from its slower availability it lasts longer in the soil than fertilizers.

But if, as we have suggested, the mineral fertilizers are used for the encouragement of the growth of the legume crops, getting nitrogen from the air and furnishing the organic matter in the soil and for the feeding of stock and the making of more barnyard manure, we can through their use accumulate humus in the soil more cheaply and rapidly than by depending on barnyard manure alone. This does not mean that we should neglect the manure, but does mean that we should have more of it through the growing and feeding of the forage raised by growing the legume crops. The organic matter and the nitrogen left in the roots of peas is gotten there more cheaply than by hauling and spreading it, but the crop itself should always be utilized and the resulting manure carefully saved, for no matter what the money crop of the farm may be, the keeping and feeding well of live stock lies at the very foundation of all successful agriculture. The following table taken from Bulletin No. 22, Special Georgia Experiment Station:

1,000 POUNDS OF	CONTAIN POUNDS.			
	Phosphoric Acid.	Lime	Pot- ash.	Nitro- gen.
Crab grass (green) . . .	0.75	1.00	0.04	4.00
Crab grass (dry) . . .	2.50	4.00	1.50	15.00
Ordinary weeds (aver- age approximate) .	1.00	3.00	0.75	10.00
Oat straw	2.00	4.00	12.40	6.20
Wheat straw	2.00	3.00	5.10	5.90
Corn stalks	3.00	5.00	6.00	3.20
Corn cobs	0.60	1.00	0.60	5.00
Cotton stalks, bolls and leaves	3.00	16.00	15.00	14.00
Cotton hulls	2.80	3.00	7.80	7.50
Oak leaves (dry)	2.60	20.00	1.70	10.00
Pine straw	0.70	2.00	0.30	6.00
Pine wood (sawdust) . .	0.07	1.20	0.08	5.00
Oak wood (sawdust) . .	0.50	2.00	1.40	10.00
Cotton seed	10.00	2.00	12.00	30.00
Cotton seed meal	25.00	6.00	17.50	67.50
Peavines (green)	1.00	3.00	3.10	2.70
Peavines (dry)	5.20	15.00	14.50	19.50
Clover (green)	1.00	4.00	4.90	4.30
Clover (dry)	3.80	17.00	22.00	20.70
Cowpea roots (green) .	1.50	4.00	4.50	4.10
Clover roots (green) . .	1.25	4.00	5.00	5.20

Muck as it exists in swamps is black humus result-

ing from vegetable decay. In the condition as dug from the swamp it is sour and comparatively useless. But if piled in layers over winter with lime or ashes the resulting compost is a valuable material for applying to the land. The dried muck will also make a valuable absorbent in the barnyard, but raw, wet muck should never be hauled directly on the land, because of its acidity which is harmful rather than beneficial. But when sweetened with lime or ashes and frosted over winter it is a very different article.

The value of stable manure is great, both as a mechanical manure, and as containing plant food. It consists of the excrement and urine of stock and cattle mixed with straw, leaves, cotton hulls, saw dust, etc. Animal matter, such as the excrements, decompose more rapidly than vegetable matter, and when mixed with vegetable matter causes it to decompose faster than it would do otherwise. It is hard to get at the amount of plant food in stable manures, for it is so different. The following table represents perhaps an average, which is taken from Bulletin No. 22, Special, Georgia Experiment Station:

1,000 POUNDS OF	CONTAIN POUNDS		
	Phosphoric Acid	Potash	Nitrogen
Stable manure (fresh)	3.50	4.50	5.00
Stable manure (rotted)	5.00	5.00	5.00

On the basis charged for commercial fertilizers it is estimated that the average value of manure annually produced by each horse or mule to be \$27.00; by each head of cattle, \$19.00; by each hog, \$12.00. It is hardly probable that near as good results are obtained in practice, and too sad to say it, many farmers lose the whole amount, because they do not take care of it. The urine is the most valuable part of the excrements of animals as it is especially rich in potash and nitrogen. It should be put upon the land as early as possible, and not allowed to stand in the rain and sunshine. It is a good plan to clean out the stalls often and place the manure on the land immediately. If this can not be done, have a shed, and place it under there and take care of it. It should not be exposed to the sun or rain any more than possible. However, it does not lose anything when

spread upon the fields. Before putting it upon the fields, the fields should be plowed immediately before, as the freshly plowed soil will absorb the escaping ammonia. Lime and stable manure should never be mixed; as the lime sets the ammonia free and it goes off into the air.

COTTON SEED.

Unless farmers are able to get a very high price for their cotton-seed it will not pay them to sell their seed and buy fertilizers. It is risky because they are liable to get cheated; for when you use cotton-seed, you know what you are using, but when you use a commercial fertilizer you do not always know what you are using. If you get 1,500 pounds meal for a ton of cotton-seed, you may exchange, but if not, put your seed under your crop. There is about 750 pounds of meal in a ton of cotton-seed. The oil in the seed is of no value as a fertilizer. The hulls have a little plant food value, and are quite valuable as a mechanical manure.

LIME.

The action of lime on land is not clearly understood by chemists, but it is known that a moderate amount of lime on land has a beneficial effect. Lime is of special value where there is a great deal of vegetable matter, as such land is inclined to be too acid, and lime corrects the acid condition. The quantity of lime applied depends, of course, upon the character of the soil. Too much lime is a detriment to the land. As a general rule from 40 to 50 bushels per acre after being slacked is about the right amount. Where the land contains a great deal of vegetable matter, such as muck land, and lands where a large amount of vegetable matter has been turned over, where lands are not properly drained, and inclined to be sour, as much as from 100 to 200 bushels per acre may be applied. In England many years ago, where land was not properly drained a great deal of lime was used, but since the land has been drained, very little lime is used. It is not necessary to apply lime every year; once in every three or four years is sufficient. The effect of lime is different on different crops. It has proven to be of much help to cantaloupes, where it seemed to be a positive hurt to watermelons on the same land. It will be of help to wheat, but its effect will not be noticeable on rye.

using lime it should be slacked in such a way that the air will not get to it any more than possible. Some farmers scoop out a hole in the field, and place four or five bushels in there and cover it with dirt. The dirt slacks the lime if it is moist. If the dirt is not moist enough, water is placed on the lime just before it is covered up.

LAND PLASTER.

Land plaster is a combination of 33 per cent. lime, 46 per cent. sulphuric acid, and 21 per cent. water. The action of land plaster is not well understood. It appears to have an indirect action on the plants, and by some is highly recommended. It is of special value on peas, vetches and other leguminous plants. Some authorities claim that it pays on all crops, but experiments made at some of the stations do not prove

red clay land, which contains a large amount of potential potash, than it will on sandy land which contains a comparatively small amount of this element. The sandy soil requires more potash in the fertilizer to give the same results. This shows again very clearly the necessity that the farmer study his soil so that he may be in a position to apply his fertilizers intelligently.

Land plaster may seem to sterilize a soil, by helping to exhaust its supply of potash. An application of this element in the shape of kainit, muriate, or sulphate of potash would correct the trouble.

FISH AS A FERTILIZER.

On the coast where fish are plentiful, that is, what is called, "trash" fish, they have been found to be very beneficial as fertilizers. Many fish are caught

Fig. 7.—Cotton Field. No Fertilizer. Yield 740 lbs. Seed Cotton per acre. Phillip Lee, Gift, N. C.

Fig. 8.—Cotton Field. Treated with Fertilizer, containing 8 per cent. Phosphoric Acid, 3 per cent. Nitrogen, 6 per cent. Potash. Yield 1120 lbs. Seed Cotton per acre. Phillip Lee, Gift, N. C.

this assertion to be correct. We see very little reason for the Southern farmer to buy land plaster, when he can get all he needs of this element with his acid phosphate.

When it is understood that acid phosphate is one-half sulphur of lime, or land plaster, and that it costs practically nothing when one is purchasing phosphoric acid any way, the talk about the use of land plaster will, we think, subside.

The effect of this land plaster in a fertilizer composed largely of acid phosphate by making potash available in the soil accounts in a measure for the fact that such a fertilizer will give better results on

that have no value in the markets, and these are used to make fertilizers. Dig out a hole say eight or ten feet square and two or three feet deep, place in a layer of fish about eight inches thick, and cover over with a layer of sand or dirt, and pack tightly, then place another layer of fish and sand as before, and keep on until you are about three feet above the ground, and then put on a very heavy layer of sand, and be sure that it is tight all around. Leave it there for six months, and then dig out whatever is needed. This fertilizer is of great value on truck farms, and is said to do the crops more good than a fertilizer that

would cost \$40.00 per ton, especially for beans. The fish that have no sale in the market, if properly used as above directed, are said to be worth as much as those that are sold.

FERTILIZER FORMULAS.

It is a very difficult thing for a great many farmers to work out fertilizer formulas. An 8-2-2 fertilizer is used more for cotton perhaps than any other. But many farmers do not know what "8-2-2" means. It means that the fertilizer of that formula has 8 per cent. phosphoric acid, 2 per cent. potash and 2 per cent. nitrogen. But some do not know what we mean when we say that the fertilizer contains 8 per cent. phosphoric acid. When we say that a fertilizer analyzes 8 per cent. phosphoric acid, 2 per cent. potash, and 2 per cent. nitrogen, we mean that one hundred pounds of this fertilizer has in it 8 pounds phosphoric acid, 2 pounds potash and 2 pounds nitrogen. In 100 pounds of fertilizer that analyzes 8-2-2 there are only twelve pounds of plant food in it. That leaves 88 pounds of matter and the question comes, What is this 88 pounds? It is what is known as a "filler." A "filler" is any substance that is put into a fertilizer, or exists there naturally, which is not a plant food. There are two kinds of fillers, natural and artificial. A natural filler is one that is placed there by nature. For instance, in cotton-seed meal, it is not all nitrogen, indeed only a small part of it is nitrogen. There is some phosphoric acid, and some potash, and other matters in a small quantity. The artificial filler is one placed there by man, for the purpose of reducing the total percentage of plant food contained in the fertilizer. The material used for artificial fillers are numerous, such as sand, powdered cinders, slate, marl, gypsum. These fillers have no value as plant food, and are only valuable as fillers. But why are they used, asks some man. To show the use of artificial fillers, suppose a fertilizer factory gets an order for a fertilizer that will analyze 8-2-2. He does not happen to have on hand cotton-seed meal, kainit, and South Carolina phosphate, but instead he only has the highest price goods on the market, such as Florida phosphate, which contains 20 per cent. available phosphoric acid; nitrate of soda which contains 16 per cent. nitrogen; dried blood which contains 14 per cent. nitrogen; sulphate of ammonia with 20 per cent. nitrogen; muriate of potash which contains 50 per cent. potash. Now, with

these materials on hand he must make a fertilizer that will have 12 pounds of plant food to the hundred, or 240 pounds to the ton. He figures out that with the material on hand he gets this formula:

825 pounds of 20 per cent. acid phosphate will give 165 pounds acid.
 215 pounds of 14 per cent. dried blood will give 30 pounds Nitrogen.
 75 pounds of 16 per cent. nitrate soda will give 12 pounds Nitrogen.
 85 pounds of 50 per cent. muriate of potash will give 42 pounds Potash.

If a man wanted an 8-2-2 fertilizer he would want 8 pounds of available phosphoric acid in every hundred pounds of the fertilizer, which would mean that he wants 160 pounds in phosphoric acid in a ton. The analysis given above makes it 165 pounds of phosphoric acid, and this is thrown in to be sure that it will meet the test. He wants two pounds of nitrogen in each hundred, or 40 pounds of nitrogen in a ton of the fertilizer. He wants 2 pounds of potash in a hundred pounds of fertilizer, or 40 pounds in a ton of fertilizer. The dried blood and nitrate of soda will make 42 pounds of nitrogen as shown above, and the muriate of potash will give 42 pounds of potash. But when we add up, we find that we have only used 1,200 pounds of acid phosphate, dried blood, nitrate of soda, and muriate of potash, all together. Now, in this 1,200 pounds of fertilizer he has the 160 pounds of phosphoric acid that the formula called for and the 40 pounds of nitrogen and the 40 pounds of potash that the formula called for, but in all he has but 1,200 pounds of fertilizer. In fact, he has given you a little more than is called for. But he can not sell this 1,200 pounds of fertilizer to you for the same price that he could if it only analyzed 8-2-2, for it will analyze more than that, and these chemicals that we used cost him more than they would had they been such that it would had 2,000 pounds been required to produce an 8-2-2 fertilizer. In other words, the chemicals are stronger, and, therefore, more costly. In fact, the farmers require a ton of fertilizer that will analyze 8-2-2, and instead of taking this 1,200 pounds of fertilizer and using it over the same ground, he uses the ton over, he has the factory to haul in 800 pounds of slate, cinders, and other worthless trash and mixes with this 1,200 pounds of fertilizer. When the fertilizer is analyzed after the cinders are mixed with it, it analyzes available phosphoric acid 8.25 per

cent., nitrogen 2.10 per cent. and potash 2.12 per cent. The man who has lost is the farmer, for the factory is going to have him pay for hauling those cinders, and mixing them in, and they must pay the railroad freight, so the farmer has lost. Now would it not have been better for you to have bought 1,200 pounds that would analyze 13.75 per cent. available phosphoric acid, 3.50 per cent. nitrogen, and 3.54 per cent. potash. The only difference between the two is that in getting a ton that analyzes 8-2-2 and 1,200 pounds of 13.75, 3.50 and 3.54 is that you save the expense of mining, pulverizing and freighting, mixing the artificial filler, such as cinders, and this, remember, is 800 pounds, and then the freight on the 800 pounds of filler from the factory to your railroad station, and then the hauling it out to your home, and handling it. It would have been much better to have bought 1,200 pounds, and mixed in the 800 pounds when you got home, say, mix compost, or if nothing better, sand. The analysis of the percentages of plant food contained in fertilizer ingredients is figured on the ton basis, hence a 16 per cent. acid phosphate means 16 pounds of phosphoric acid to the 100 pounds, or 320 pounds to the ton. Kainit runs 12 1-2 per cent. actual potash and will give you 50 pounds potash in 400 pounds of the material. Muriate of potash contains 50 per cent. potash.

Nitrate of soda contains 20 per cent. of ammonia or 20 pounds of ammonia in each hundred pounds. Cotton-seed meal contains 8 per cent. of ammonia and in 500 pounds of meal you have 40 pounds of ammonia. Now if you want a mixture to contain 2 per cent. of ammonia in mixing a ton, use 500 pounds cotton-seed meal, which will give you 40 pounds of ammonia or 2 per cent. in 2,000 pounds.

If you want 8 per cent. of phosphoric acid, then use in the mixture 1,000 pounds of acid phosphate analyzing 16 per cent. To get 2 per cent. potash in a ton use 320 pounds of kainit or 80 pounds of muriate of potash.

The analysis of fertilizers is so important, and gives so many farmers trouble, that we will give another example. Suppose for some reason that you want a fertilizer that will analyze 4 per cent. nitrogen, 6 per cent. potash, and 7 per cent. phosphoric acid. This means that every hundred pounds of fertilizer you prepare will contain 4 lbs. nitrogen, 6 lbs. potash and 7 pounds phosphoric acid. In the 200 pounds of fertilizer you would need double that amount, or 8

pounds nitrogen, 12 pounds of potash and 14 pounds of phosphoric acid, 100 pounds 14 per cent. acid phosphate would furnish you the necessary available phosphoric acid, and 24 pounds of muriate of potash will supply the 12 pounds of actual potash. This leaves 76 lbs. to complete your 200 pounds in which you must have the 8 pounds of nitrogen, and as cotton-seed meal only contains about 7 pounds to the hundred, you would not be able to get this nitrogen from the meal alone; but must use either high-grade blood or nitrate of soda, at least in part; as the blood contains about 16 per cent. of nitrogen, or 16 pounds to the hundred, 50 pounds of it would furnish you the 4 per cent. nitrogen you need to make your fertilizer complete. You could then add 26 pounds of dirt to complete 200 pounds. If you use cotton-seed meal, the 76 pounds will only contain about 5 pounds of nitrogen; so that your fertilizer will only analyze 2 1-2 per cent. of this element. Nitrate of soda contains about the same per cent. of nitrogen as blood, and can be substituted for blood, but would not be as lasting. If you must use meal, acid phosphate and kainit, you would not be able to make a fertilizer analyzing as high as you desire; as these materials do not carry the sufficient amount of the necessary elements. In using these it will be necessary to reduce the analysis pro rata and use more of the fertilizer per acre.

You can figure out per cent. very easy when you understand that kainit carries 12 pounds or 12 per cent. of potash to the hundred; cotton-seed meal 8 pounds or 8 per cent. of ammonia equal to about 7 per cent. nitrogen, and acid phosphate 14 per cent. carries 14 pounds to the hundred of phosphoric acid. In making a fertilizer we take the requisite amount of the different materials carrying the plant food we wish our fertilizer to contain, always remembering that the number of pounds of each kind of plant food put in must be divided by the total number of pounds of fertilizer mixed up to give you the analysis of the whole.

CHEMICAL ANALYSIS OF THE SOIL.

It was at one time thought to be of great value to a farmer for a chemist to make an analysis of the soil, and see in what the soil is deficient. It has been demonstrated that this idea is not of so much practical importance when it is tested. For instance, it was found by chemical analysis that a certain soil

contained about one-tenth of one per cent. phosphoric acid, or calculating to a depth of nine inches about 3,000 pounds of phosphoric acid per acre, and yet the crop on that land was suffering for phosphoric acid. The truth of the matter is, that the phosphoric acid that was on the soil was not available for the plant roots. So a chemical analysis may show that the soil contains a sufficient quantity of a plant food, when actual test by experience proves that the land is in need of that very plant food. For a plant food to be of any service to the plant it must be soluble in water. You may experiment with your land and determine in what manner just what the land needs. The following plan has been suggested, and will prove of much benefit to the farmer if they will try it:

Fig. 9.—Cotton Field. No Fertilizer. Yield 581 lbs. Seed Cotton per acre. J. M. Jones, Bournham, Miss.

fertilizer in one plot may not be felt in an adjoining plot. It would be well to locate these experimental plots on some of your poorest land, or that which stands most badly in need of fertilizer. When all is ready, carefully number the plots from one to ten so that you may keep a record of the nature and amount of fertilizer applied on each plot. Let us suppose that you decide to plant cotton on the ten prepared plots for the purpose of finding out what fertilizing constituent is most needed by your soil when growing cotton. Plant the cotton in your usual manner, after a careful preparation of the soil of the plots, thoroughly ploughing and harrowing the plots in order. Then apply the fertilizers as follows:

Fig. 10.—Cotton Field. Treated with Fertilizer, containing 8 per cent. Phosphoric Acid, 3 per cent. Nitrogen, 6 per cent Potash. Yield, 1,520 lbs. Seed Cotton per acre. J. M. Jones, Bournham, Miss.

METHOD BY WHICH THE FARMER MAY ANALYZE HIS OWN SOIL.

First, select a piece of ground as level as possible, so that rain may not wash the fertilizer from one plot into an adjoining plot. Secondly, for the purpose of the experiment, mark off ten plots, each just one-tenth of an acre in area. If convenient make the plots long and narrow, say one hundred and thirty-six feet long by thirty-two feet wide; these dimensions would enable you to have eight long rows, four feet apart, in each plot. Any other shape of plot will answer, only be careful to lay off the plots so that they shall each contain one-tenth of an acre, or 4,356 square feet. Separate the plots from each other by paths at least three feet wide, so that the effect of

- No. 1.—No fertilizer.
- No. 2.—143 pounds of cottonseed meal.
- No. 3.—200 pounds of 14 per cent. acid phosphate.
- No. 4.—80 pounds of kainit.
- No. 5.—No fertilizer.
- No. 6.—200 pounds of acid phosphate and 143 pounds of cottonseed meal.
- No. 7.—143 pounds of cottonseed meal and 80 pounds of kainit.
- No. 8.—200 pounds of acid phosphate and 80 pounds of kainit.
- No. 9.—200 pounds of acid phosphate, 80 pounds of kainit and 143 pounds of cottonseed meal.
- No. 10.—500 pounds air-slaked lime.

In many of our Georgia soils lime is sadly lacking, and it may be just the thing needed by the soil, in conjunction with certain other fertilizers. To discover

if this be the case, after having fertilized plot No. 2, mark off a strip 2 1-2 feet in width diagonally across the plot, that is, running from one corner to the opposite corner. Apply to this strip 50 pounds of air-slacked lime, and work it in well with the soil and other fertilizer with a rake. Do the same with each of the other plots, omitting No. 10. Then when the crop begins to grow, if lime was specially needed by the soil in any of the plots, you ought to notice a marked superiority in the two and a half foot strip which runs diagonally across all the rows in all nine plots.

In the above fertilizers it is presumed that the acid phosphate is the kind most usually sold, containing 14 per cent. of available phosphoric acid, so that 200 pounds supplies 28 pounds of actual phosphoric acid to the plot.

The cotton-seed meal is presumed to contain 7 per cent. of nitrogen so that 143 pounds of it supplies 10 pounds of nitrogen to the plot, and the kainit to contain 12 1-2 per cent. of potash, so that 80 pounds yield 10 pounds of potash to the plots the kainit is applied to.

In applying the fertilizers observe the following precautions: Sow each fertilizer on the plot to which it is to be applied broadcast, using your best care and judgment to distribute the fertilizer evenly over the entire plot. In order to get an even distribution it is best to sow in such quantity that you will have to go over each plot at least twice to get all the fertilizer distributed. Take care not to sow while the wind is blowing, as it may blow some of the fertilizer on to the adjoining plots. After sowing, harrow the ground, and then it will be ready for you to plant.

Plant thick enough to insure a perfect stand. Treat all the plots exactly alike, except as to the fertilizers applied. Prepare the ground in each plot the same, plant the cotton all at the same time, and always cultivate the same and at the same time each day. Take pains to have the same number of plants in each row. It will be well to keep a notebook with a page for each plot in which to record your observations.

In this book record: 1st. The kind of fertilizer applied to each plot and the amount applied, on the page set apart for the respective plots from 1 to 10. 2nd. Note down the date the cotton was planted. 3rd. Note the date the cotton came up in each plot. 4th. When the cotton is about two inches high on the plot containing no fertilizer, note the height and

appearance of the other plots. 5th. After you have thinned out to a uniform stand, record the number of missing plants, if any, in each plot. Of course, use every endeavor to have the same number of plants in each plot, but in case of accident to some, be sure to put down the number missing in any plot so as to make allowances. 6th. Record any other observations of interest during the growth of the crop on the different plots, such as the comparative dates of blooming, number of bolls to the stalk, date of opening of the bolls, height of the stalks after maturity of the plant. 7th. Keep the seed cotton from each plot to itself, weigh it by itself, and record the weight of the seed cotton from plot No. 1 on page No. 1, and so on with the others. When you have picked and weighed the last pound of cotton, then you will, I think, be able to decide for yourself what fertilizer or combination of fertilizers your land requires. Of course, if you have a bad season, very dry or very wet, you will not be able to decide so well, and in that case repeat the experiment another year. In this way you can analyze your own soil and do it better than the best chemist in the world can do it for you, because you have appealed to the soil itself; you have spoken to it in the language of nature, and it has replied in the same mute, but eloquent tongue, demonstrating the truth of her answers before your very eyes. The above is taken from Bulletin No. 42 Georgia Experiment Station.

You can form some idea of what your soil needs by the way your crops grow. If the plants are dark green and grow off rapidly it shows that ammonia is abundant, and if they are pale or yellowish in appearance ammonia is needed. If the plant seems weak and easily affected by disease, potash is needed, also when crops do not fill out well, or the lint on cotton-seed is light, potash is lacking. Phosphoric acid makes the plant fruit early and heavily, and has a general tendency to bring crops to early maturity. White lint cotton contains very little plant food, the principal element of which it is composed is potash, and if we want a heavy yield of lint cotton we must be sure this element is well represented in our fertilizer.

For the benefit of the farmer who can not work out the formula, we give several here for different crops. The average farmer believes in a fertilizer that will analyze 8 per cent. phosphoric acid, 2 per cent. nitrogen, and 2 per cent. potash. The following formulas will come up to that analysis:

TILLING THE SOIL FOR PROFIT AND PLEASURE.

No. 1.

Acid	1200 lbs.
Cotton-seed meal	600 lbs.
Kainit	200 lbs.

If you wish to substitute cotton seed for the meal, you will use:

No. 2.

Cotton Seed	1200 lbs.
Acid	600 lbs.
Kainit	200 lbs.

No. 3.

Acid Phosphate, (14 per cent.)	1150 lbs.
Cotton-seed meal	500 lbs.
Kainit	320 lbs.
Total	1970 lbs.

No. 4.

Acid Phos. (15 per cent.)	1100 lbs.
Cotton-seed meal	500 lbs.
Muriate of Potash	80 lbs.
Filler of Dry Sand	320 lbs.
Total	2000 lbs.

No. 5.

Acid Phos. (16 per cent.)	1000 lbs.
Dried Blood	250 lbs.
Muriate of Potash	80 lbs.
Filler of Dry Sand	670 lbs.
Total	2000 lbs.

No. 6.

Acid Phos. (16 per cent.)	1000 lbs.
Nitrate of Soda	200 lbs.
Muriate of Potash	80 lbs.
Filler of Dry Sand	720 lbs.
Total	2000 lbs.

The analysis of the above four last formulas when mixed with shovels and hoes would be as follows:

Phosphoric Acid	8.00 per cent.
Ammonia	2.00 per cent.
Potash	2.00 per cent.
Total	12.00 per cent.

Or in other words, a regular 8-2-2 complete Commercial Fertilizer containing 240 pounds of plant food to the ton.

Fertilizers that will analyze 9-3-4 are quite popular, and the following formulas will analyze that proportion. These formulas are suitable for cotton, as a general rule:

No. 7.

Acid Phosphate (16 per cent.)	1100 lbs.
Cotton-seed meal	750 lbs.
Muriate of Potash	160 lbs.
Total	2010 lbs.

No. 8.

Acid Phosphate (15 per cent.)	1250 lbs.
Dried Blood	375 lbs.
Muriate of Potash	160 lbs.
Filler of Sand	215 lbs.
Total	2000 lbs.

No. 9.

Acid of Phosphate (20 per cent.)	900 lbs.
Cotton-seed Meal	750 lbs.
Muriate of Potash	160 lbs.
Filler of Sand	190 lbs.
Total	2000 lbs.

The above three formulas when mixed will analyze as follows:

Phosphoric Acid	9.00 per cent.
Ammonia	3.00 per cent.
Potash	4.00 per cent.
Total	16.00 per cent.

We also give another list of formulas which are excellent for cotton. No formula can be said to have any special value over the others. The farmer should use the one that he can get the easiest. Each one will analyze 20 pounds nitrogen, 50 pounds of phosphoric acid, and 15 pounds potash in the whole formula.

No. 10.

Muriate of Potash	30 lbs.
Acid Phosphate	334 lbs.

Nitrate of Soda 125 lbs.

No. 11.

Muriate of Potash 20 lbs.
 Acid Phosphate 281 lbs.
 Cotton-seed meal 286 lbs.

No. 12.

Cotton-seed Hull Ashes 45 lbs.
 Acid Phosphate 261 lbs.
 Cotton-seed meal 286 lbs.

No. 13.

Wood Ashes (unleached) 164 lbs.
 Acid Phosphate 261 lbs.
 Cotton-seed meal 286 lbs.

No. 14.

Kainit 64 lbs.
 Acid Phosphate 273 lbs.
 Cotton-seed meal 143 lbs.
 Cotton seed 13½ bus.

No. 15.

Acid Phosphate 266 lbs.
 Nitrate of Soda 13 lbs.
 Stable Manure 4000 lbs.

No. 16.

Muriate of Potash 30 lbs.
 Acid Phosphate 334 lbs.
 Dried Blood 167 lbs.

No. 17.

Muriate of Potash 10 lbs.
 Acid Phos. with Pot. (2 per cent. K
 Cotton-seed meal 286 lbs.

No. 18.

Kainit 58 lbs.
 Acid Phosphate 300 lbs.
 Nitrate of Soda 70 lbs.
 Stable Manure 2000 lbs.

No. 19.

Muriate of Potash 20 lbs.

Acid Phosphate 300 lbs.
 Nitrate of Soda 64 lbs.
 Cotton seed 13½ bus.

No. 20.

Kainit 45 lbs.
 Acid Phosphate 264 lbs.
 Cotton seed 26-2-3 bus.

Commercial Fertilizer to analyze as below:
 Available Phosphoric Acid 10.00 per cent.
 Ammonia 4.85 per cent.
 Use 500 pounds per acre.

The formulas from 10 to 20 inclusive are intended for land that is about worn out.

For cotton on the red hills, and the soil similar to red hills, we would advise that you use the following:

No. 21.

Acid Phosphate, 16 per cent. 1100 lbs.
 Cotton-seed meal 750 lbs.
 Muriate of Potash 80 lbs.

Total 2000 lbs.

In mixing your fertilizers weigh out the required amount of each ingredient necessary to make a given part of one ton, say 500 pounds. Mix with hoes or shovels on a tight floor or on a smooth, hard place on the ground.

For gray soil with clay near the top of the ground, the following makes a good fertilizer for cotton:

No. 22.

Acid Phosphate 1125 lbs.
 Cotton-seed meal 750 lbs.
 Muriate of Potash 125 lbs.

This formula when mixed, will analyze as follows:
 Phosphoric Acid 9.00 per cent.
 Ammonia 3.00 per cent.
 Potash 3.00 per cent.

For sandy soils:

No. 23.

80 to 120 lbs. cotton-seed meal per acre.

160 to 240 lbs. acid phosphate per acre.
 40 to 60 lbs. kainit per acre.
 280 to 420 lbs. total per acre.

For the level lands of the Southern long leaf pine region:

No. 24.

60 to 120 lbs. cotton-seed meal per acre.
 120 to 240 lbs. acid phosphate per acre.
 60 to 80 lbs. kainit per acre.
 240 to 440 lbs. total per acre.

For any well drained soil on which cotton is known to be especially liable to black rust:

No. 25.

120 to 160 lbs. cotton-seed meal per acre.
 80 to 120 lbs. acid phosphate per acre.
 80 to 120 lbs. kainit per acre.
 280 to 400 lbs. total per acre.

For red bottom land, the following makes an excellent fertilizer for cotton:

No. 26.

Acid Phosphate (18 per cent.)	777 lbs.
Cotton-seed meal	500 lbs.
Nitrate of Soda	100 lbs.
Muriate of Potash	75 lbs.
Total	1452 lbs.

The above would analyze 10.50 phosphate, 3.51 nitrate, 3.10 potash.

I would apply the whole amount of the above formula entirely and apply about 250 pounds to the acre in the furrow, with the planting seed, at the time of planting. All the ingredients, except the nitrate of soda, should be applied at least two weeks before planting time; but the nitrate of soda should not be applied so long in advance.

For worn cut creek bottoms, we recommend the following for cotton:

No. 27.

Acid Phosphate (14 per cent.)	100 lbs.
Cotton-seed meal	700 lbs.
Muriate of Potash	75 lbs.

Use 400 pounds or more per acre. The fertilizer

should be applied about two weeks before planting.

WHEAT FERTILIZERS.

The fertilizer analyses as given above are good for wheat on the same kind of lands, except that the acid phosphate should be decreased to one-half of what is given for cotton. Also when using these fertilizers, the nitrate of soda should not be mixed with the other ingredients, but it should be reserved and applied as a top dressing in the spring.

The Experiment Station at Bouregard, France, gives the following formula for wheat:

No. 28.

Acid Phosphate	350 lbs.
Sulphate of Ammonia	130 lbs.
Muriate of Potash	90 lbs.

This should be applied when the wheat is sown, and is enough for one acre. Early in the spring 90 pounds of nitrate of soda should be applied as a top dressing.

The following is a general formula for wheat, oats, and other small grains, and grasses:

No. 29.

Cotton-seed meal	800 lbs.
Acid Phosphate	1000 lbs.
Kainit	200 lbs.

Use 200 to 600 lbs. per acre.

No. 30.

Acid Phos. (20 per cent.)	900 lbs.
Cotton-seed meal	1000 lbs.
Muriate of Potash	120 lbs.
Total	2020 lbs.

9-4-3 Formula.

No. 31.

Acid Phos. (16 per cent.)	1125 lbs.
Dried Blood	500 lbs.
Muriate of Potash	120 lbs.
Filler of Sand	255 lbs.
Total	2000 lbs.

These formulas when mixed will analyze as follows:

Phosphoric Acid	9.00 per cent.
Ammonia	4.00 per cent.
Potash	3.00 per cent.
Total	16.00 per cent.

Top dress wheat and oats in the month of March with 75 pounds nitrate of soda broadcast per acre.

CORN FERTILIZERS.

Most farmers are of the opinion that corn does not need fertilizers, and hence they use all their money to fertilize cotton and buy corn. If they would put more fertilizers to corn, and give it better attention they will come nearer paying out of debt than some of them are doing now. The following formulas are offered as general formulas:

No. 32.

Cotton-seed meal	200 lbs.
Acid Phosphate	1600 lbs.
Kainit	200 lbs.
Use 200 up to 1000 lbs. per acre.	

No. 33.

Acid Phos. (15 per cent.)	1250 lbs.
Dried Blood	375 lbs.
Muriate of Potash	80 lbs.
Filler of Sand	295 lbs.
Total	2000 lbs.

9-3-2 formula.

No. 34.

Acid Phos. (16 per cent.)	1125 lbs.
Cotton-seed meal	750 lbs.
Muriate of Potash	80 lbs.
Total	1955 lbs.

These formulas when mixed will analyze as follows:

Phosphoric Acid	9.00 per cent.
Ammonia	3.00 per cent.
Potash	2.00 per cent.
Total	14.00 per cent.

For corn on the average worn and so-called "exhausted" upland soils:

No. 35.

Acid Phosphate (14 per cent.)	1000 lbs.
Cotton meal (2 1-2:7:1 1-2)	1250 lbs.
Muriate of Potash (50 per cent.)	30 lbs.
(Or Kainit: 12 1-2 per cent., 120 lbs.)	

Total2280 lbs.

This would analyze as follows:

Available Phosphate Acid	7.50 per cent.
Nitrogen, (equal to ammonia 4.65)	3.83 per cent.
This is relatively the same as 10:5:2.	

The mixture would be rendered more prompt in effective action by substitution in place of 40 pounds of the cotton meal, about 200 pounds of nitrate of soda. The practice is to apply about 20 to 30 pounds of nitrate per acre at the time of planting, scattering a small pinch of it not nearer than three to four inches of seed corn.

For corn on well improved upland, or on old bottom land, or fresh lands:

No. 36.

Acid Phosphate (14 per cent.)	1000 lbs.
Cotton meal (2 1-2:7:1 1-2)	870 lbs.
Muriate of Potash (50 per cent.)	30 lbs.
(Or Kainit: 12 1-2 per cent., 120 lbs.)	

Total1900 lbs.

This would analyze about as follows:

Available Phosphoric Acid	8.50 per cent.
Nitrogen (equivalent to ammonia 3.90)	3.21 per cent.
Potash (20)	1.47 per cent.

On freshly cleared soil, or well improved old uplands, or cotton, if only a light application is intended the potash may be left out entirely and the cotton meal still further proportionately reduced in quantity.

In view of the caution against applying a large quantity of commercial fertilizers to corn, it may be stated that 300 pounds of the above formula may be considered the maximum amount for one acre of land.

For water melons and sweet potatoes apply the following fertilizers:

9-3-9 formula.

No. 37.

Acid Phosphate (20 per cent.)	900 lbs.
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TILLING THE SOIL FOR PROFIT AND PLEASURE.

Cotton-seed meal 750 lbs.
 Muriate of Potash 360 lbs.
 Total 2010 lbs.
 9-3-9 formula.

No. 38.

Acid Phos. (16 per cent.) 1125 lbs.
 Dried Blood 375 lbs.
 Muriate of Potash 360 lbs.
 Filler of Sand 140 lbs.
 Total 2000 lbs.
 9-3-9 formula.

No. 39.

Acid Phos. (15 per cent.) 1250 lbs.
 Nitrate of Soda 300 lbs.
 Muriate of Potash 360 lbs.
 Total 1910 lbs.

These formulas when mixed will analyze as follows:

Phosphoric Acid 9.00 per cent.
 Ammonia 5.00 per cent.
 Potash 9.00 per cent.
 Total 21.00 per cent.

No. 40.

Acid Phosphate 800 lbs.
 Muriate of Potash 200 lbs.
 Nitrate of Soda 400 lbs.

No. 41.

Acid Phosphate (14 per cent.) 1000 lbs.
 Cotton meal 500 lbs.
 Nitrate of Soda 250 lbs.
 Sulphate (or muriate of Potash) 250 lbs.
 Total 2000 lbs.

No. 42.

Cotton-seed meal 600 lbs.
 Acid Phosphate 1000 lbs.
 Kainit 400 lbs.
 Use 600 to 2000 lbs. per acre.

No. 43.

70 lbs. Cotton-seed meal.

800 lbs. Acid Phosphate; 13 per cent.
 200 lbs. Nitrate of Soda.
 300 lbs. Muriate of Potash.

This will give you ammonia 5.9 per cent; phosphoric acid, 6.4 per cent.; potash, 7 per cent.

No. 44.

Phosphoric acid, 7 per cent.
 Potash, 8 per cent.
 Cotton-seed meal, 800 pounds.
 Acid Phosphate (high grade,) 900 lbs.
 Muriate of Potash, 300 lbs.

This will make a ton of the above fertilizer. Mix thoroughly until the whole mass is of an even color throughout, being careful to pound up all lumps.

If you can apply your fertilizer two or three weeks in advance of planting, use the fertilizer without the cotton-seed meal, but if you have to plant and fertilize at the same time, use the one containing the cotton-seed meal.

FRUIT TREES.

A good fertilizer for fruit trees can be made as follows:

No. 45.

1000 lbs. cotton-seed meal.
 300 lbs. nitrate of soda.
 700 lbs. acid phosphate.

TOBACCO FERTILIZER.

The subject of fertilizers for tobacco is treated under the head of tobacco growing, as it is of so much importance, it is thought best to treat that subject under that head.

FERTILIZERS FOR TRUCK FARMING.

The truck farmer must get his crop in early if he expects to make a success. It is of great importance therefore that he use the very best grade of guano. The farmer who is dependent upon early crops may afford to buy poor fertilizers, but this is doubted, but the truck farmer must not be content. When we speak of a high-grade fertilizer, of course, it is understood that we mean one that is available at once,

and not one that will be available next month or next year. The all round garden fertilizer should have about 20 per cent. phosphoric acid, from 10 to 14 per cent. nitrogen, and from 40 to 50 per cent. potash. The following table gives the amount that should be used in an area smaller than an acre, for the average gardener does not want to figure on the acre.

FRUITS.	Pounds per plant	Pounds per Square Rod	Pounds per acre
Apples	5.5	3.8	600
Blackberries	0.4	4.4	700
Cherries	4.5	5.6	900
Cranberries	0.25	3.1	500
Currants	0.25	3.8	600
Hooseberries	0.25	3.8	600
Grapes	1.3	5.0	800
Peaches	5.0	6.25	1000
Pears	5.5	3.8	600
Plums	4.5	5.6	900
Quinces	2.25	4.4	700
Raspberries	0.25	5.0	800
Strawberries	0.4	10.0	1600

The following formulas are said to be excellent for truck growers:

For celery: 7 per cent. Ammonia, 5 per cent. Available Phosphoric Acid, 8 per cent. Potash.

No. 46.

300 lbs. Nitrate of soda,	} WILL YIELD	
800 lbs. Fish scrap		
600 lbs. Acid phos. 13 per cent.		6.9 per cent. Ammonia
300 lbs. Muriate potash.		5.5 per cent. Avail. Phos. acid.
2000 lbs.		8.0 per cent. Potash

No. 47.

250 lbs. Nitrate of soda	} WILL YIELD	
600 lbs. Dried blood		
850 lbs. Acid phosphate, 13 per cent.		7.2 per cent. Ammonia
300 lbs. Muriate potash		5.5 per cent. Avail. phos. acid
2000 lbs.		7.8 per cent. Potash

For Irish potatoes: 6 per cent. Ammonia, 7 per cent. Available Phosphoric Acid, 8 per cent. Potash.

No. 48.

300 lbs. Nitrate of soda	} WILL YIELD	
600 lbs. cotton seed meal		
800 lbs. Acid phos.		5.4 per cent. Ammonia
300 lbs. Muriate potash		7.2 per cent. Avail. phos. acid
2000 lbs.		8.1 per cent. Potash

No. 49.

300 lbs. Nitrate soda	} WILL YIELD	
600 lbs. Fish scrap		
800 lbs. Acid phos.		5.8 per cent. Ammonia
300 lbs. Muriate potash		6.8 per cent. Avail. phos. acid
2000 lbs.		7.9 per cent. Potash

No. 50.

200 lbs. Nitrate soda	} WILL YIELD	
900 lbs. Fish scrap		
600 lbs. Dissolved bone black		6.4 per cent Ammonia
300 lbs. Muriate Potash		6.6 per cent. Avail. phos. acid
2000 lbs.		7.8 per cent. Potash

No. 51.

220 lbs. Nitrate soda	} WILL YIELD	
500 lbs. Dried Blood		
970 lbs. Acid phos. 14 per cent.		6.1 per cent. Ammonia
310 lbs. Muriate potash		6.8 per cent. Avail. phos. acid
2000 lbs.		8.0 per cent. Potash

No. 52.

300 lbs. Nitrate soda	} WILL YIELD	
600 lbs. Tankage		
800 lbs. Acid phos., 13 per cent.		5.4 per cent. Ammonia
300 lbs. Muriate potash		6.0 per cent. Avail phos. acid
2000 lbs.		8.3 per cent. Potash

No. 53.

360 lbs. Nitrate soda	} WILL YIELD	
600 lbs. Tankage		
800 lbs. Acid phos., 13 per cent.		5.5 per cent. Ammonia
300 lbs. Sulph. pot. H. G.		6.4 per cent. Avail. phos. acid
2000 lbs.		7.8 per cent. Potash

For beets and lettuce: 6 per cent Ammonia, 5 per cent. Available Phosphoric Acid, 8 per cent. Potash.

No. 54.

300 lbs. Nitrate soda	} WILL YIELD	
800 lbs. Cottonseed meal		
600 lbs. Acid phos., 13 per cent.		6.2 per cent. Ammonia
300 lbs. Muriate potash		4.9 per cent. Avail. phos. acid
2000 lbs.		8.5 per cent. Potash

No. 55.

200 lbs. Nitrate soda	}	WILL YIELD
800 lbs. Fish scrap		
700 lbs. Acid phos., 11 per cent.		
300 lbs. Muriate potash		
2000 lbs.		
		5.9 per cent. Ammonia
		5.4 per cent. Avail. phos. acid
		8.5 per cent. Potash

For cabbage, cauliflower, cucumbers and melons: 6 per cent. Ammonia, 5 per cent. Available Phosphoric acid, 6 per cent. Potash.

No. 56.

300 lbs. Nitrate soda	}	WILL YIELD
750 lbs. Cottonseed meal		
700 lbs. Acid phos., 11 per cent.		
250 lbs. Muriate potash		
2000 lbs.		
		6.0 per cent. Ammonia
		4.8 per cent. Avail. phos. acid
		7.1 per cent. Potash

For Spinach: 5 per cent. Ammonia, 8 per cent. Available Phosphoric Acid, 6 per cent. Potash.

No. 57.

200 lbs. Nitrate soda	}	WILL YIELD
650 lbs. Fish scrap		
920 lbs. Acid phos., 14 per cent.		
230 lbs. Muriate Potash		
2000 lbs.		
		5.2 per cent. Ammonia
		7.7 per cent. Avail. phos. acid
		6.0 per cent. Potash

No. 58.

300 lbs. Nitrate of soda	}	WILL YIELD
500 lbs. Cottonseed meal		
1000 lbs. Acid phos., 14 per cent.		
200 lbs. Muriate potash		
2000 lbs.		
		5.0 per cent. Ammonia
		7.6 per cent. Avail phos. acid
		5.6 per cent. Potash

For radishes and turnips: 5 per cent. Ammonia, 7 per cent. Available Phosphoric Acid, 8 per cent. Potash.

No. 59.

250 lbs. Nitrate soda	}	WILL YIELD
550 lbs. Cottonseed meal		
900 lbs. Acid phos. 13 per cent.		
300 lbs. Muriate potash		
2000 lbs.		
		4.6 per cent. Ammonia
		6.5 per cent. Avail. phos. acid
		8.3 per cent. Potash

For asparagus: 5 per cent. Ammonia, 7 per cent. Available Phosphoric Acid, 8 per cent. Potash.

No. 60.

200 lbs. Nitrate soda	}	WILL YIELD
700 lbs. Cottonseed meal		
800 lbs. Acid phos., 13 per cent.		
300 lbs. Muriate potash		
2000 lbs.		
		4.0 per cent. Ammonia
		6.1 per cent. Avail. phos. acid
		8.4 per cent. Potash

For eggplant and tomatoes: 5 per cent. Ammonia, 6 per cent. Available Phosphoric Acid, 7 per cent. Potash.

No. 61.

200 lbs. Nitrate soda	}	WILL YIELD
700 lbs. Cottonseed meal		
840 lbs. Acid phos., 13 per cent.		
260 lbs. Muriate potash		
2000 lbs.		
		4.9 per cent. Ammonia
		6.3 per cent. Avail. phos. acid
		7.4 per cent. Potash

For onions: 5 per cent. Ammonia, 5 per cent. Available Phosphoric Acid, 8 per cent. Potash.

No. 62.

200 lbs. Nitrate soda	}	WILL YIELD
750 lbs. Cotton seed meal		
750 lbs. Acid Phos., 11 per cent.		
300 lbs. Muriate Potash		
2000 lbs.		
		5.1 per cent. Ammonia
		5.1 per cent. Avail. phos. acid
		8.5 per cent. Potash

For sweet potatoes: 3 per cent. Ammonia, 7 per cent. Available Phosphoric Acid, 8 per cent. Potash.

No. 63.

100 lbs. Nitrate soda	}	WILL YIELD
400 lbs. Fish scrap		
1180 lbs. Acid phos., 11 per cent.		
320 lbs. Muriate potash		
2000 lbs.		
		3.5 per cent. Ammonia
		7.8 per cent. Avail. phos. acid
		8.3 per cent. Potash

No. 64.

100 lbs. Nitrate soda	}	WILL YIELD
500 lbs. Cottonseed meal		
1100 lbs. Acid phos., 13 per cent.		
300 lbs. Muriate potash		
2000 lbs.		
		3.5 per cent. Ammonia
		7.8 per cent. Avail. phos. acid
		8.3 per cent. Potash

For beans and peas: 3 per cent. Ammonia, 7 per cent. Available Phosphoric Acid, 7 per cent. Potash.

No. 65.

100 lbs. Nitrate soda	}	WILL YIELD
450 lbs. Cottonseed meal		
1200 lbs. Acid phos., 11 per cent.		
250 lbs. Muriate potash		
2000 lbs.		
		2.9 per cent. Ammonia
		7.1 per cent. Avail. phos. acid
		6.9 per cent. Potash

HOME-MADE FERTILIZER.

The formulas for the different fertilizers have been given in detail. It seems that any farmer with common sense ought with these formulas be able to mix

up his fertilizers. That it will pay him there can be no doubt. He can mix it at times when he can not do other work, and then he knows exactly what he is using if he mixes it himself. A man by mixing his own fertilizers can save about one-third of the cost. Figuring at that rate it will not take many tons to run away up yonder in the saving. Sometimes it will be necessary for farmers to buy the chemicals together, so that they can get it in car load lots, but it will beat paying the fertilizer man all the profits.

COMPOSTING.

That composting is important there can be no doubt. It will pay every farmer to compost. It is very simple, and every farmer can make a compost if he desires.

Tobacco Fertilized.

Tobacco Unfertilized.

Tree Sprayed with Bordeaux Mixture.

Tree not Sprayed.

BOOK VI.
INSECT DEPARTMENT.

EDITED AND REVISED BY

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SCALE INSECTS AFFECTING THE PEACH

THE SAN JOSE SCALE.

This is by far our most destructive scale insect, and one that every fruit grower should learn to recognize, as it may attack pear, plum, apple, apricot, quince, persimmon, currant and other tree and bush fruits as well as the peach. It has been demonstrated without a doubt that this scale can be controlled in infested orchards, and it therefore behooves every fruit grower to learn to recognize this pest and be prepared to fight it from its first appearance. By doing so much damage and loss will be avoided.

Historical.—The exact origin of the San Jose scale was for a long time in doubt, though up to the year 1901 it was generally supposed to be a native of Japan or some Eastern country. During that year, Prof. C. L. Marlatt made an extensive trip through Japan and after making a careful investigation, came to the conclusion that its native home must be elsewhere. His investigation extended into China and there in the Northern portion was found the native home of the San Jose scale.

In the United States the San Jose scale was first discovered at San Jose, Cal., in the early seventies and soon spread to several orchards in that vicinity. In 1880 the insect was studied and described by Prof. Comstock, then Entomologist of the United States Department of Agriculture. Several years later, in 1893, this insect was discovered in an orchard at Charlottesville, Va. This discovery led to an investigation revealing the fact that the San Jose Scale had been imported into some Eastern nurseries, probably in New Jersey, five or six years previous to 1893, and from those nurseries it had been widely distributed over the eastern fruit growing States. When discovered at Charlottesville, many other points of infestation occurred and it soon became apparent that extermination would be impossible. Hence every effort was directed towards finding a method of killing the scale in the infested orchards. These efforts have been crowned with success, so that now in the South as well as elsewhere, scale infested orchards are sprayed each year with every assurance of success.

Description.—The San Jose scale is so small that any description must be largely general in its nature. The full grown individuals are only about 1-16 inch in

diameter, hardly the size of a small pin head. Its characteristics, shape and coloring can only be detected accurately by the use of a good hand lens, and when examined closely much variation will be noticeable between individuals.

A full grown female San Jose scale is ashy-gray in color, almost round in outline, and in the center of the up-

Fig. 1.—Twig with San Jose scale of all ages; magnified five times. (After Alwood, Vir. Crop. Pest. Comm., Spec. Bull., No. 45.)

per surface of the scale there is a small dark colored ring surrounding the nipple. This nipple is characteristic of all scale insects belonging to this same family, its location and color often being a help in determining the exact species. The nipple is formed in part by the first molt or cast skin of the young insect while the subsequent scale formation is due largely to secretions from the body of the insect, these secretions gradually hardening when exposed to the air. Close examination will reveal two or more quite distinct rings around the nipple. These rings are developed when the insect undergoes its second, third or fourth molt. The resulting scale is slightly conical, sloping evenly in all directions. The above is a description of the outward appearance

of a full grown female scale formed under perfect conditions. When crowded on a branch they often assume widely differing shapes.

Fig. 2.—Old San Jose scale with true insect exposed, to right. (After Alwood, Vir. Crop Pest Comm., Spec. Bull., No. 45.)

This mature scale as described above conceals the body of the true insect underneath. By using a pin or knife point the hard scale may be lifted revealing the orange-yellow body of the female insect. Fig. 2

The male San Jose scale differs from the female by having an elongated growth to one side. In size the males are smaller and often darker in color and the central nipple and first ring will be noticed at the anterior end of the elongated scale. Fig. 1 represents the comparative size and shape of the male and female scales as they appear on an infested twig.

Life History.—Speaking specifically of the life history of the San Jose scale, the females, when from 33 to 40 days old, begin to give birth to living young. Eggs are never deposited by this species. The young scale insects are almost microscopical in size, having oval shaped bodies of a bright yellow color. Soon after birth they commence moving about looking for a place to settle and commence feeding. Often from 12 to 24 hours are resumed before they settle down and insert the minute beak with which the juices of the plant are sucked up for the nourishment of the young insects. After these young scale insects once settle and commence feeding their position is never changed, except in the case of

the male which changes to a winged form. At the end of twelve days, according to Dr. L. O. Howard, Foot note (U. S. Dept. of Agr., Bureau of Ent., n. s. Bull, No. 3.) the first molt occurs, going to make up the nipple of the subsequent scale as already described. Up to this period the two sexes are exactly alike. When this first molt occurs the insect under the scale changes in appearance, the legs disappear, and the little insects look like yellow flattened balls. At from 18 to 20 days the second molt takes place, and from then on the males and females differ widely in appearance. The males begin the development of the elongated scale covering while the true insect underneath changes to a pupa from which there emerges at the expiration of 24 to 26 days the adult winged male as shown in the illustration. (Fig. 3.) The female insects take longer to become fully mature.

Fig. 3.—San Jose scale, adult male—greatly enlarged, (After Howard, Yearbook, 1894, U. S. Dept. of Agr.)

Dr. Howard places the time at thirty days. At this age the body of the female contains quite well developed embryonic young which begin to make their appearance from the 33rd to the 40th day. These minute young insects seek a feeding place as already described.

Examination for a scale infested tree during summer will show insects of all sizes, from newly born larvae to full developed males and females. Each adult female may give birth to from 300 to 400 young, covering a period of possibly two weeks; hence the first born may be past the first molt when the later ones appear. There are at least five generations each season in the South.

It should have been stated that the males and females are nearly jet black except for the central nipple, until about one-half grown, the ashy-gray color appearing later. These perfectly round, nearly black scales, having a prominent nipple surrounded by a slightly grayish ring, are very characteristic and easily distinguished from nearly all other scale insects.

How the Insect Passes the Winter and How to Detect It.

The winter stage is passed by the San Jose scale as half grown or nearly mature individuals. Most of the mature females perish from cold and exposure to the weather. During winter a badly infested tree will present a gray appearance, described by some as looking as though coated with wet ashes. The old dead scales may be packed closely together and piled on top of one another. This color will be relieved in places by the black, circular, half-grown scales as described above. The greater number of young scales will be found on the less thickly coated portion of the infested limbs and around the base of young shoots and branches. By drawing a knife blade or thumb nail along an infested branch an oily, yellowish fluid will exude, caused by crushing the soft-bodied insects under the scales. Another characteristic feature of the San Jose scale is that it causes the bark to turn red at the point of attack. This is especially noticeable on the young wood of the peach. The bark turns red nearly or quite to the wood, as determined by shaving off a thin section. Isolated scales may cause a red blotch, in diameter several times the size of the scale itself. The bark of infested peach-trees often shows a marked depressed or pitted appearance, explained by the fact that the bark nearly ceases growth at the exact point of attack, while the surrounding tissue continues to increase in volume. Peach trees badly infested with scale often commence to die the second year, though sometimes when infested at the age of two or three years they will survive for several years afterwards. Wherever orchards are watched closely, this dying may be prevented by proper remedial treatment as described in the next paragraph.

Remedies.

During the many years that remedies have been tested against the San Jose scale, almost everything having an insecticidal value has been tested. The whale oil soap treatment has been given a thorough test in Georgia and other States, and, while giving more or less satisfaction, it has proved to be too expensive for general use. Kerosene and crude petroleum in mechanical mixture and as emulsions were used in Georgia quite extensively during the early fight against the San Jose scale. Both were tested thoroughly by Prof. W. M. Scott, first Entomologist for Georgia. He found that the use of either kerosene or petroleum was attended with some danger of killing the sprayed trees—largely

on account of careless labor—hence, their application has been practically abandoned except in the case of kerosene which is still recommended for summer treatment as mentioned farther on. Caustic soda has been carefully tested, as well as many patent scale washes calculated to kill scale, but proving to be of very little value.

Results obtained from the use of Lime-Sulphur-Salt washes have demonstrated without any doubt that in them a safe and reliable remedy for the scale has been found.

Winter Treatment.—For winter treatment of scale infested trees, the following wash is recommended to be used as a spray, applying it with a spray pump to every tree in infested orchards. This recommendation is based on the experience of large orchardists who have tested this wash on thousands of trees with most excellent results.

Lime-Sulphur-Salt Wash.

Formula—

Lime	20 pounds.
Sulphur	16 pounds.
Salt	5 pounds.
Water to make	50 gals.

Mix the sulphur into a thin paste with a small amount of water and then add it to about 15 gallons of boiling water in a kettle (or in the boiling tank if steam is used) and stir thoroughly. While this mixture is at the boiling point, add the stone lime, which will immediately commence to slake, causing violent ebullition. While the lime is slaking, much of the sulphur will be dissolved as will be evident from the rich amber color resulting. The lime should be stirred frequently while slaking and water added as necessary to prevent burning or too violent boiling. After the lime is through slaking, add the salt and continue the boiling for at least 35 minutes or longer, if it seems necessary, to dissolve all the sulphur.

This wash, when properly prepared, should be a dirty yellowish green color when agitated, but if allowed to settle, a clear amber colored liquid will appear on the surface. There is always a residue which settles quite readily, necessitating frequent stirring, or better, constant agitation while in the spray tank. A wash of this kind should be strained through a wire screen or heavy burlap to remove all large particles of lime or other foreign matter that would tend to clog the spray pump. It is essential to have a large per cent. of what may be

termed the residue, forced through the pump and onto the trees as it plays an important part toward killing the scale.

Lime-Sulphur Wash.

Formula—

Lime 20 pounds.

Sulphur 16 pounds.

Water to make 50 gals.

This wash is made in the same way as the one just mentioned, simply leaving out the salt. The lime and sulphur wash proved in our experiments practically as effective as the wash, including salt. Some reliable

are perfectly dormant. They can not safely be used after the trees bud out in spring or at any time during summer. Badly infested trees should be sprayed twice during winter and when this is done, once in December and again in January or February, San Jose scale may be practically exterminated. Trees only slightly infested are usually sufficiently protected by one thorough spraying during January or February of each year.

Equipment for Boiling and Spraying.

For small orchards the lime-sulphur washes can be prepared in iron kettles, arranged over a brick arch.

Fig. 4.—A simple steam boiling outfit for preparing lime-sulphur washes: B, boiler; ss, steam pipes; gg, globe valves; 1, 2, 3, and 4, 50-gallon barrels; xx, pipes for drawing off mixture after boiling; F, large pipe carrying liquid from pipes xx to wagon tank or spray-barrel; a, lower end of steam pipe with cross-arms and one-eighth inch openings for escape of steam; P, platform 6 feet above ground; j, pipe supplying water from elevated tank or steam jet; h, water hose for carrying clear water to 1, 2, 3, and 4. (After Newell, Ga. St. Bd. of Ent., Bul. 21.)

authorities, however, still insist that the salt is essential, so it is deemed best at this time to offer both formulas and let individual preference decide which to use. Either one has proved thoroughly effective during the past two seasons.

The lime-sulphur washes as recommended are intended primarily for winter spraying work while the trees

For convenience, where there are many trees to be sprayed, these kettles should be of not less than 60 gallons capacity. While it is possible with two such kettles, or even one, to prepare the wash for a good sized orchard, still the use of steam for boiling is so much more rapid and economical that the average orchardist will find it profitable in the end to equip himself

with a steam boiling plant. The size and capacity of this plant will depend mainly upon the size of the orchard. A boiling outfit of this kind is shown in figure 4, to give an illustration of the general plan followed in arranging tanks, pipes, etc. The individual will readily modify this plan to suit his own conditions and facilities.

In the first place, it is important that this plant be located in or near the orchard, or at some central point which is accessible to the orchards to be sprayed. It is equally important that the outfit be located at a suitable water supply. If water from an elevated tank or from town waterworks can be utilized, so much the better. Failing in this, the plant should be located at a spring, well or stream of clear water, in order that the water may be delivered to the boiling tanks by a steam jet, thus saving the time and labor necessary to handle it with buckets. An equally important point is to have the elevated platform, upon which the boiling tanks are located, at least six feet above the ground, so that the mixture after being boiled, can be drawn off directly into the spraying tanks or barrels. Almost any boiler of sufficient steaming capacity can be utilized for furnishing the steam. Boilers located at cotton gins, saw mills, etc., are often made use of by placing this boiling outfit near them and making the necessary connections. Portable boilers, such as are used for sawing wood, or as traction engines, can be utilized to good advantage. For a small boiling outfit a good steam feed cooker will answer the purpose very well. For boiling the mixture, either barrels or tanks can be used. If tanks are decided upon, these should not exceed 150 gallons capacity under any circumstances. The larger the boiling receptacle the more stirring will be necessary. Upon the whole it is usually better to use a large number of 100 gallon tanks or of 50 gallon barrels than to use fewer and larger tanks. Added convenience in preparing small amounts of the wash is also secured where barrels are utilized. A separate globe valve should control the steam supply to each barrel or tank. Particular attention is called to the cross-arms "A" in the figure. These cross-arms deliver the steam at several points near the bottom of the barrel and this assists very materially in keeping the mixture stirred up. The cross-arms have one-eighth inch holes bored in them for the escape of steam. Each barrel should have its outlet pipe controlled with a gate valve. It is convenient to have all the outlets open into a common discharge pipe as shown in the figure. In this way, the material can be drawn off from any one, or from all of the tanks at one time.

The spraying outfit to be used will depend largely upon the size of the orchard to be sprayed. In the case of very large commercial orchards, wagon tanks, holding from 200 to 250 gallons, should be used. These tanks can be purchased from one of the manufacturers of good spraying apparatus at prices ranging from \$10.00 to \$20.00, and these tanks can be used upon any ordinary farm wagons. For winter work, wagons with broad tires are preferable. The necessary pump, hose, extension pipes and nozzles to go with such a wagon tank, will cost from \$12.00 to \$20.00, depending upon make, etc.

For small orchards of 10,000 trees, or less, barrel pumps answer well. Good pumps of this style, mounted in barrels of 50 gallons capacity, complete with hose, agitator, extension pipes, and nozzles, can be purchased at from \$14.00 to \$20.00 each. It is only necessary to place such a pump in a light wagon and it is ready for use. For winter spraying every pump should be equipped with two leads of hose, each not less than twenty feet in length. Where the trees are planted far apart, 30-foot lengths of hose are even better, enabling the men to get around the trees readily and to good advantage. Each line of hose should have fitted to it a 6-foot extension rod, at the end of which is the Vermorel or Mistry nozzle. These extension rods are readily made by any blacksmith from quarter-inch gas pipe. A stop-cock at the lower end of this extension rod (at its junction with the hose), is also a great convenience, in order that the operator may turn off the flow without having to reach or handle the nozzle. We have heard some complaints about the difficulty of spraying with the lime-sulphur washes on account of the hands and face becoming sore as a result of the caustic properties of the wash. If extension pipes, long leads of hose, and reasonable care are used, there will be but a minimum of difficulty from this source. Where extension pipes, or suitable substitutes therefor, are not used and the operator must work with his hands actually holding the nozzle itself, sore hands will result as a matter of course. The long leads of hose enable the operator to work at some distance from the wagon, so that the spray is not blown upon the team or upon the man working, the pump. If the hose connections are kept tight there is no reason why the workmen should continually have their gloves and clothes saturated with the mixture. The cheapest leather gloves obtainable, thoroughly saturated before use with lubricating oil, will be found the cheapest and most serviceable. The faces of the workmen can be protected by canvas masks if necessary, and the caustic action of the wash may be lessened by lib-

eral applications of vaseline or petroleum to the skin. Precautions of this kind are almost an absolute necessity when colored laborers are employed, as they will usually persist in spraying against the wind anyhow, in spite of all advice that may be given them.

Suitable strainers must be provided for all pumps, and the wash as it comes from the boiling tanks, thoroughly strained before being placed in the spray tank. Copper strainers can not be used for this purpose. The strainers must be of iron or brass.

nary copper knapsack pump can not be used, as it will be eaten up in a few days' time. Iron vessels and apparatus should be used as far as possible. The wash acts slowly upon brass, but its action upon the better makes of barrel pumps will not be appreciable if these latter are thoroughly rinsed out with clear water each night. At the close of the spraying season, of course the entire pump should be thoroughly cleaned, all parts well oiled and the pump kept under suitable cover until again needed.

Fig. 5.—A Suitable Spraying Outfit for a Medium-Sized Orchard. (Eclipse pump mounted in barrel, two leads of 20-foot hose, 6-ft. iron extension rods and single Vermorel nozzles). (From Ga. St. Board of Ent., Bull. 14.)

For small or family orchards a bucket pump and a two gallon pail will answer the purpose. Such a bucket pump should always be equipped with not less than ten feet of hose if anything larger than small shrubs are to be sprayed. With the short 3-foot piece of hose usually furnished by the manufacturers with these pumps, it is impossible to properly spray an average sized peach or plum tree. These bucket pumps can be bought at prices ranging from \$6.00 to \$9.00.

In handling the lime-sulphur mixtures, copper vessels and apparatus must be entirely avoided, as the wash has a marked corrosive action upon the copper. The ordi-

Summer Spraying for San Jose Scale.

Orchards properly treated during winter will seldom require summer spraying so far as the San Jose scale is concerned. Sometimes, however, a new infestation may be discovered in late spring or summer, and in order to prevent the scale from multiplying so rapidly through the summer months, the trunk and main limbs of the infested trees may be treated with the lime-sulphur wash prepared as for winter spraying. It can be applied with a mop or large brush or a spray pump may be used if care is observed to prevent the spray from being thrown on the foliage. A wash of the strength recom-

mended will burn peach foliage severely and often kill back young, tender shoots.

Kerosene Emulsion as Summer Treatment.

In view of the results obtained by various experiments it is deemed safe to recommend the use of kerosene emulsion as a summer treatment for San Jose scale; provided, however, that the work be done strictly according to direction with emulsion properly made, so that the kerosene will not separate in the spray tanks.

Stock solution—

Kerosene Emulsion.

Kerosene	8 gallons.
Hard Soap	2 pounds.
or Whale Oil Soap	4 pounds.
Water	4 gallons.

Place 4 gallons of water in a 15 or 20 gallon kettle, bring this to a boil and in it dissolve the soap. Remove this soap solution—while boiling hot—from the fire and add 8 gallons of kerosene, after which the mixture must be violently agitated for about ten minutes. As the kerosene and soap solution combine a smooth, creamy emulsion will result, the bulk will increase somewhat, and when properly prepared the resulting emulsion will remain without separating for several weeks. This emulsion is most readily made by using a small force pump, having a direct discharge and throwing a one-eighth inch stream, pumping the solution back into itself with considerable force. After ten minutes pumping, the emulsion will be perfect. Soft water should be used for making emulsions, but if such water is not readily obtainable, hard water may be broken by the addition of a little lye and can then be used with safety. Persons making emulsions for the first time should be sure to agitate the mixture as directed, otherwise while it may look thoroughly mixed it may soon separate when allowed to stand.

The stock solution may be diluted to any required strength. For summer treatment, I would recommend using an emulsion containing 20 per cent. of kerosene. In the experiments referred to above, 25 per cent. emulsion was employed without injury to the trees, but the 20 per cent. strength was almost equally effective; 20 per cent. emulsion kills nearly all the scale when applied during the summer months; 15 per cent. emulsion has often been recommended, but it does not always give satisfactory results. It is not advisable to spray trees with nearly ripe fruit, as the fruit absorbs the kerosene

and may taste so strong when ripe, as to render it unsalable and unfit for home use.

PUTNAM'S SCALE INSECT.

Of the scale insects occurring in the South, this is perhaps the species most closely resembling the San Jose. Fortunately, this scale is by no means as destructive and not at present one to be seriously feared. It is well, however, to know what scale insects may occur in the peach orchards, as by watching constantly for all species the more destructive forms will be discovered. In New York State, Dr. E. P. Felt records this scale as being the most common species of *Aspidiotus* on fruit trees and shrubs in that State. In Massachusetts, it has been reported as being particularly destructive in an apple orchard. In Virginia, this scale is quite commonly mistaken for the San Jose.

Description and Life History.—Putnam's scale insect is in many respects similar to the San Jose scale, and hence a comparative description only will be given.

The adult female scale is slightly larger than the San Jose, being about 1-12 inch in diameter. In color they are dark gray, and the nipple is reddish colored and slightly to one side of the center. The male scales are dark gray with the reddish nipple showing prominently. Like the San Jose scale, this species passes the winter as partly grown individuals, but according to Dr. E. P. Felt, (Bull. N. Y., State Museum, No. 46), they are usually more nearly mature than the over-working San Jose scales. In Spring, the males and females complete their growth, the former emerging as small winged individuals and the latter depositing eggs under the protecting scale. Dr. Felt states that only one brood develops in New York, but in the South there are probably at least two. The rate of reproduction of the Putnam's scale is slow compared to the San Jose scale, which is fortunate, as otherwise it might be a very destructive insect.

Remedies.

The over-wintering, partly grown scales may be killed by an application of the lime-sulphur wash as recommended for the San Jose scale. If the infested trees are sprayed during winter, no summer treatment will ordinarily be necessary. But if numbers of young crawling insects are observed during summer, they may be destroyed by the kerosene emulsion treatment as recommended on this page.

CHERRY SCALE.

Historical.—This scale insect was first described by Prof. W. G. Johnson, in 1896, it having been discovered by him in Illinois in 1894. It frequently occurs on wild cherry and was for that reason given the name, Cherry Scale. Prof. Johnson, writing in 1896* (*U. S. Dept. of Agr., Bur. of Ent., Bull. No. 6, p. 75), stated that it was not an uncommon thing to find 7 or 8 year old cherry trees in Illinois literally covered with this

be considered at present, as a particularly destructive scale insect. In the majority of orchards, where it has been discovered, parasites have apparently succeeded in holding it in check sufficiently to avoid the necessity of spraying, as must always be done to control the San Jose scale.

Description and Habits.—The Cherry scale, like Putnam's scale insect, is closely allied to the San Jose, and to the novice it is not easily distinguishable. The

Fig. 6.—Cherry scale: 1, two male scales, very much enlarged; 2, twig infested with grown scales, natural size; 3, portion of 2, enlarged; 4, full grown female, much enlarged; 5, half grown scale, greatly enlarged. (After E. P. Felt N. Y. State Bull. No. 46.)

destructive scale insect. At the same time, he stated that many parasites were known to attack this species, and his fact may explain why the cherry scale is no more destructive in Georgia at present.

In the South, the cherry scale is found in greater or less numbers in nearly every old peach orchard, but in connection with this wide distribution, it should be stated that the cherry scale has not been, and can not

full grown female scale, as well shown in the illustration, (Fig. 6,) is nearly round; natural color yellowish gray; scales rather flat and about 1-12 inch. in diameter. Near the center of the scale, but always somewhat to one side, is the reddish nipple or exuvia. The male scales are elongated, smaller than the females, and the nipple at the anterior end is bright orange red. This bright color is especially prominent when the scales

have been handled, rubbing off the thin outer surface covering.

The Cherry scales spend the winter as partially grown individuals, completing their growth in early spring, and unlike the San Jose scale, the females deposit eggs from which little lice hatch, similar in appearance to the young of the San Jose. Just the date when the first young appear in from the eggs of the first brood is not definitely established. There are probably as many as three generations each season in the South. On scale infested trees, young crawling lice may be found during almost all of the summer months.

Remedies.

The remedies recommended for the San Jose scale are equally effective against the Cherry scale. While spraying is not generally practiced against this insect, the writer has observed orchards where spraying would be advisable. The winter spraying should suffice if thoroughly done, and in that event summer treatment will not become necessary.

WEST INDIAN PEACH SCALE.

This scale insect deserves more than passing attention, as it is capable of doing great damage, its importance in the South being second only to the San Jose scale.

Historical.—The West Indian Peach Scale is known to occur in many countries among which may be mentioned England, Italy, Australia, Japan, China, South

Africa, Panama and the West Indies. It is supposed that the native home of this insect was either Japan or the West Indies, and from the latter place it has derived the common name, West Indian Peach scale. In the United States this scale is known to exist in Massachusetts, Washington, D. C., Ohio, Florida, Alabama and California, as well as in Georgia. In 1899, Prof. W. M. Scott reported that about 10,000 trees were utterly destroyed at Irby, Ga. With our present knowledge of the destructive powers of this insect, it is well to keep a sharp lookout for fear it may increase to destructive numbers. All fruit growers should be prepared to recognize this scale at a glance. By exterminating any newly discovered infestation, the possibility of a recurrence of the calamity at Irby will be reduced to a minimum.

Description and Life History.—A glance at Fig. 7 will show the reader that this is an insect quite different in appearance from the preceding forms mentioned

Fig. 8.—West Indian Peach scale: Adult male—greatly enlarged. (After Howard, Yearbook, 1894, U. S. Dept. of Agr.)

Fig. 7.—West Indian Peach Scale: a, branch covered with male and female scales—natural size; b, female scale; c, male scale; d, group of male scales—enlarged. (After Howard, Yearbook, 1894, U. S. Dept. of Agr.)

above, the chief difference noticeable being the wide variation between the male and female scales, and the shape and color of the former. The adult female scales are gray and not readily noticeable. The nipple is always to one side of the center and characterized by being ridged and comparatively large. The females usually cluster on the trunks of infested trees. The males are most prominent, being white in color, elongated, parallel sided and having the exuvia or nipple situated at the anterior end. They prefer to cluster near the base of large limbs and when abundant, give the tree a white-washed appearance.

Concerning the life history, Dr. L. O. Howard writes as follows* (*Yearbook, Dept. of Agr., 1894, p. 267:*) "During the winter this insect is found in Washington, D. C., only in the condition of the mature female. The

eggs are developed early in May, and the young larvae hatch by the middle of the month. The males (see Fig. 8), begin to issue the middle of June and impregnate the females, and the latter begin egg-laying by the end of the month. The second generation is full grown by the middle of August, and the third egg-laying begins at this time. In this latitude the development is comparatively regular."

Remedies.

Winter spraying with the lime-sulphur wash will be found effective, and this is probably the best remedy, though summer treatment with kerosene emulsion or whale oil soap solution, just after the young have hatched, may at times become necessary. Whenever a fruit-

insect itself forms the scale and when examined closely it will be observed that the outer body wall is hardened, but not separate from the insect within.

The nearly mature female lecanium (Fig. 9,) is hemispherical, somewhat elongated, brown in color and quite hard in texture. The nearly grown scales may be found clustered on small twigs and branches during winter when they are readily seen. When spring arrives these insects commence to grow and soon the females deposit eggs. The male scales change to a winged insect, but on account of being so small and living only a short time, the adult males are seldom observed. The eggs may be found in the hard scale, which, when crushed, appears to contain only a powdery substance. The female insect shrivels up in the shell

Fig. 9.—Peach Lecanium: Newly hatched larva on right; unimpregnated female next; full grown females on twig—natural size. (After Howard, Yearbook, 1894, U. S. Dept. of Agr.)

grower discovers any infested trees, they should be immediately dug up and burned, while the surrounding trees should be given a thorough winter spraying.

PEACH LECANIUM.

This scale insect, quite unlike the forms just mentioned, is a native European species. It has become established in some Southern orchards and in certain instances quite severe infestations have been reported.

Description and Life History.—Unlike the San Jose scale and closely allied species, this scale insect does not develop a specific hard, scaly covering. The lecaniums are known as naked scale insects, often called "soft scales." "Turtle-back scale" is also a common appellation and one quite suggestive of the appearance of the peach lecanium and other closely allied species. The

and practically disappears when the eggs are developed. From these eggs, young lice appear, probably for the most part during June. A young lecanium larva is shown in the figure.

When the insects are abundant on peach twigs, a perceptible amount of honey dew is frequently secreted. This sweet substance gives rise to a smut fungus which often covers the bodies of the scales, destroying many of them.

Remedies.

It has usually been considered that the best time to destroy the peach lecanium and other lecaniums is just after all the eggs are hatched in early summer. This may be done provided the orchardist will observe the date of hatching and prepare to spray the trees soon thereafter. The unprotected young will succumb to a

treatment of 15 per cent. kerosene emulsion or to whale oil soap, one-half pound to one gallon of water. Generally speaking, such spraying should be done in the South about the middle of June. Such work will seldom be necessary, however, wherever orchards are sprayed thoroughly with lime-sulphur wash during winter.

PLUM PULVINARIA.

The Plum Pulvinaria belongs to the class of scale insects known as "soft scales." While somewhat closely

insects commence to grow and develop the white cottony growth which constitutes the egg sac, and is a very conspicuous object. As the females near maturity a close examination of an individual would reveal a small brown, hardish bodied insect at one end of the cottony sac. In the sac would be found numerous minute eggs. These eggs hatch in early summer and the young crawl out on the foliage and there develop into the adult form as described above. (Fig. 10.) Before the foliage falls, the partly grown females have fastened themselves to the limbs and branches, there to pass the winter.

Fig. 10.—Plum Pulvinaria: On foliage as found during summer. (From Photo.)

related to the Lecanium scale, just mentioned, it differs much in appearance from the lecaniums proper.

Description and Habits.—The winter is passed by the half grown female scales on the branches and twigs of infested trees. In the winter stage, they are not particularly conspicuous. In spring, these ever-wintering

Remedies.

The winter spraying measures advocated for San Jose scale are effective against this pest also.

BORING INSECTS ATTACKING THE PEACH.

General Remarks.—Peach trees in the South are

attacked annually by boring insects causing considerable damage, much of which could generally be avoided were these insects more familiar to the fruit growers. The common peach-tree borer, which works at the base of the trees, is known by nearly all fruit-growers, but many do not know the life history of the insect and therefore do not know how to fight it intelligently. The following description with remedial suggestions, is intended to be of value by causing greater familiarity with this insect. The fruit-tree bark-beetle should also be made the object of study and watched for each year, and also the peach-twig borer with which many fruit growers are familiar. In general, it may be said that the peach-tree borer is one of the worst enemies of the peach in the South, though the other boring insects mentioned herewith cause considerable damage in certain years.

THE PEACH-TREE BORER.

Nearly one hundred years ago the peach-tree borer was described, and since that time it has been more or less familiar to fruit growers in the Eastern and Middle States. Before the introduction of the peach into the United States this insect probably lived in wild cherry or plum. It has been determined that the peach-tree borer is a native of the Eastern States and has followed the peach wherever it has been planted in the Middle and Western States, until now peach growers in all parts of our country east of the Rocky Mountains are generally familiar with the work of this important peach-tree pest.

General Description.—The gummy discharges about the base of peach-trees, caused by the larvae of the peach-tree borer, is a well-known sight to every fruit-grower. All stone fruits, such as peach, plum and cherry, throw out this copious mass of gum when injured in any way, and the peach more particularly. Discharges of a brownish gummy mass, more or less mixed with borings, earth and larval excrement, when occurring at the base of peach or plum trees, indicate the presence of borers underneath. These masses of gum often extend entirely around the base of badly infested trees, but being close to, or beneath the surface of the soil, they may be overlooked for some time unless the earth is scraped away from the trees.

The adult peach-tree borers resemble wasps in size and shape, being sometimes mistaken for them. The sexes differ so much in appearance that one would hardly take them to be the same species. The adult

moths are shown in Figure 11, a and b, where the difference in size can be noted. The female moths have the fore wings blue, covered with scales, while the hind

Fig. 11.—Peach-tree Borer: a, adult female; b, adult male; c, full grown larva; d, female pupa; e, male pupa; f, pupal skin partially extruded from cocoon—all natural size. (After Marlatt, U. S. Dept. of Agr., Bur. of Ent., Circ. 54.)

wings are transparent, resembling those of the males. Both sexes are steel-blue in general body color, but the abdomen of the female is marked with a broad orange band which is absent on the body of the male.

The adult moths appear mainly during the last part of August and the first half of September, as stated farther on, and the females soon commence to deposit eggs. From these eggs minute worms hatch and soon begin to bore into the bark near the ground, causing an exudation of gum as mentioned above. When full grown the worms or borers are about one inch in length, yellowish white in color with the head and first body segment brown. (Fig. 11, c.) When full grown the larvae leave their channels in the trees and construct a cocoon at the surface of the ground, near the base of the tree from which they emerged, and change to a chrysalis, or pupa, in the cocoon. From the cocoon the adult moths issue, escaping from the pupal skin, which is usually left attached to the cocoon as shown at Fig. 11.

The above is a very general description of the peach-tree borer and its work. A more specific discussion of the life history follows, as it has a direct bearing on the method of treatment and should be well understood.

Life History.—Starting with partially grown larvae (borers) as found during winter in infested peach trees, we will follow out the entire life history of the peach borer. The writer is indebted to Prof. H. N. Starnes, of the Georgia Experiment Sta-

tion, for the facts pertaining to the life history of this insect. Prof. Starnes' observations show that the larvae are about one-half or two-thirds grown at the approach of spring, having fed until late in fall and probably remained in a hibernating state during a portion of the winter. During the spring and early summer the larvae complete growth, and it is during this feeding period that a great part of the injury is inflicted on the infested trees. When full grown the larvae leave their channels in the wood and proceed to construct cocoons near the surface of the ground at the base of the trees. These cocoons are dirty brown in color, depending somewhat on the color of the soil. They are about one inch in length. (Fig. 11.)

By far the largest number of larvae leave their channels during the latter part of July and the first part of August, though some individuals come out earlier and some later. Immediately after constructing their cocoons the larvae pupate, changing to the pupa or chrysalis, which is a shiny brown object of the shape illustrated at d and e in Fig. 11. The pupa stage lasts from three to four weeks, when the change to the adult takes place, and there emerges the adult moth as already described. The cocoons with the pupal skin extruded (Fig. 11) are easily found about the base of infested trees.

Considering that the great majority of larvae spin cocoons and pupate during the month of August and that the adult moths emerge in at least four weeks thereafter, it is evident that most of the adult moths will be found during September. Prof. Starnes states that the majority of moths—in the latitude of Griffin, Ga.—emerge between August 26th and September 15th. Soon after emergence mating takes place and oviposition soon follows.

The eggs are very small, oval and light brown in color. They are deposited by the females on the trunk, mainly close to the level of the ground, but at times high up on the trunk and even on the lateral limbs. Quoting Prof. Starnes: "The eggs are practically all hatched by October 15th, and the young larvae, which are at first very minute, drop to the surface of the ground and begin to channel into the interior of the tree, where they remain throughout the winter, dormant a small part of the time, but feeding vigorously throughout fall and spring and well into the summer."

This point about the egg-laying and hatching, and the manner in which the young larvae bore into the

trees is of great importance, as on it hinges the best methods of treatment.

Remedial Measures.

Now that we are familiar with the true history of the peach tree borer it is evident that some of the time-honored recommendations for preventing the borer must be modified or changed somewhat. The life history, as stated above, is based on work done near Griffin, Ga., and there is a probability that the exact dates may vary in different parts of the South. However, this variation will not be sufficient to interfere with general recommendations regarding the proper treatment for this insect. Any suggestion made in this article must of necessity be somewhat general in its nature to admit of being applied in all parts of the South.

The principal valuable preventive and remedial measures will be discussed under separate heads, based largely on the life history of the insect as already described.

(1) **Wrapping.**—Trees may be wrapped about the trunk with brown paper or newspaper, to a height of eighteen inches. This wrapping should be fastened about the top with small wire or stout twine, to prevent larvae from entering under the paper from above. The wrapping should be put in place by August 1st, at the latest, as it is intended to hinder the first born larvae from reaching the trunks of the trees. Tarred paper might be employed, but as it is only intended to remain for three months some cheaper paper will answer about as well.

(2) **Mounding.**—After the paper covering is in place the soil should be immediately mounded about the base of each tree, ten inches high, covering the lower portion of the paper. Where trees are treated in this way the larvae hatching from eggs high up on the trunk and main limbs, after dropping to the top of the mound, will be forced to reach the trees through the paper wrapping, and at a point ten inches above the level of the ground. Before the little larvae succeed in affecting an entrance, many will be devoured by ants and birds. Ants are often our best friends by capturing many little borers soon after hatching and before they have been able to tunnel under the bark, where they would be protected.

(3) **Worming.**—After the above treatment, wrapping and mounding, has been attended to by August 1st, as recommended, it might seem that the trees would be thoroughly protected. That is not always true, however, as some larvae may get down under the paper wrapping from above, and some may succeed in forcing an entrance through the paper at the surface of the mound. For these reasons alone, worming should begin the last week in October, for it has been shown that nearly all the eggs are hatched by October 15th. The reason for worming at this time is to get as many young larvae as possible before they have injured the trees. Worming at this time will necessitate removal of the paper wrappings, and leveling of the mounds. In fact, to leave the paper on longer in any event, would be to offer protection to the young borers underneath. A knife will not be required for worming, as a great per cent. of the larvae present will be on the surface of the bark feeding on tender spots and covered with a mass of gum mingled with excrement and borings. This gummy mass together with the worms beneath, may be scraped off with a curved bill-hook arrangement, bluntly pointed at one end and provided with a double edge which should not be sharp—about like a hull table knife. This hook may be heavy enough to serve for digging and cutting if desired, and should be provided with a substantial handle about twelve inches long. With such a hook trees can be wormed rapidly. The majority of the young borers will be found on the tree trunks several inches above ground and being for the most part on the surface, they may be easily scraped off.

The hook mentioned above is one recommended by Mr. C. M. Porter, of Douglas, Ga., and the writer believes that no better implement has been devised for this work.

(4) **Caustic and Deterrent Washes.**—After worming in fall some form of caustic wash should be applied to the tree trunks to kill the larvae which have been exposed, but remain on the trunk, and to prevent the dislodged larvae from re-entering the trees. It appears to be somewhat doubtful about a wash applied earlier in the fall preventing the adults from depositing eggs. Prof. Starnes reports that eggs are laid on the lateral branches; this habit has also been observed by the writer. I have seen moths deposit eggs on the leaves of nursery stock at least three feet above the ground. Washes of a deterrent na-

ture applied to peach tree trunks before the moths appear would probably cause more eggs to be laid higher up, and unless the wash applied is capable of repelling the little larvae when hatched, it would be of little value.

Lime-Sulphur-Tar Mixture.—A wash that has proven fairly satisfactory, having both deterrent and caustic properties, is one first recommended by Prof. W. M. Scott. It is made as follows: Slake one bushel of lime with a small amount of warm water. While the lime is slaking add ten pounds of sulphur, previously stirred into a paste. To this mixture add one-half gallon of gas tar and then dilute with water to about 50 gallons. This wash carries sufficient lime to form a good coating over the bark, while not being thick enough to flake off badly when dry. By adding two pounds of Paris green to the above we have a deterrent, caustic and poison wash.

Hale's Borer Wash.—Mr. J. H. Hale, President of the Hale Georgia Orchard Co., recommends the following wash: Two quarts of strong soap and a half pint of crude carbolic acid, with two ounces of Paris green, are thoroughly incorporated in a bucketful of water, and enough lime and clay added to make a thin paste.* A wash of this description, if applied about July 15th, would act as a deterrent and poison. To be most thoroughly effective it should be applied to the trunk and main limbs and be replaced when loosened by rain.

Prof. Starnes reports that he cannot recommend any one wash in view of his experience with many different formulas. For applying to trees just after fall worming he recommends the following:

Lime and Potash Wash.—A simple mixture of thick whitewash and ball potash—1 1-2 pounds lime, 2 1-4 ounces caustic potash to the gallon of water.

It is quite probable that the lime-sulphur mixtures recommended for San Jose scale treatment may be used with good success. They certainly possess the caustic property necessary to kill young borer larvae and by adding a little more lime than the scale formula calls for, it would cover tree trunks sufficiently to act as a deterrent to both the adult moths and the larvae.

Summarizing the remarks regarding borer washes, none are worthy of unrestricted recommendation. The best time to apply any wash is just after the

*Formula from Cir. 54, p. 4, Bur. of Ent., U. S. D. A.

fall worming. If washes are applied earlier and before the trees are wormed they should be sufficiently thick and caustic to repel larvae which attempt to enter the trunks of the trees.

(5) **Spring Worming.**—In view of the information now at hand regarding the life history of the peach-tree borer it does not appear advisable to depend on spring worming. The borers are all under the bark in spring and must then be removed with a sharp knife or killed in their burrows with a wire probe. Where other measures have not been properly attended to, spring worming may be necessary and beneficial. It would at least tend to reduce the numbers of adults appearing in fall, and prevent much injury during summer months. In general it would seem preferable to devote considerable time and work to the fall treatment as already described, and if some borers have escaped they should be dug out in early spring. A caustic wash may be applied after the spring worming, but it will only destroy larvae which have been exposed but not actually killed.

Best results in controlling peach borers will be obtained only when the various remedial measures—as suggested—are combined, and each feature of the work given careful attention.

THE FRUIT-TREE BARK-BEETLE.

(Known also as shot-hole borer.)

Historical.—This insect is a native European species. In the United States it was first noticed in 1877 in New York, where it was attacking the peach. No doubt many other localities were infested at the same period though not then discovered. It has now been found in all the Eastern States and at least as far west as Kansas. This insect has been known to injure the following fruits: Plum, cherry, apricot, nectarine, apple, pear and quince, as well as the peach.

Habits and Nature of Injury.—Early writers usually held to the opinion that the fruit-tree bark-beetle would not attack perfectly healthy trees, and some who will still assert that the first writers were correct.

The weight of evidence is conclusive, however, that the bark-beetles first attack weakened and dying trees, but often when numerous, turn their at-

tack to trees which are apparently in good health. As appropriately stated by J. M. Stedman*: "It is very largely a matter of opinion when one pronounces a tree perfectly healthy that has become infested with this pest, but no doubt one should regard a tree as healthy when there is absolutely no reason to suspect anything different except that it has now become attacked by this insect."

The fruit-tree bark-beetle works for the greater part of its lifetime under the bark of the infested tree. A tree in which this insect has been breeding

Fig. 12.—Work of Fruit-tree Barkbeetle in twig—natural size. (After Chitt., U. S. Dept. of Agr., Bur. of Ent., Cir. No. 29.)

will show many branches like Fig. 12, illustrating the nature of the work under the bark, as well as the outward appearance, showing the holes made by the adult beetle. Young peach trees often commence to wither and dry up towards the end of the limbs before any other sign of borers is discovered. When that occurs the insects will often be found beneath the bark as described farther on.

Description.—The adult fruit-tree bark-beetle is a small cylindrical beetle, about one-eighth inch length and only about one-third as broad. They are uniformly black in color except the tips of the elytra or wing covers and a portion of the legs, which are a dull red. Fig. 13-a illustrates the peculiar punctuation on the thorax and wings, and the peculiar blue shaped abdomen is well shown in Fig. 13-b. T

*Missouri Agri. Expt. Sta. Bull. No. 44.

young borer or grub is white except for the brown head, as illustrated at d. The pupa—the form assumed by the larva just before changing to the adult beetle—is pictured in the figure at c.

Winter Stage and Life History.—The winter is passed by this insect in the larval or grub stage in their channels under the bark. In spring about the middle or latter part of March, the parent beetles eat their way out from under the bark, making little holes scarcely 1-16 inch in diameter. These parent beetles soon commence to bore into the trees, and begin the construction of an egg chamber which is nearly always formed in the direction of the long axis of the limb, or nearly so. They seem to prefer to enter at the base of the limbs, or at the forks

Fig. 13.—Fruit-tree Bark-beetle; a, adult beetle; b, same in profile; c, pupa; d, larva; all magnified about ten times. (After Chitt., U. S. Dept. of Agr., Bur. of Ent., Circ. No. 29.)

made by lateral spurs, and often at the base of buds near the extremities of the small branches. The beetles are frequently found, on badly infested trees, entering the trunk nearly to the base of the trees. The egg chamber is formed partly in the cambium layer and partly in the wood directly beneath. An egg chamber varies from one inch or less to an inch and a half in length, and as it is formed minute side pockets are constructed to each side, in which eggs are deposited. It is supposed that each female lays about eighty eggs. The minute grubs hatching from these eggs burrow at right angles to the egg chamber. When a limb is badly infested these channels cross and re-cross one another, until the cambium layer of bark, and the wood just beneath, is reduced almost to powder. The typical egg chambers and side galleries are well illustrated in Fig. 14. The young grubs continue to feed as described until full grown when they make a slightly deeper burrow

and there change to the pupae from which emerge the adult beetles as already described. These beetles escape by simply eating their way out through the bark, making the characteristic round hole. As each beetle must make a hole through which to escape and another when entering to construct the egg chamber, the great numbers of holes found in an infested limb are easily accounted for.

Fig. 14.—Bark removed from twig, showing egg chambers and galleries of Fruit-tree Bark-beetle; a, a, main gallery; b, b, side or larval galleries; c, c, pupal cells—natural size.

(From U. S. Dept. of Agr., Bur. of Ent., Circ. 29.)

Generations Each Year.—Concerning the number of broods each year, no definite observations have been made. In Missouri, Prof. Stedman found three and sometimes a fourth. Considering the fact that many adults were observed this year during the early part of July, and as these must have been the third brood, it is reasonable to predict that we have four generations to contend with in the peach orchards of the South.

Remedies.

Clean Culture.—As heretofore stated the bark beetles seem to prefer to breed in dying trees. Herein will be found the clew to a remedy, or more properly speaking, prevention. All dead and dying trees should be destroyed by burning during winter. This work must be done at least before the first of March

in order to destroy all the young borer larvae hibernating under the bark. All adult beetles—it is generally supposed—die during winter, hence if all wood containing young borers is destroyed there will be practically no borers left to re-infest the orchard the following spring. Of course, there will always be a few slightly infested trees left, and from them some adult borers will develop. A small number of adults in March may increase to considerable numbers by the time the second and third broods appear. In addition to burning all brush and dead trees during winter, the orchards should be closely watched during summer, and when infested trees are discovered or even single infested limbs, they should be removed and burned.

Fertilizing and Cultivating.—Slightly infested trees will sometimes recover, after the attacked portions have been removed. To aid this recovery the orchardist should cultivate and fertilize as appears necessary to keep the trees in a healthy, vigorous state of growth. Very healthy trees are more able to withstand an attack from the fruit-tree bark-beetle, than are poorly nourished, slow-growing trees.

Washes.—Understanding the life history of the bark-beetle as already described, one will readily perceive that the application of washes either poison or deterrent, cannot be expected to prove of certain value. The larvae working beneath the bark cannot be killed by any exterior application, and the adult beetles do not feed over a sufficient area of the bark to insure successful poisoning. A deterrent wash, one that will repel the beetles, is therefore the most promising. By adding poison to whatever wash is used some beetles may be killed if they attempt to reach the bark through the wash.

The writer has not been enabled to test the value of the washes that have been recommended by various writers. One that has given fairly good success in Missouri, recommended by J. M. Stedman, is as follows:

Deterrent and Poison Wash.

Dissolve as much common washing soda as possible in six gallons of soft water, and then dissolve one gallon of ordinary soft soap in the above and add one pint of crude carbolic acid and mix thoroughly. Two pounds of lime is then slaked in two

gallons of water and filtered so as to remove all dirt and small lumps; this is now added to the above and mixed; while to all is added one-half pound of Paris green or one-fourth pound of white arsenic, and thoroughly mixed.

The above wash will act as a repellent to keep the adult beetles from boring into the trees to deposit eggs. It will not kill the young grubs under the bark. It may poison a few beetles if they attempt to eat through. The trunk and large limbs of trees to be protected must be kept thoroughly covered with this or any other wash which should be applied about the first of March and as often thereafter as necessary to keep the trees well protected. The first application may be made with a spray pump and then every portion of the tree should be covered. Later applications cannot well be applied to the smaller branches and twigs and for that reason it cannot be thoroughly effective.

Wherever orchards are sprayed with lime-sulphur wash for the San Jose scale it is probable that no other wash will be necessary, or at least would not be practical in view of the additional expense.

Fig. 15.—Peach Twig Borer: a, moth with wings spread; b and c, same with wings closed, illustrating normal position. (After Marlatt, U. S. Dept. of Agr., Bur. of Ent., Bull. No. 10.)

THE PEACH TWIG BORER.

Early in spring the orchardist may be looking through his peach orchards and notice that many of the young shoots of the new growth are dying back a few inches at the tips. He will wonder what the cause of this trouble may be. Upon examining the

dying twigs a slender brownish worm may be found in the little twig just about at the point where the twig commenced to die. This will usually prove to be the larvae of the peach twig borer. This insect is quite common in many parts of the South though many peach growers are not aware of its identity.

The peach twig borer is evidently a native of Europe and was probably brought to this country on some shipment of nursery stock. It was first regarded as an important peach pest about the year 1872, according to Marlatt,* when it was reported as causing excessive damage in young peach orchards in Maryland. It has since been reported from many of the peach growing States, and will, in time, if not already so, become cosmopolitan in its distribution.

Description and Life History.—The adult moth is shown in Fig 15 in the natural position, as when resting on a branch, and with the wings spread to

Fig. 16.—Peach Twig Borer: a, new shoot of peach dying from attack of larva; b, larva enlarged; c, pupa enlarged. (After Marlatt, U. S. Dept. of Agr., Bur. of Ent., Bull. No. 10.)

show the characteristic markings. These moths appear in early summer from the worms or larvae causing the first dead twigs as mentioned above. The first brood of moths soon commence to deposit eggs around the base of the new leaves as described by Prof. C. L. Marlatt, and from these eggs minute larvae hatch, at first very small, pale yellow in color, with black extremities. These larvae proceed at

once to bore into the shoot on which they are located. Sometimes they enter the shoot and burrow for a short distance in the center; these burrows being from one-fourth to one and one-half inches in length. Or they may simply bore to the center of the shoot, and, apparently dissatisfied with the location, wander away to another shoot. Thus a single larva may bore into and injure several new twigs in the course of its wandering life. The writer has observed many such cases; a twig often showing only a small hole with no sign of the intruder, though the twig was found in a dying condition. In California it is claimed that the summer broods attack the growing peaches, but this injury has not been noticed in the South, so far as the writer is aware.

The larva or worm attains a length when full grown of nearly one-half inch; color dull reddish brown, with the head and posterior end dark brown or black. The body tapers toward either end and is sparsely clothed with long hairs. (Fig. 16, b.) When grown the larvae spin a scanty web in the leaves or rubbish about the trees or even in the dried leaves of the injured shoot. In this web the larvae change to the pupae (Fig. 16, c), from which the adult moths emerge.

Winter Stage.—It has been determined that there are probably four broods. The larvae of the last brood seek their winter quarters, and this point in their life history is of great importance as it offers a chance for easily destroying most of these insects during winter. It has been found by Prof. Marlatt that the larvae of the last brood construct small silken cells in the spongy bark at the crotches of the branches of the peach, and there pass the winter. In these quarters they are only poorly protected and often fall prey to birds and predaceous insects, and they are also frequently killed by a parasitic mite.

Remedies.

It would at first thought be supposed that the larvae could be trapped when the first dying twigs appear in summer by simply cutting off the injured shoots, and by burning, destroy the larvae within. This is in fact a possible remedy, but as stated above, a single larva may injure several twigs; hence many twigs might be removed to capture only a few of the insects. Furthermore the larvae attain full growth in about two weeks, so that the time during

*U. S. Dept. of Agr., Bur. of Ent., Bull. No. 10.

which the worms could be trapped is comparatively short.

The larvae passing the winter in the crotches of the trees are easily killed by a spray of lime-sulphur wash as advocated for the San Jose scale. In California this insect is effectually controlled by the winter treatment. Wherever trees must be sprayed for the San Jose scale or other scale insects, the peach twig borer will be so reduced by the treatment that they will not cause serious trouble. Young peach trees could be washed or painted with the lime-sulphur wash where it is not necessary to spray the entire orchard.

grower though the worms occurring in the fruit and the marks on the skin are familiar objects.

Description.—The curculio, or weevil, as it is sometimes called, is a small, dark brown, rough backed beetle, looking like a dried bud when shaken from the trees, which resemblance is increased by its habit of drawing up its legs and remaining for a time without motion, seemingly lifeless. In other words, this beetle when disturbed will play "possum," and when in that position it is indeed hard to distinguish from a small dried bud. The color is dark brown variegated with white, ochre-yellow and black. The wing covers have short

Fig. 17.—Terminal twig of peach tree killed by larva of peach twig-borer. (Photo by A. C. Lewis.)

THE CURCULIO.

Wormy peaches are nearly always found in every peach orchard each year, and much fruit is ruined and thrown away on this account. By far the majority of the worms occurring in peaches in the South are the larvae of the Curculio, usually named "plum curculio."

The adult curculio or beetle is commonly called "The little Turk." Owing to its small size this insect is not generally observed by the average fruit

ridges, those in the middle of the back forming two humps which are shiny black; just behind the humps there is a wide band of ochre-yellow and white. The beetles vary in size but average nearly one-fifth inch in length. They are provided with membraneous wings—under the visible wing covers as described above—with which they fly easily for considerable distances.

Habits and Life History.—The beetles pass the winter under protection of weeds, rubbish, etc., in

the orchard, under and around peach trees, and also in the leaves and brush in the edge of forests, which frequently adjoin the peach orchards. In spring when peach trees are just pushing out the tender buds, the curculio emerge from their winter quarters and commence to feed on the opening buds. Mating soon takes place and by the time the first fruit is set the females are ready to deposit eggs.

The egg puncture made by the female curculio is very characteristic on plums but not as distinct on the fuzzy skin of the peach. (Fig. 18.) Before depositing an egg the beetle first makes a small crescent-shaped incision with the snout, which she also employs to force the egg under the skin. Only one egg is deposited in a place, and as long as plenty of

Fig. 18.—The Curculio: Egg punctures on peach—natural size; adult beetle, on right—enlarged. (From U. S. Dept. of Agr., Farmer's Bull., No. 33.)

peaches remain unstung only a few will be found with more than one egg puncture. If fruit is scarce several eggs may be found in a single peach.

The eggs thus deposited soon hatch into white, footless grubs which commence to bore toward the center of the fruit, finally lodging near the seed. Such infested fruit often drops when about the size of a grape. Oftentimes a peach may attain a size of nearly one inch in diameter before being stung, and may then develop and ripen prematurely even with a worm within, constituting the common "wormy" fruit. The irritation arising from the egg punctures and the gnawing of the young grubs causes the fruit to become gummy, diseased, and either ripen prematurely or form imperfect fruit. Frequently small holes are eaten in the peaches simply for the purpose of feeding, and from the wounds thus inflicted the gum often exudes, and rot frequently sets in at the injured spot, thus causing much additional injury.

In fallen, wormy fruit the grubs complete their

growth and after leaving the fruit enter the ground and pupate. In about three or four weeks the adult beetles develop from the pupate. It is generally supposed that there is only one brood each year, though this fact has not been definitely established. The egg laying period of a single female may extend over eighty days, which accounts for the fact that small worms are found in nearly mature peaches. It is also possible that a partial second brood occurs in some sections of the South.

Remedies.

Jarring.—This is one of the oldest recommendations and possibly the best even at the present time. Taking advantage of the fact that the adult curculio will curl up and drop when disturbed, it is possible to capture large numbers by jarring trees over a sheet, from which the beetles can be collected and destroyed. Many devices have been suggested for capturing the curculio in this way. One is a patented affair, shaped like an inverted umbrella with a slit in one side in which the trunk fits when the arrangement is pushed under the tree. This device is fitted with one wheel and handles like a wheel-barrow. After this arrangement is pushed under a tree the trunk is hit a couple of sharp raps with the padded end of a pole. The curculio thus disturbed, drop to the slanting sheet from which they slide to the center and drop into a can containing a little kerosene. The worst objection to such an outfit is that all insects, including many beneficial lady-bugs, are often destroyed along with the curculio.

The Hale Orchard Co., Fort Valley, Ga., have a simple arrangement, which has been used with success. Two light wooden frames are made, each about 6x12 feet, and in the side of one frame a cut is made, large enough to accommodate a tree trunk. These frames are covered with stout cotton cloth and when placed under a tree, with two of the long edges together, a broad surface is secured, which will catch every insect dropping from the tree above. A padded pole is used for jarring the tree. It requires five men for each outfit, two for each frame and one to jar the trees. By having several double frames and a large force of negroes a large orchard can be covered in a few hours. Jarring should commence early—at first break of day—and be vigorously performed until about half-past eight in the

morning. Later than this hour many of the curculio will be hiding in the rubbish under the trees and thus escape. An orchard can be quite thoroughly protected by jarring every morning after the fruit is first beginning to set, continuing the work as long as the beetles are numerous. After the first few days, where the work is thoroughly done, the beetles will become quite scarce.

The advantage of this jarring method over the patent device is that it is cheaper, and the curculio can be collected from the sheets without destroying the beneficial insects.

Spraying.—Authorities differ regarding the value of poison sprays for killing curculio. It is an un-

use Paris green in connection with Bordeaux mixture, 4 ounces of Paris green to each barrel. Or arsenate of lead may be used, 2 pounds to 50 gallons of water, or in the same proportion with Bordeaux mixture.

Gathering Fallen Fruit.—This should properly be called prevention, as it tends to reduce the number of adult curculio developing each season. It is of great importance to prevent curculio from increasing from year to year. All fallen fruit should be gathered and destroyed by burying or feeding to hogs. This practice is of considerable value by destroying rotten fruit as well as the curculio. Even in orchards where spraying and jarring have been

Fig. 19.—Jarring for Curculio. Method employed by Hale Orchard Co., Fort Valley, Ga.

questionable fact that the curculio feed to some extent on the opening buds and also on the fruit; but experiments have not demonstrated that many beetles can be poisoned by spraying. The new buds develop so rapidly that it is almost impossible to keep them covered with poison spray, and by the time the foliage is fully formed the peaches are also large enough to offer food to the adult curculio. Thorough spraying will, however, poison a certain number of beetles, and for this work it would be well to

practiced it would be advisable to gather all fallen fruit. This must be picked up every few days to prevent the larvae from leaving and entering the ground.

Clean Cultivation.—This hinges closely on to the foregoing paragraph as gathering fallen fruit is really a part of clean cultivation. The adult beetles hide during winter in rubbish, weeds, etc., hence all such harboring places should be prevented by keep-

ing orchards clean and free from weeds and brush. Forests immediately surrounding orchards offer abundant winter protection to the curculio, and where the damage would not be too great a portion of these forests adjoining the orchards should be burned over each winter, which would result in destroying hundreds of over-wintering curculio.

PLANT LICE INJURIOUS TO THE PEACH.

Under this head we have several species, all closely resembling each other in size and shape, though often differing in color. Some species differ quite widely in habits and life-history, and also in appearance if submitted to close scrutiny. As the treatment recommended for this family of insects is about the same for one and all, the description of one or two species will serve to illustrate the varia-

first knowledge of this particular species dates back to 1898 when it was discovered by Prof. W. M. Scott in a plum orchard at Fort Valley, Ga. During that year and the one following it was observed on plum and peach, causing considerable injury to the growing tips of young trees, and particularly to nursery stock—June-budded peach. In 1899 Prof. Scott determined the life history in general and since then it has been considered as an important peach insect.

Life History.—The winter is passed in the egg stage, these eggs being found scattered over the terminal shoots. From these eggs, which are dark brown in color, and very small, small wingless lice hatch, appearing just about as the buds commence to open in spring. Within a short time these young lice reach maturity and become "stem mothers."

Fig. 20.—Winged form of New Plum Aphis. (After Scott, U. S. Dept. of Agr., Bur. of Ent., Bull. No. 31.)

tion in life history, so it is not deemed necessary to mention all the different species that might attack the peach.

Indication of Aphis.—When peach trees in early spring or summer are discovered with the tips presenting a dwarfed growth, and with the leaves curled and twisted, aphis may be looked for. These will be found on the underside of the curled leaves and often clustered in great numbers around the tender shoot and terminal bud. Hundreds of individuals may occur on a single leaf as a single aphis is less than 1-10 inch in length.

THE NEW PLUM APHIS.

Although this species has been named "Plum Aphis," it is by no means confined to the plum. Our

Each individual is an agamic female capable of giving birth to living young without the intervention of the male. Each stem mother gives birth to several young, which in turn reach maturity and bring forth more young in a like manner. The majority of these develop into agamic females resembling the stem mother, though some individuals develop wings and fly to other localities where they establish new colonies. These winged agamic females (Fig. 20) give birth to young resembling those from the stem mother. During the season there may be ten or more generations, as described above. From the last generation each season true males and females develop, which mate, thus providing for the winter eggs.

It is no uncommon sight to see a stem mother surrounded by a hundred or more aphis of all sizes.

By sucking the plant juices the leaves are made to curl and twist, always toward the side on which the lice are located. When the leaves become badly curled it will be readily understood that the lice are well protected and hard to reach with any insecticide. This characteristic curling of leaves should be carefully noted, as it is closely connected with the subject of remedies which will be considered after mention has been made of one more species of aphid.

THE BLACK PEACH APHID.

Description and Life History.—This species, as its name implies, is shining black or deep brown in color. Winged and wingless forms both occur, new colonies being established by means of the former. The young aphid are faint greenish-brown, becoming darker as they near maturity. All these forms will be found on the growing tips of infested peach trees in early spring causing the leaves to curl in the characteristic manner.

Unlike the plum aphid this species does not winter in the egg stage. About mid-summer many of the aphid on the leaves and branches make their way to the ground and to the roots where the winter is passed. Dr. John B. Smith* states that no males have been observed and no eggs have been discovered; hence it is assumed that the black peach aphid breeds agamically all the year round. Early in spring the root form make their way to the surface and to the branches, and there colonies are formed on the opening buds, later living on the fully developed leaves and tender stems.

Remedies.

Plant lice live by sucking the plant juices, and for that reason they cannot be poisoned with arsenicals. Contact poisons must be employed for these insects. For the forms which occur above ground we have a simple remedy, as kerosene emulsion at 15 per cent. strength or a strong soap solution will kill all the aphid with which it comes in contact. Now it will be seen why the matter of the curled leaves becomes significant. It is almost impossible to spray a tree with emulsion, or any solution, so as to reach all the aphid inside the curled leaves. This can only be affected by dipping, which is out of the question

with orchard trees of any size, though it may be practiced with nursery stock. By watching closely for the first appearance of aphid in spring the first colonies may be discovered and destroyed by spraying before the leaves become curled. If many leaves are curled when the infestation is first discovered, it may become necessary to gather the badly curled leaves by hand, and follow with the emulsion to destroy all remaining aphid. (For preparing kerosene emulsion see directions on page 182)

Whale oil soap solution, 1 pound to 3 gallons of water, will be found as effective as the emulsion; or tobacco decoction may be prepared by boiling 3 pounds of tobacco leaves or stems, in 5 gallons of water for about three hours. This decoction may be used without dilution and will prove very effective.

The black peach aphid occurring on the roots of peach trees will seldom become serious if the form appearing above ground is properly destroyed each year, at least enough to reduce them to insignificant numbers. The greatest danger is that this insect may be spread on nursery stock, but even that danger is mitigated by fumigation which is required of all nurserymen in some States. Liberal applications of tobacco dust about the roots of nursery stock is valuable for destroying the root form of peach aphid.

Any plant lice occurring on leaves or branches may be killed by spraying with the contact insecticides mentioned above, and no one need fear this form of insect if the first colonies appearing in spring are properly destroyed.

ROOT KNOT OR NEMATODE GALL.

While not an insect, strictly speaking, the nematode worm, which is the cause of root knot on peach trees, should be mentioned in connection with other peach insects. These knots are caused by a small "eel-worm" or nematode, an individual being almost microscopical in size; but the knots resulting from their attack are readily noticed. (Fig. 21.) A close examination of fresh knots will usually reveal the little cavities containing eel worms in all stages of development.

Usually it has been observed that the root knot is most prevalent on trees in sandy soils, such as are found in some parts of South Georgia, while in the stiff clay lands this trouble is seldom noticeable.

*N. J. Exp. Sta. Bull. No. 72.

The symptom of root knot, which can be seen above ground, is usually a scanty yellow growth. Young trees often die from the effect of root knot during the second or third year, but where older trees are attacked they may survive for several years or almost indefinitely, although making a poor growth.

No good remedy for this trouble is known though

Fig. 21.—Root Knot on peach root caused by "eel worms" or nematodes. (From U. S. Dept. of Agr., Farmers' Bull. No. 33.)

much damage therefrom may be avoided by adhering to certain rules.

In the first place, orchardists should not plant trees bearing roots which show root knot; or if only a very little is present it should be carefully pruned off before planting. Another thing that should be understood is that the nematode worms live on several common garden and field crops, such as cabbage, okra, turnip, egg-plant, cotton and cow-peas. In the case of the cow-pea we have an exception in the variety of pea known as the "Iron" cow-pea. This variety is practically resistant to the nematode worm and can be planted with safety in the peach orchard, and in view of the fact that so many cow-peas are grown in the peach orchards, it is fortunate

that we have this resistant variety. All plants which are susceptible to attack from the nematode worm should be kept out of peach orchards where the worms are known to occur. This practically results in a starving out process.

Insecticides are of little if any value against the nematode worms. In Florida it was found that heavy applications of potash fertilizer, either sulphate or muriate, 3,000 lbs. per acre, were of some value, but the large amounts necessary make their use prohibitive.

It has been suggested that nematode worms may be destroyed by heat, and this may be practical over small areas, especially where only an occasional tree is infested. Under such conditions each infested tree should be dug up by the roots leaving a fair sized hole, above which a pile of brush and wood could be burned. Afterward by filling the hole with fresh earth from an uninfested field, another tree could be planted in place of the old one. This tree would be able to develop a strong, vigorous root system before the nematodes again became abundant.

As a general thing it will not be profitable to plant a peach orchard in land where the nematode worms are abundant, as long as uninfested land can be selected. Land once infested will remain so for several years, but the worms will die out gradually if the land is planted in corn, or some such resistant crop.

CATERPILLARS

Caterpillars are not as a rule a serious enemy of peach trees. Every year, however, a few outbreaks occur, but the damage in the past few years has been almost of no consequence. A few words, however, in this connection may be of interest.

THE AMERICAN TENT-CATERPILLAR

Every one is familiar with the white webs of the tent-caterpillar, which are found on wild cherries and apples in spring, and which increase in size at an alarming rate. This tent-caterpillar sometimes attacks peach trees, and although easily destroyed are often allowed to work unmolested. (For remedies see discussion of Apple Insects.)

OTHER CATERPILLARS.

The tent-caterpillar is easily controlled without

spraying, but some leaf-eating worms are not so easily captured. Whenever the foliage of fruit trees is being destroyed by caterpillars it may be readily protected by spraying with some arsenical poison. Peach foliage is very easily injured by arsenical sprays; hence the following dilute formula is recommended to be employed against any leaf-eating caterpillars.

Formula:—

Paris Green or Green Arsenoid	...1 pound
Quick Lime	 3 pounds
Water	175 gallons

Paris green may also be used in connection with weak Bordeaux mixture, at the rate of 4 ounces of the former to 50 gallons of the latter. One spraying with either of the above mixtures will usually kill enough caterpillars, when present, to prevent their causing any considerable injury.

APPLE INSECTS

WOOLLY APHIS.

This little insect belongs to the same family as the plant lice which infest the buds and leaves of the apple during the early summer, and differs from the

Fig. 22.—Woolly aphid (*Schizoneura lanigera*). a, Agamic female; b, larva louse; c, pupa; d, winged female with antenna enlarged above; all greatly enlarged and with waxy excretion removed. (Marlatt, Cic. No. 20, sec. s., Div. of Ent., U. S. Dept. of Agr.)

latter mainly in that it secretes a white cottony substance about its body and infests, as a rule, the roots of the trees. Where trees are infested when they come from the nursery they are likely to be found seriously injured in from two to four years after planting. Its presence on the root is indicated by cottony masses under which, by a close examination, may be detected the brownish-pink bodies of the lice. By feeding upon the roots these lice cause abnormal swellings or galls, the tissue of which soon dies, and

Fig. 23.—Woolly aphid (*Schizoneura lanigera*). a, Root of young tree illustrating deformation; b, section of root with aphids clustered over it; c, root louse, female—a and b, natural size; c, much enlarged. (Marlatt, Cic. No. 20, sec. s., Div. of Ent., U. S. Dept. of Ag.)

the roots are destroyed. The main support of the tree being thus impaired, a high wind soon topples it over. The root-infesting form of the woolly aphid is shown in Figure 23.

Besides the root-infesting form, there is an "aerial" form (see Figure 22) which attacks the trunk and limbs but the injury from this form is not great. This form feeds mostly in cracks, old cuts or bruised places in the bark and its presence is readily detected by the white cottony appearance of the colonies. The damage done by this form is little more than a killing of the bark at the point of attack. The aeri-

al form is readily killed by spraying thoroughly with a whale oil soap solution made of one pound of whale oil soap to each gallon of water; with kerosene emulsion, or with some tobacco solution such as diluted Rose Leaf Tobacco Extract. A home-made tobacco decoction is easily prepared by boiling three pounds of tobacco stems in five gallons of water for three hours, adding water from time to time to make up for evaporation. These colonies on trunk and limbs must be thoroughly drenched with whatever insecticide is used, as the cottony covering protects them effectually from any light application. We consider the aerial form more of an advantage than otherwise, as it serves to give the orchardist warning of the more serious injury that is likely occurring on the roots of the trees at the same time.

An apple tree having its roots infested with woolly aphis usually presents a sickly appearance, with a yellowish foliage and a noticeable scarcity of healthy leaves. Examination of the roots will usually disclose the "aphis galls" in such cases.

As the root-infesting form of this insect is the most injurious, it is important that the main measures should be directed against it. The remedy is easy to apply, but its efficiency depends upon its use when the aphis first appears and while the trees are young. Tobacco dust is an effective remedy and has been used with most gratifying success in Ohio.

In applying this to four or five-year-old apple trees, remove the soil for about two or three feet on each side of the tree, and to a depth of three or four inches. Into this opening sprinkle about five pounds of tobacco dust and replace the dirt. Larger quantities should of course be used upon older and larger trees. Other remedies, such as boiling water, potash soap, ashes, etc., have been tried, but always with little or no success. The tobacco dust remedy should be applied in the spring as soon as the ground is "settled," and its thorough success will depend upon its application before the trees get old and become badly infested.

APPLE TREE BORERS.

A common injury to apple trees is that caused by borers in the main trunk near or just above the surface of the ground. There are two borers which may cause damage, known as the round-headed and the flat-headed. These names are descriptive of the larvae of these two different insects, and, as they

imply, the one is nearly cylindrical in form, with a head about the same size as the body, while the other has a flattened head, which is very broad as compared with the width of the body. There is also a marked difference in the life-history of the two insects.

ROUND-HEADED BORER.

The adult round-headed borer is a beautiful beetle, about three-fourths of an inch in length, of a pale, brownish-yellow color and having two broad, creamy-white stripes running the entire length of the body. These beetles appear during May and June and the females soon thereafter commence to deposit their eggs in cracks or crevices in the bark near the base of the tree. The egg hatches in about two weeks into a minute worm which immediately bores through the bark and begins to feed on the sapwood. For the first year, the larvae confine their attacks to the sapwood, making a disc-shaped burrow about the size of a silver dollar. Unless several are present the injury is not likely to be very noticeable the first season. At the close of the first season the larva or borer, which is as yet but partly grown, goes to the lowest part of the burrow and remains there quietly through the winter. The second year of the borer's life is also passed in the sapwood but it no longer confines itself to a small area, but may work around a small tree, completely girdling it. When more than one borer is present in a small tree this is often the case. The second winter is also passed in the lowest part of the burrow. The third season of the borer's life finds him boring into the heart of the tree, and in the case of a small tree the channel may extend nearly or quite to the opposite side of the trunk.

The borer attains its full development the third summer and after boring into the heart of the tree the channel through which it entered is closed with sawdust-like castings and another opening is made through which the adult beetle may escape the following spring. In this latter channel the larva passes the third and last winter of its life, and in spring the complete change to the adult takes place, and there emerges the beautiful beetle already described.

When a borer is discovered in a tree, the only remedy is to dig him out with a sharp knife. This can be done in August and September. Knowing the life-history, it is evident that borers should be

removed every year, in order to get them while still in their first season's development. If a borer has gone into the heart of the tree a sharp wire may be thrust into the opening and twisted about to kill the borer, even though he may not be entirely removed.

When looking for borers, a sharp lookout should be kept for discolored patches of bark, which, when pressed with the finger give way and indicate the hollow underneath. Oftentimes the presence of a borer is indicated by an exudation of sap together with some of the sawdust intermingled. The sap, or gum, however, does not often come out in great quantities as it does upon peach trees which are attacked by the peach tree borer.

In addition to apple trees, the round-headed borer may attack quince, Juneberry, native crab apple, ash and possibly other trees.

FLAT-HEADED BORER.

The adult flat-headed borer is a beetle about one-half inch in length, with a flattened, oblong body, tapering toward the posterior end. The color is greenish-black, with bronzy reflections, while the legs shine like burnished gold. The feet are shining green in color. As to the life-history of the flat-headed borer, but little need be said except that it is supposed to complete its transformation—from egg to adult—in a single year. From eggs that are laid this summer, adult beetles will develop next summer. The remedy is the same as for the round-headed borer and should be attended to at the same time, namely, during August and September.

REMEDY FOR BORERS.

Aside from the knife remedy, the trees may be protected by a coat of whitewash or a thick alkali soap solution. A still better plan is to wrap the trees, to a height of about eighteen inches, with thick brown paper tied firmly and pressed into the cracks so that no insect can crawl underneath it. Dirt should be piled around the lower end of this band. Whitewash or the soap solution may be applied above the band, but whatever is used for a protection should be applied as early as May 1st to be thoroughly effective. It is also advisable to repeat this application about June 1st, especially if there have been heavy rains. When paper is used this latter should be removed about the first of Au-

gust. All these exterior coverings and applications of whitewash only serve to discourage the adult beetles from depositing eggs, and have no effect whatever upon borers that may have entered the tree.

THE CODLING MOTH.

This is one of the insect enemies that have supposedly come to us from the Old World, and it has now spread to nearly all parts of the United States where apples are grown. The annual damage to the

Fig. 24.—Codling moths, natural size. (After Slingerland, Bul. 142, Cornell University Exp. Station.)

apple crop of the country by this insect is enormous, being estimated by Prof. C. B. Simpson at 12,000,000 barrels, worth about \$11,400,000.* The great majority of the "worms" found in apples are the larvae of this insect. It is evident that the codling moth is at present working more injury to the apple crop of the South than any other pest, the San Jose scale not excepted.

Fig. 25.—Codling moth larva or "apple worm," enlarged about 4 times. (After Simpson, Bul. 41, Div. of Ent., U. S. Dept. of Agriculture.)

The adult codling moth is a small but beautiful insect, but on account of its diminutive size it is seldom noticed by the average apple grower. The adult moths are well illustrated in Figure 24.

*Bulletin 41, Division of Entomology, page 18.

The moths appear in the spring at about the time the apple trees are in bloom and eggs are deposited on both the young apples and on the foliage. There are many opinions as to how and where the young larvae first enter the apple, but it is well established that a great majority of the spring generation crawl into the blossom end of the small apples and there burrow into the flesh of the latter. The larva, when partially grown, is of a delicate pink color, and when matured may attain a length of one-half inch or over. (See Figure 25).

Many of the wormy apples drop before attaining their full size, but the larvae within them continue to feed until grown, when they burrow out of the apple and select a protected place in which to spin their cocoons. Loose bark and rubbish offer favorable inducements to these larvae, and it is in such material in the apple orchard that many cocoons will be found. A knowledge of this habit is of importance as bearing upon the control of this insect.

Remedies.

Spraying with arsenical poison has been found highly profitable, but this spraying must be done at the proper time or it will be of little value. The right time is just after the petals have fallen, and while the calyx end of the apple is still open. At this time it also will be noticed that the apples all stand erect in such a way that a drop of water or spray mixture will be held by the apple as in a cup. (See Fig. 26.) Thus the meal that awaits the codling moth larva is a poisoned one, and as most of the larvae enter the blossom end of the fruit, they will not live to reach the interior of the fruit. This poison spray is best applied in the form of Bordeaux mixture 4-6-50 to which either six ounces of Paris green or two and a half pounds of arsenate of lead is added. The poison should be mixed with a very small amount of water, into a paste, before it is added to the Bordeaux mixture.

See directions for preparing Bordeaux Mixture on page 182.

The arsenate of lead is preferable to Paris green, as the former is not so readily washed off by rains. Paris green, if used slightly in excess, is likely to burn the foliage severely, but with arsenate of lead, there is not this danger. This spraying should be repeated two weeks later, using the same formula for Bordeaux mixture and the same amount of pois-

on. No danger may be apprehended from these early sprayings with poisoned Bordeaux, as by the time the apples are edible—even for cooking purposes—all of the poison will have been washed off by the rains. When it is also desired to control the apple scab, or where the apples are ordinarily attacked by the bitter rot fungus, a third spraying should be given the trees about three weeks after the second. It may be well to emphasize the point that by spraying, we do not mean "sprinkling."

Fig. 26.—Showing the right time to spray for codling moth. The bunch on the left is at proper stage for spraying, while the apples on the right are too far developed for spraying to insure best results. (After a photo by A. L. Quaintance).

Spraying means a thorough but thin application of the spray mixture to all parts of the tree and foliage, as well as fruit, and this application can be made only with a good force-pump which is equipped with a good, fine Vermorel, Mistry, or Bordeaux nozzle. He who "sprinkles" may expect failure.

Mention was made of the fact that apples falling prematurely, contain the larvae in various stages of development. For this reason all wind-falls should be kept cleaned up during the entire season and either burned or fed to stock, in order that the larvae within them may be destroyed before they have a chance to escape. In this way the future generations of the insect may be considerably reduced. Where apples are stored in cellars, bins or out-houses, the latter should be carefully and thoroughly screened to prevent the escape of adult moths which may develop from any apples which are placed in storage. Serious infestations by the codling moths have often been traced directly to the carelessness in not properly screening storage cellars.

Fig. 27.—A wormy apple showing the mass of brown material thrown out at the blossom end by the codling moth larvae. (Alter Slingerland, Bul. 142, Cornell University Experiment Station.)

By taking advantage of the habit of the larvae, after leaving infested apples upon the tree, of crawling down the trunk to find a sheltered place in which to spin cocoons, we have also a simple method of trapping them by putting bands about the tree. For this purpose strips of burlap, old sacks or brown paper may be used. These bands should be four or five inches wide and held in place by stout twine. One band should be placed about the trunk of the tree and another around each principal limb. These bands should be put in place within three weeks after the blooming period and examined every week or ten days and all larvae, pupae or cocoons found under them destroyed. Although the cocoons are not over one-half inch in length, they are white in color and readily found. The bands must be examined at least once every ten days to prevent the adults from escaping. To place bands upon the trees and neglect

them, furnishes the codling moth larvae with the most favorable conditions for successfully reaching maturity.

THE AMERICAN TENT-CATERPILLAR

Everyone is familiar with the white webs of the tent-caterpillar so that no extended discussion will be necessary. Certain points in the life history of this insect should be known.

During winter the eggs may be seen on the small twigs where they occur in a mass, encircling the twig. Each mass contains over 200 eggs which are glued tightly together and covered with a glutinous matter which gives the mass a glistening brown color. The mass of eggs is usually about three-fourths of an inch in length and a little thicker than a plain gold ring.

In spring the little caterpillars hatching from these eggs commence at once to form a web in the nearest crotch. As the caterpillars increase in size the nest is enlarged until it becomes a very conspicuous object. The caterpillars feed during the daytime, leaving the nest for this purpose. During rainy or cloudy days they seldom wander from the nest.

When full grown these caterpillars attain the length of about two inches; body quite hairy, and ornamented with a continuous white stripe along the back, while on either side short yellow stripes occur somewhat irregularly. Each caterpillar changes to a pupa in a yellow, loosely constructed cocoon which is usually located in some protected place, such as a fence corner.

Remedies.

The egg masses may be found during the winter while the trees are bare. In spring if trees are closely watched, the little webs may be found while their inmates are still very small. These nests should be cut out and burned or crushed by hand. Such work, however, must be done in early morning, or about sundown, or on dark, cloudy days, as at other times many of the caterpillars will be feeding away from the nest and thus escape.

APPLE CURCULIO.

This pest is somewhat smaller than the plum cur-

culio, and is dark brown in color. Upon the hinder part of its body, it has four brownish humps. The adults drill holes into the young apples in order to obtain food, and to secure a place to deposit eggs. As soon as the eggs are hatched the young grubs burrow into the core where they feed and grow. One important feature of the work of this insect is that the affected apples do not fall to the ground, thus making it difficult to combat the pest. The best remedy is to gather the affected apples, and destroy them by feeding to the hogs. Great numbers of the adults may be captured by shaking the trees and catching them on a sheet which is placed beneath, after which they may be destroyed by dropping in a pail of water which is covered with kerosene oil.

CANKER WORMS.

The parents of the canker worm are moths, and there are two species, one appearing in the spring and the other in the fall. The males have wings, while the females are wingless and only about a half an inch long. The caterpillars are greenish brown in color and are called measuring worms. Full grown worms are about one inch long. They feed upon the leaves of the apples, pears and peaches, and other fruit trees. The best treatment is to prevent the female moths from laying eggs on the trees, and this can be done by smearing the trunk of the tree with a band of tar and printers' ink mixed with linseed oil, which will prevent the females from crawling up the trunks of the trees to deposit their eggs. These bands should be renewed as long as the weather is warm. However, this treatment is liable to injure the bark of young trees, unless a band of paper is first tied around them, on which the mixture is placed, instead of on the bark of the tree.

In using a paper band care must be taken to have it fit close against the bark, as the insects may crawl under it. Another remedy is to allow the worms to hatch and then spray the trees with Paris green, using a quarter of a pound to fifty gallons of water in addition to one pound of stone lime, or with Bordeaux mixture. Arsenate of lead is also valuable and has the advantage of adhering better than Paris green. Use at the rate of 2 lbs. to 50 gallons of water. The first application of poison should be made just as soon as the first worms appear and a second application should be made after a week or ten days,

if the worms are not all killed. This remedy is often more suitable than the use of repellent bands of tar, or other sticky substances.

SEVENTEEN YEAR LOCUST OR CICADA.

This insect is wedge-shaped and is brownish black in color. The seventeen-year locust is not as large as the common dog-day locust, and the latter is greenish in color. They are called seventeen-year locusts because of the length of time they spend in the ground in an immature stage. Some of the Southern broods only live thirteen years in the immature stage, while in the North the life of the insect is seventeen years. The adults are present about a month and cause a great deal of trouble by depositing their eggs on twigs of the apple, oak, and many other trees. The eggs are deposited in a double row in a slit made in the wood. When the insects are present in large numbers they seriously injure and sometimes kill the trees. When the young hatch, they fall to the ground, and live there the remaining thirteen or seventeen years. Kerosene emulsion will destroy the locusts when they first come out of the ground, but after the swarm has begun flying about there is no remedy. Hogs root out and destroy immature locusts in the ground, while domesticated fowls, sparrows and other birds feed upon them when they appear.

THE MEXICAN COTTON BOLL WEEVIL.

Introduction.

No insect in the history of our country has become more widely known in a few years than the cotton boll weevil, and to-day there is no insect or other enemy of the cotton plant that deserves more attention or careful study. In 1903 the loss to the cotton crop in Texas alone was estimated by the Government Entomologist, Dr. L. O. Howard, at \$15,000,000.00 while in 1904 the loss was estimated at 400,000 bales of cotton, which at the price of only \$50.00 a bale would represent \$20,000,000.00. The cotton crop of 1904 was the largest that has ever been known in the history of our country and some may say that the boll weevil could not have had much to do toward lessening the yield. Those who have studied the matter, however, assert that such a crop cannot again be produced for many years

and while all conditions were favorable to the production of a large cotton crop, the conditions for boll weevil increase were not as good as might reasonably be expected in ordinary years. Thus we must consider the boll weevil as an important question which must not be overlooked.

The boll weevil first appeared in Texas near Brownsville about 1892, having probably crossed the Rio Grande river in unginned cotton or in cottonseed. Since that time the boll weevil has traveled at the rate of about 50 miles a year, until now, as mentioned farther on, it is within about 75 miles of the Mississippi river. Mexico is undoubtedly the native home of the boll weevil, and it is also known to occur in Cuba. The earliest record we have of injury to cotton by the boll weevil is in 1848 in the State of Coahuila in Mexico.

Fig. 28.—Bucket Spray Pump. Should be equipped with at least 15 foot length of hose.

Every farmer living in the cotton growing States should learn to recognize the weevil in order to detect its first appearance in the cotton fields. To enable those persons living in sections where the boll weevil has not yet appeared, to gain a knowledge of the boll weevil the following description and illustrations are presented. The description of the boll weevil and also the insects frequently mistaken for the boll weevil is taken from bulletin No. 12 of the Georgia State Board of Entomology. The writer of that bulletin, Prof. Wilmon Newell, has had wide experience with the boll weevil, both in Texas and Louisiana.

DESCRIPTION OF THE BOLL WEEVIL.

The Adult Weevil.—The adult boll weevil is a

brownish beetle varying in length from one-eighth to five-sixteenths of an inch, and measuring usually slightly over one-sixteenth of an inch across the body at the widest part. The weevil is provided with a long "snout" or proboscis and is not unlike the common acorn weevil in appearance. It is not by any means a far distant relative of the chestnut weevil, the plum curculio and a number of other common weevils with which almost everyone is familiar. Weevils shown natural size in Fig. 30.

In color the boll weevils vary from a slight gray to a dark chocolate brown or black. As a usual thing, the older the weevil the darker in color it becomes, owing to the minute hairs or scales wearing off the body surface. Under an ordinary magnifying glass the weevil is seen to be covered with minute scales, closely resembling hairs. These hair-like scales are clearly shown in Figure 29. The wing-covers are seen to be finely lined, the fine lines or ridges running lengthwise of the body. By far the most reliable character in distinguishing a boll weevil from other similar weevils is the presence of two small spines upon the interior of the femur ("upper joint") of the fore-leg. One of these spines

Fig. 29.—Cotton boll weevil: a, beetle from above; b, same from side—about five times natural size (original.)

is considerably larger than the other. These two spines are not found upon the fore-legs of any other of our common weevils although the occurrence of a single spine is common to many different weevils.

The adult boll weevils pass the winter in trash rubbish, grass, old cotton bolls, and similar material about the infested fields, and also in the leaves and trash of timber lands. These hibernating weevils leave such quarters in the spring, at about the time the first cotton is above ground and beginning to form squares, and having fasted since the previous

autumn, begin to feed to a considerable extent upon the tender buds and stems of the young cotton plants. As noted above, the weevil has a long beak, the end of which is a pair of small but very strong mandibles. With these mandibles the outer layer of the cotton bud or square is torn off, the beak inserted into the softer tissue beneath and this latter actually consumed. A square showing a feeding puncture made by the weevil is seen in Fig. 31. Punctures are made in a similar way by the females in which to deposit eggs, as well as for feeding, but according to Prof. W. D. Hunter, the punctures made for feeding are usually much larger and deeper than those made for receiving the eggs.

The Egg.—The egg of the boll weevil is described

Fig. 30.—Boll Weevils on Cotton Boll.

by Prof. W. E. Hinds as being pearly white in color, oval in form, and about one-thirtieth of an inch in length by a little over 1-2 as wide. The egg is deposited by the female weevil in punctures made in squares or bolls for that purpose. Within the square or boll the egg is well protected from parasites and other enemies. An egg is shown among the anthers in an unopened square in Fig. 32, the position of the egg being indicated by the arrow. The eggs hatch in from 2 1-2 to 4 days. As a rule the females deposit only one egg in a square or form and more than one is rarely deposited in the same square unless as is the case during middle and late summer, squares are not produced in the plants fast enough to accommodate the many females then in the fields. In such cases the eggs are frequently deposited in the young bolls and sometimes more than one egg is deposited in a single square. As long as there are plenty of uninfested squares in the cotton field there is little or no egg deposition in the bolls. Owing to the difficul-

ties of observation, it is hard to say just what is the general average number of eggs deposited by each female, but Professor W. E. Hinds made careful and accurate observations upon several females, all of which deposited over 225 eggs each.

The Larva.—The larva which hatches from the egg within the square or boll, is a white footless "grub" with a brownish colored head and a pair of very substantial mandibles, with which it proceeds to feed upon the tissue surrounding it. The entire larval stage is passed within the square, form or boll in which the egg is deposited, as is also the next or pupal stage. The larva enlarges rapidly after hatching from the egg and by the time it has reached maturity has eaten the greater part of the contents

Fig. 31.—Cotton square flared, showing egg puncture of boll weevil—natural size (original.)

of the average-sized square. During mid-summer the larval stage varies from 6 to 8 days, while in early summer and in autumn it is longer. It has been found that during November and December the larval stage averaged from 20 to 30 days.

One of the first indications of infestation by boll weevil is the flaring of the involucre or "shuck" surrounding the square. This opening of the involucre takes place usually a short time after the larva

hatches from the egg and a few days later the infested square is shed by the plant. A characteristic flared square is shown in Fig. 33. The presence of boll weevils in any considerable numbers in a cotton field is always accompanied by a profuse shedding of squares. However, the latter are often shed on account of certain weather conditions, but in this case no insects or larvae are likely to be found with-

Fig. 32.—Unopened Cotton Bloom, Showing Egg of Boll Weevil among the Anthers, Much Enlarged. (After Sanderson, Proc. Sec. An. Ses. Tex. Cot. Conv.)

in them if they are examined soon after falling. Injury from almost any cause will result in the shedding of squares, and squares which have been eaten into by the boll worm (not boll weevil) are of course shed by the plants. The presence of white larva within shed squares or forms should be regarded with suspicion and all such should be carefully examined. In cotton fields badly infested by the boll weevil the feeding punctures and the punctures made for egg deposition cause the squares to shed as fast as formed and before they have any opportunity to develop into bolls.

The Pupa.—When the larva has completed its growth it ceases to feed, becomes shorter and broader and enters the "pupal stage," during which it takes no food.

The future proboscis, legs and other parts now

begin to appear. The pupae are well illustrated in Fig. 33. This stage lasts from three to six days in mid-summer and is longer at the approach of cold weather. The pupa changes into the adult boll weevil, which emerges from the square or boll (See Fig. 33) and although light in color and soft-bodied upon emergence from the square, it soon becomes darker, the body-covering hardens and the weevil takes its first meal as a fitting celebration of its safe arrival at maturity.

Rate of Increase and Destructiveness.

From the foregoing it will be seen that during mid-summer the time elapsing between egg deposition and the arrival of the weevils at the adult stage may vary from 12 to 18 days. If an average allowance of 6 days be made for the time elapsing between emergence and the beginning of egg deposition by the adult, a generation may be produced

Fig. 33.—Cotton boll weevil: larva at left, pupa at right—about five times natural size (original.)

every 18 to 30 days. During late autumn the period of development is of course much lengthened. Upon facts obtained by actual observation in the infested cotton fields of Texas, Prof. W. D. Hunter estimates that the progeny of a single pair of boll weevil may in a season reach 134 millions of individuals.

As each female during her lifetime deposits egg in each of from 100 to 200 squares, all of which are prevented from making bolls, the magnitude of the destruction will be readily understood.

At the approach of frost in the autumn, the adult weevils seek suitable quarters in which to pass the winter. For the most part rubbish about the cotton fields, leaves in timber lands, grass, partially opened bolls, etc., are selected. In the case of baled cotton which is lying on the ground about gin houses during the autumn, boll weevils are likely to enter the bagging, and if the bale is subsequently moved to other localities the hibernating weevils may be carried with it. During autumn there is also a poss-

ity of weevils, which are seeking hibernating quarters, entering bales of hay, straw, etc., in the infested region. During the hibernating period the boll weevil is in a semi-dormant condition in which it can survive for several months without any food, and during this time it is possible for it to be transported many miles to new or uninfested localities. In the weevil-infested sections of Texas, boll weevils are found abundant in the cotton seed at gin houses, as well as in cotton-seed hulls. As would naturally be expected, the shipment of these cotton products is often found to be the means of distributing the boll weevil to new localities.

Since the first appearance of the boll weevil in Texas it has spread eastward at the rate of about 50 miles a year until at this time it is within about 75 to 100 miles of the Mississippi river. At the present rate of spread it will only be a matter of 12 or 15 years when the boll weevil will be over the entire cotton producing sections of the South. Indeed, in a much shorter time it will spread over the greater part of the area, and the territory which it is about to invade is the richest cotton country east of the Mississippi river. When the cotton boll weevil has spread over the entire cotton belt it is estimated that it will cost the South \$250,000,000.00 per year. Many States are enforcing a quarantine against articles that are likely to carry the boll weevil, and it is confidently hoped that the measures will retard the progress of the weevil, though it is known that the natural spread of 50 to 60 miles a year cannot be prevented unless something appears which it is not now known.

Remedies.

Since the boll weevil was first studied by the experts of the United States Department of Agriculture, there have been hundreds, and we might truly say thousands, of remedies suggested for the control of the boll weevil. In spite of all this work no remedy has been devised, but it has been demonstrated many times over that a system of growing cotton under what is known as the cultural method, makes it possible to grow profitable crops of cotton in sections infested by the boll weevil. It would require too much space to go into all the details and explanations of why the cultural method is the best way to fight the weevil. For the sake of brevity the following recommendations are given.

The reader should note that particular importance is placed on fall destruction of cotton plants to destroy the food of the weevil and thereby cause many of them to starve before winter begins.

From Farmers Bulletin No. 216 by W. D. Hunter in charge of the Cotton Boll Weevil in Texas and Louisiana, we take the following recommendations:

"Although the very large yields of cotton of former times may no longer be possible in the region now infested by the boll weevil, it is entirely feasible to produce cotton at a margin of profit that will compare favorably with that resulting from the production of most of the staple crops of the United States, by following what has become generally known as the cultural method. This method consists of the following changes and modifications of the system of cotton raising, made necessary by the boll weevil. It was originally suggested by a careful study of the life history and habits of the pest, and naturally any improvements that may eventually be made will be the result of the continuation of that study. It has now been tested successfully on a large scale by the Bureau of Entomology, as well as by many planters during three seasons. Of greatest advantage is the reducing of the numbers of the weevils by the destruction of the plants in the fall. The advantage thus gained is followed up by bending every effort toward producing an early crop at the next season.

"(1) Plant early. If possible, plant seed of the varieties known to mature early, or obtain seed from as far North as possible. This recommendation is made as a suggestion for the benefit of those planters who have not taken care in the selection of the cotton seed for planting on their plantation. By far the best method for obtaining early seed is by selection in the field.

"It is much better to run the risk of re-planting, which is not expensive, than to have the crop delayed. The practice of some planters of making two plantings to avoid having all the work of chopping thrown into a short period is very bad policy from the boll weevil standpoint.

"Early cotton of improved varieties has yielded from two to three times as much as native cotton under the same conditions, and in many cases much more. Planted at the same time, the early varieties begin to bloom much earlier than native cotton.

"The early varieties, in general having a small

stalk and short tap-root, are adapted only for rich soil. They also fail to grow well in the very light, drifting sandy loams of many of the river valleys of Texas, which, in long seasons before the advent of the boll weevil, often produced the largest yields. In these situations early varieties will yield but little more than native cotton.

"(2) Cultivate the fields thoroughly. The principal benefit in this comes from the influence that such a practice has upon the constant growth and consequent early maturity of the crop. Very few weevils are killed by cultivation. Much of the benefit of early planting is lost unless it is followed by thorough cultivation. In case of unavoidably delayed planting, the best course for the planter to pursue is to cultivate the fields in the most thorough manner

the weevils become so numerous that practically all the fruit is being punctured. This will generally not be later than the first week in October. Merely cutting off the stalks, by means of the triangular implement used for that purpose throughout the South is by no means as effective as plowing, because the stumps remaining give rise to sprouts which furnish food until late in the season to many weevils that would otherwise starve. The plowing, moreover, serves to place the ground in better condition for early planting the following spring. In some cases turning cattle into the fields is advisable. Aside from amounting to a practical destruction of the plants, grazing of the cotton fields furnishes considerable forage at a time when it is generally much in demand. Nevertheless, cattle should never be turned

Fig. 34.—Boll Weevil Larvae within Cotton Bolls. (After a photo by E. Dwight Sanderson.)

possible. Three choppings and numerous plowings constitute the thorough system of cultivation that is made necessary by the boll weevil. The old plantation rule for the cultivation of cotton, "Once a week and once in the row," is an excellent one.

"(3) Plant the rows as far apart as experience with the land indicates is feasible, and thin out the plants in the rows thoroughly. On land which in normal seasons will produce from 35 to 40 bushels of corn the rows should be 5 feet apart. Even on poor soil it is doubtful if the distance should ever be less than 4 feet.

"(4) Destroy, by plowing up, windrowing, and burning, all the cotton stalks in the fields as soon as

ed into cotton fields in which Johnson grass has become started.

"Recommendations 1, 2, and 3 are all aimed toward avoiding damage by hastening the maturity of the plants and do not involve the actual destruction of the weevils. Recommendation 4, however, reduces the numbers of the pests by destroying the very great proportion developing late in the fall, and is consequently directly remedial.

"(5) It is known that at present fertilizers are not used to any considerable extent in cotton producing in Texas. There is, nevertheless, no doubt that they should be—not that the land is poor, but that earlier crops may be procured. At present it

is sufficient to call attention to the fact that it has been the uniform experience of experiment stations and planters in the eastern part of the belt that certain fertilizers, especially those involving a large percentage of phosphoric acid, have a strong tendency toward hastening the maturity of the plants.

Insects Frequently Mistaken for the Boll Weevil.

Many cotton planters, with commendable zeal, have closely observed the insects occurring in their cotton fields within the past year, and as a result have discovered many kinds of insects the existence of which was previously unknown to them. Many of these have been mistaken for boll weevils. In order to assist the farmer in recognizing the more common of these, a number of species are illustrated on

Where cotton follows cowpeas the adult cowpea-pod weevils sometimes attack the young cotton plants soon after they come up, and do considerable damage.

Fig. 36.—Cowpea-pod Weevil. (After Chittenden, Bul. 45, Div. of Ent., U. S. Dept. of Agr.)

Fig. 35.—Adult Boll Weevil Emerging from Square within which it developed. (After a photo by E. Dwight Sanderson.)

the following pages, and the differences by which they are distinguished from the boll weevil, pointed out. In most cases the illustrations will make this difference clear, without any added description.

The Cowpea-pod Weevil. (*Chalcodermus aeneus* Boh)—This little beetle, which is supposed to breed in the pods of cowpeas, is about the same size as the boll weevil, but is a jet black color. The body-surface is smooth shining black, and instead of the wing-covers being finely lined as in the case of the boll weevil, both elytra and thorax are covered with minute impressions.

The use of an ordinary hand magnifying glass will readily distinguish this weevil from this boll weevil.

The Acorn and Chestnut Weevils.—The acorn wee-

Fig. 37.—Acorn Weevil, *Balaninus victoriensis* Chit. (After Chittenden, Bul. 44, Div. of Ent., U. S. Dept. of Agr.)

vil, the chestnut weevil, and other nut-feeding weevils, all of which closely resemble each other, are discovered from time to time upon cotton plants. It is extremely likely that their occurrence upon cotton is purely accidental, as when cotton is growing near or under chestnut or oak trees. In any event, no damage to cotton need be apprehended from them. A weevil which is typical of the appearance of this group of insects is shown in Fig. 37.

The Blood-weed Weevils.—During the winter a careful examination of the stems of ragweed or blood-

Fig. 38.—Blood-weed Weevil, *Lixus* sp. (After Hunter, Bul. 45, Div. of Ent., U. S. Dept. of Agr.)

weed about almost any field will reveal the presence of long slim weevils in the pith or interior of the stalks. These are the blood-weed weevils, of which there are several species. They are readily distinguished from the boll weevil by the fact that they are long and slim, as shown in the illustration (Fig. 38.) The majority of these blood-weed weevils are one-half inch or more in length, while the boll weevil is ordinarily about one-fourth inch in length and of an entirely different shape.

Other Snout Beetles.—The plum gouger, Fuller's

Fig. 39.—Imbricated Snout Beetle, *Epicaerus imbricatus* Say. (After Chittenden, Bul. 45, Div. of Ent., U. S. Dept. of Agr.)

rose beetle, the imbricated snout beetle and even so common an insect as the plum curculio have been mistaken for boll weevils. None of these feed upon cotton and when found upon cotton plants or among cotton seed their occurrence in such places must be considered as accidental. The imbricated snout beetle is shown in Fig. 39.

Click Beetles.—Every country schoolboy is acquainted with the long, flattened snapping beetles, which when laid upon their backs, "snap" violently into the air. During mid-summer these snapping beetles are occasionally found in cotton bolls which have been injured by the boll worm. They seem to be present for the purpose of feeding on the decaying tissue and exudations following the attacks of the boll worm. We think it extremely improbable that they are responsible for any damage to cotton,

Fig. 40.—Click Beetle, *Monocrepidius vespertinus*. (From Chittenden, Bul. 45, Div. of Ent., U. S. Dept. of Agr.)

as we have never learned of their attacking healthy bolls or squares. Their shape, as well as their habit of "snapping," when laid upon their backs upon a level surface, will readily enable anyone to distinguish them from the boll weevil.

The Cotton Sharpshooter.—It seems strange that an insect which is not a weevil at all or which is not even a beetle, should be mistaken for a boll weevil.

The cotton sharp shooter, shown in Fig. 41, is about one-half inch in length and is not infrequently found upon cotton, which it injures by puncturing both the young growth and the squares and forms. The insect is very agile, running to the opposite side of the cotton stem when approached, and flies readily. It is not easily captured, and this fact alone will always relieve the planter's mind of any fear that it may be a boll weevil. Ordinarily the real boll weevils can be picked from the plants or

squares without any precaution being taken to avoid their escape.

Fig. 41.—Cotton Sharpshooter, *Homalodisa triquetra*. (After Riley & Howard in *Insect Life*.)

The Cotton Boll Worm. (*Heliothis armiger*.)—

There is a tendency on the part of some persons, not familiar with insects, to confuse the names "boll weevil" and "boll worm," believing that these terms apply to one and the same insect. As a matter of fact they are entirely distinct and separate insects belonging to two widely separated Orders or groups.

The parent of the boll worm is a moth, not likely to be taken for a boll weevil by even the most unobserving. The attacks of the boll worm larvae upon the cotton squares or bolls often give rise to reported occurrences of the boll weevil. The attack of the nearly-grown boll worm upon the bolls, takes the form of distinct holes, which are about one-fourth of an inch in diameter, made usually in the base or side of the boll. No such injury as this is ever made by a boll weevil. The holes eaten into squares by the very young boll worms may, however, be confused with the holes made in squares by adult boll weevils when the latter emerge. In the case of injury of this kind, a careful search will usually reveal the young boll worm in the act of eating into the square, or even eating within it. The boll worm larva is readily separated from the boll weevil larva. The young boll worm is supplied with legs, whereas the boll weevil larva is a footless grub, white in color, and incapable of crawling from square to square as the young boll worms do.

THE COTTON BOLL WORM.

Injury from this insect has long been familiar to all cotton growers in the entire South. Its regular appearance in greater or less numbers each year has caused growers to give but little attention to the injury caused by the boll worm. In the following paragraphs it will be seen that boll worm injury to cotton is not common until about August 1st, when its favorite food plant, corn, has become hard and distasteful.

Besides feeding on cotton the boll worm is often a serious pest on corn, tomatoes, beans, peas, okra and tobacco. All the other crops mentioned are injured by the boll worms boring into the fruit, or in the case of beans and peas, into the pods.

The Insect Described.

The boll worm belongs to the class of insects that have four distinct stages in their development, namely: adult, egg, larva and pupa. The adult is a moth which commonly flies in the night, but when disturbed during the day-time they fly with a quick darting motion that is quite characteristic. The moths vary in size, but in general they have a wing expanse of about one and one-half inches. The color may also vary greatly, ranging from a dull yellow to a dull olive-green with numerous dark spots and markings on the wings. These moths may be easily distinguished from the cotton leaf-worm, or caterpillar moth by the fact that when at rest the boll worm moth holds its wings slightly raised and parted to expose a portion of the body, while the cotton caterpillar moths always rest with the wings tightly closed. The accompanying figure shows the general shape and size to good advantage. (Fig. 42.)

Moths usually appear in spring about the time that corn is ten or fifteen inches high,* and in general they prefer to deposit eggs on young corn instead of cotton, the eggs being laid on all parts of the plant, but a preference is shown for silk if it is present.

The eggs are small, oval in shape, whitish or yellow in color, and may be seen with the unaided eye. Each female deposits on an average 1,100 eggs. These eggs hatch in from 3 to 10 days, depending on the season.

From these eggs minute worms are hatched which are at first pale green in color, but soon become

*Quaintance & Bishop, U. S. Dept. of Agr. Farmers Bul. 212.

darker. The full grown larvae may vary in color from pale green to brown or almost black. These worms are voracious feeders, a single individual often destroying a large number of squares or bolls. This habit of going from one place to another on the plant, for the purpose of feeding, explains the reason why the farmer finds many young squares with a hole in the base but no sign of the transgressor. (See Fig. 43.) Boll worms when first hatched wander around on the plant feeding on the leaves until they find a square or form into which they bore. It is during this time that the worms may be poisoned with arsenicals. A full grown boll worm measures from 1 1-4 to 1 1-2 inches in length,

Fig. 42.—Cotton Boll Worm: a, adult moth; b and c, larvae; d, chrysalis or pupa; (After Howard, Yearbook, U. S. Dept. of Agr., 1898.)

(see Fig. 1) and they may complete their growth during the summer season in about fifteen days.

When full grown the worms descend into the ground where a cell is constructed in which the pupal stage is passed. This period usually covers about two weeks on the average. From the pupa there emerges the adult moth, as already described, ready to mate and deposit eggs for the next generation.

In the South there are at least four and possibly five generations, so it will readily be seen that if

Fig. 43.—Cotton squares destroyed by Boll Worms. (Original.)

the boll worms confined their attacks from the first to cotton the damage would be tremendous. In general it may be said that the third brood is the one that injures cotton most severely.

Remedies and Prevention.

Of the two, prevention is the best, but for the protection of this year's crop, if the boll worms appear, the remedy must be considered. There are two main methods of preventing injury to cotton. The use of corn planted in rows through the cotton field to serve as a trap, and the application of arsenical poisons to destroy the worms when on the cotton.

Corn as a trap plant should be planted in rows every 200 or 300 feet throughout the entire field. This corn should be planted late, about the middle of May or June 1st, so as to be in prime silking condition about August 1st. As the boll worm moths

seem to prefer corn to cotton most of the eggs will be deposited on the corn, which can be destroyed or fed to stock when the worms are partly grown. If an early maturing variety of corn is planted about May 1st, and more of the same variety planted about June 1st, the planter will always have an attractive plant for the moths during the period when they are expected to be most abundant. Cowpeas should be planted between the corn rows in time to be in bloom when the corn is in silk. The blooms will attract the moths.

Poisoning should be attempted when the forms

the plant at once (See Fig 44) has proved to be most economical. This fact has been demonstrated by experiments conducted in the Southern States; notably, Texas and Georgia. It has been found that the best way to apply the poison is to mix it with fine lime dust—cheap flour can be substituted—used in the proportion, 1 pound of Paris green to 4 pounds of dust. This should be applied so as to put at least 2 pounds of the Paris green to each acre. Owing to the fact that the boll worms feed to some extent on the leaves and pass frequently from one place to another even when working on the

Fig. 44.—Method of applying Paris green in dry form to cotton plants. (Photo by Wilmon Newell.)

first appear on the cotton. Experiments in Texas by Prof. A. L. Quaintance in 1904 showed that it will pay well in most cases to poison for the third brood. In some sections, as the worms of the second brood do so much damage, it will probably be found advisable to poison as soon as the first worms appear on the cotton. This will be about June 1. The old method of applying poison by means of the simple dusting apparatus carried by a man who walks rapidly along the row dusting both sides of

squares and bolls, it is possible to destroy large numbers with the use of poison.

The dusting apparatus shown in Fig. 45 is made from a one inch board, 4 1-2 feet long and three inches wide, by boring an inch and a half auger hole five inches from each end, and attaching under each hole a sack five inches wide by about fifteen inches long. These sacks can be made from unstarched sheeting running about 4 pounds to the yard. If it is found that the poison is being applied too fast or

too slow the proportion of lime, or flour and Paris green, must be changed so that the required amount of actual poison will be applied per acre.

THE COTTON CATERPILLAR.

This enemy of cotton is mentioned here, and fig.

Fig. 45.—Dusting apparatus for applying Paris green to cotton plants.

Possibly the most valuable and economical way of fighting the boll worm is to plow the land during the fall and winter, thus breaking up the pupal cells in which the winter is passed. It has been found that nearly all the pupa thus disturbed will die during the winter. This practice should be followed in all sections where the boll worm is known to occur. This is also a valuable way of fighting many other insects such as Corn Stalk Borers, Grub Worms, Squash Vine Borers, and all insects that pass the winter under ground.

Attacking Other Crops.

As already mentioned, tomatoes are often injured by boll worms, though when occurring on tomatoes they are generally known as "tomato fruit worm." The damage is caused by the worms boring into the green and ripening tomatoes, in which large excavations are often made. When occurring on tomatoes the worms usually have to be picked off by hand. Poison in liquid form, as recommended further on for cotton caterpillar, may be applied while the plants are small. The worms frequently bore into the stems of tomato plants at first, but soon transfer their attacks to the fruit. Winter plowing of gardens will aid in keeping this pest in check.

Corn injured by boll worms should be cut and fed to stock to destroy the larvae and the eggs which may be present. Early corn is most liable to be infested and a strict cleaning out of all infested plants during June or July will greatly reduce the numbers of the following broods.

When peas and beans, that will be shelled before using, are attacked, the poison in the form of arsenate of lead or Paris green and lime mixture is recommended.

ures presented principally to show the difference between it and the boll worm.

The main points of difference to be noted between the cotton caterpillar, or leaf worm, as it is sometimes called, and the boll worm, is in their mode of injuring the plant. While the boll worms feed to some extent on the foliage, the cotton caterpillar feed entirely on the leaves and buds unless in extreme cases where the plant is entirely defoliated. At such times they may gnaw into the squares and green bolls, but seldom do much injury in this way.

Fig. 46.—Cotton Caterpillar Moth: a, wings expanded; b, wings closed, at rest. (After Riley, Fourth Rept., U. S. Entom. Comm.)

Fig. 46 shows the adult caterpillar moth, which may be compared with the boll worm moth. Fig. 47 represents full grown caterpillars. Unlike the boll worm the caterpillar does not go into the ground to pupate. This stage is passed in a folded leaf on the plant. There are always several generations each year and as the complete life cycle from egg to adult may be covered in from three to four weeks, it is evident that the increase may at times be very rapid.

Remedy.

The remedy is the same as recommended for boll worms in regard to poisoning. The plants should

be watched closely and poison applied while the caterpillars are small—as they are more easily kill-

ed then—and the injury to foliage avoided. Dusting with Paris green and lime dust should be done during the early morning hours, as it will adhere better to the plants at that time. In wet weather dust is frequently washed off by rains, and in that event we would advise the use of Paris green in water, using a formula,

1 pound Paris green,
2 pounds stone lime,
100 gallons water.

Or in place of the above, arsenate of lead (Disparine) may be used at the rate of 3 pounds to 50 gallons of water. The latter will adhere somewhat better than Paris green mixture, but cannot always be as readily obtained when needed at short notice.

Fig. 47.—Cotton Caterpillar: a, from side; b, from above; twice natural size. (After Riley, Fourth Rept., U. S. Entom. Comm.)

INSECTS INJURIOUS TO CORN AND TRUCK CROPS.

THE CORN STALK BORER.

This enemy of corn has been known since early in the nineteenth century, as it was described by Rev. Lansdown Guild in 1828, who reported its presence in sugar-cane in the Island of St. Vincent in the West Indies. Dr. Howard concludes that it must be a native of the West Indies or of South America where the cultivation of sugar-cane was first begun in America. In 1855 this pest was reported as injuring sugar-cane in the State of Louisiana, and in 1881 we learn that the U. S. Division of Entomology made observations on the ravages of this pest in Louisiana, where it was severely injuring sugar-cane. In Georgia it was found in Lincoln County in 1880, and was reported from South Carolina about the same time. It was probably some years previous to this date that the borer began to attack corn as well as sugar-cane.

Life History and General Appearance.

The corn stalk borer is a white six-footed larva attaining a size when full grown of about one inch in length (See Fig. 48.) The winter is passed in the pupa stage embedded in the corn stubble near the

surface of the ground. Early in spring the moths issue from the over-wintering pupae and when the corn is only a few inches high the eggs are deposited on the stem and leaves. These eggs hatch in a short time into small borers which at once commence to tunnel into the stalk and up through the pithy center. The injury may be quite considerable and may even necessitate replanting.

Observations made by the writer show that some of the borers of the first brood may attain full growth by the first week in June. The change to the pupa at once takes place, usually in the stalk above ground, and adult moths emerge at least as early as the middle of June in the latitude of South Georgia. Moths continue to issue until about the middle of July.

Corn stalk borers are very active and pass frequently in and out of the stalk in which they are working, thus making a large number of holes. The accompanying figure shows the appearance of a corn stalk in which borers were at work. Most of the damage is confined to the three lower joints, but in a few cases larvae and pupae were found three feet up in the stalk.

The adult corn stalk borer is a delicate looking moth, fore wings dull yellowish brown, in some cas-

es having very little color. The males in all cases have the fore wings a little darker than the females, and the former are always somewhat small in size. Wing expanse varies from a little over one inch to a little more than one and one-half inches. The hind wings are always clear white or cream in color.

Fig. 48.—A corn stalk cut open showing borers within. (Original.)

The writer is informed that the corn stalk borer injured corn in Georgia in 1900 to an extent of 50 per cent. It has been observed that the injury is greatest during dry seasons, as 1900 was very dry, as was also the season of 1904.

Borers may occur in corn stalks without seeming to

injure the yield, but usually a certain per cent. of the stalks are destroyed while the corn is still small. This injury should be guarded against, and can be largely averted by following the suggestions given in the paragraphs on Remedies.

Remedies.

Considering the habit of the stalk borer it is evident that the damage cannot be stopped after the borer has once gained access to the stalk, without at the same time destroying the corn. It is not practical to remove the borers, unless from a few stalks of corn in the garden, as is recommended for the squash vine borer. It is clearly apparent that corn following corn year after year is most liable to infestation because of the number of borers that winter over in the old stubble. The usual practice in the South of allowing the corn stubble to remain on land is the principal cause of the bad invasions of stalk borers; along this same line rotation of crops offers a relief from the pest. This is an old suggestion, but it remains good.

In infested fields all corn stubble should be gathered and burned to destroy the pupae that are wintering therein. Deep plowing in early spring to bury all stalks that were not gathered will be advantageous. The pupa should be buried so deeply that the emerging moths cannot escape.

If rotation of crops, burning stubble and deep plowing are practiced, corn stalk borers can generally be successfully controlled.

CORN ROOT WORM.

Corn is often attacked by a root worm soon after the plants appear in the spring. The injury is caused by the larva of a beetle that is common in the South and known as the twelve-spotted *Diabrotica*, the scientific name being *Diabrotica 12-punctata*. To farmers it is locally known as "bud worm" on account of its causing the bud to wilt when the roots are attacked.

The adult *Diabrotica* is a green beetle (See Fig. 49) about one-third to one-half inch in length, oblong in outline, tapering toward the anterior end, and having three transverse rows of four black spots on the wings. The adults often feed voraciously on melon, squash and cucumber, and they have been known to feed on almost every farm crop imaginable. In fact, they are practically omnivorous.

These root worms have been found to injure corn in bottom lands most severely, and especially early plantings. Corn planted after May 5th to 10th is seldom injured severely, as most of the eggs are deposited previous to that time. When corn is planted early a surplus of seed can be used and in most cases enough plants will be uninjured to insure a full stand without re-planting. A simple rotation of crops will often suffice to prevent injury from corn root worms.

Fig. 49.—Adult beetle, parent of corn root worm (enlarged).
(Original).

The suggestion that corn can be treated so as to become distasteful to corn root worms, was shown to be worthless by Quaintance in 1900.* So also was the use of kainit as a fertilizer in killing the larvae. In one case he found root worms even worse where kainit was applied.

Melons, squash and cucumber plants attacked by the adult *Diabrotica* should be dusted with land plaster and Paris green in the morning while the plants are wet with dew. As this insect eats large holes in the foliage the use of poison will be found advantageous.

As a matter of interest it may be stated that the 12-spotted *Diabrotica* has often been charged with spreading diseases, such as the pear blight, by visiting the blooms and carrying the blight bacillus from one point to another.

THE SQUASH VINE BORER.

Like the corn stalk borer this insect does its damage by burrowing in the stalks of its host plant. Its injury is confined mainly to squash and pumpkins, but melons, cucumbers, etc., may be attacked. The adult moth, parent of the borer, is one of our

most beautiful species, and described by Quaintance as having fore wings opaque, shining olive brown in color, with metallic green reflections; the hind wings transparent with a narrow fringe of scales. Hind pair of legs are thickly fringed with hairs, which on the inside are black, and on the outside orange colored. The body is about three-fourths of an inch long and the wings may expand one and one-fourth inches. (See Fig. 50.)

The moths appear about the middle of May and

Fig. 50.—Moth, or parent of the squash vine borer. (After Quaintance, Ga. Ex. Sta. Bul. 45.)

deposit eggs on various parts of the plants, mainly along the stem, as determined by Quaintance. Eggs hatch in from six to fifteen days and the larvae attain full growth in about one month.

How to Detect Presence of Squash Vine Borers.

During the latter part of May and the first part of June examine the vines and if there are any accumulations of yellowish excrement around the stem, carefully cut open the stem and remove the white grub-like borer. This will often save the plant without much injury resulting from cutting. The injury is caused by the borers making large channels in the stem (See Fig. 51,) and often causing the whole plant to shrivel and die. Ordinary insecticides and repellents are of very little use. The grower must watch closely and remove the borers when they are present. After the crop is gathered the vines should at once be pulled and burned to destroy all borers of the second brood.

Fall plowing and harrowing the gardens will de-

*U. S. Dept. of Agr., Div. of Ent., n. s. Bul. 26.

stroy many pupae; this coupled with clean culture and destruction of infested stalks will result in keeping the borers in check in most cases.

Fig. 51.—A squash stem cut open showing the borers within.
(After Quaintance, Ga. Exp. Sta. Bul. 45.)

CUTWORMS.

Cutworms may easily be classed as one of our most injurious species of insects. Working silently in the night, as they do, a vast amount of injury may occur before the damage is discovered. A knowledge of the life history and habits is necessary in order to understand how to fight this pest.

Life History.—The adult cutworm moths appear during the months of June and July, and soon after arrival begin to deposit eggs on the grass, weeds and rubbish. A grassy sod may be selected as the place to deposit eggs or any field where there is an abundance of grass and weeds. Eggs hatch in a short time and the young cutworms, at first very small, begin to feed on any succulent vegetation at hand. At this time of year they are so small and the food so abundant that the injury caused is not noticeable. By the time cold weather approaches the cutworms may be in all stages of maturity, from one-half inch in size to nearly full grown. So far no noticeable injury has occurred. Cutworms pass the winter in little earthen cells in the soil under rubbish, stones or any protected place.

In the spring when the land is plowed the cutworms, emerging from their winter quarters with ravenous appetites after their long winter fast, begin to feed on any vegetation at hand. It is, therefore, evident that the first plants to come up in the garden will be liable to be cut off by the little cutworms.

Description.—The adults of our cutworms are moths belonging to the family, Noctuidae, meaning night fliers, and for that reason they are seldom seen unless attracted to lights. Moths range in size from one and one-half to two and one-half inches in wing expanse. Color of front wings dark brown or grey; hind wings always lighter than fore wings. Cutworms have naked bodies, eight pairs of legs, three in front and five at the posterior end of the body; color may vary from dirty green to grey or dirty brown. Full grown worms average one and one-half inches in length.

Remedies.—Injury from these insects may be largely prevented by any or all of several methods. First of all should be mentioned fall plowing to expose the pupal cells in which cutworms pass the winter. This should be practised in fields where cutworms have been numerous. Second, poison the cutworms in the spring with poisoned bran-mash or clover, before the crop is planted. This can be accomplished by fitting land a few days previous to the time when seed is to be sown. For poisoned bran-mash use one pound of Paris green, forty pounds of bran, two quarts of molasses and mix this with just enough water to make a thick dough that

can readily be made into balls. This mash may be placed on the land in little heaps just before night-fall. The cutworms being deprived of all other food, if the land has been fitted as suggested, will readily eat the mash while it is fresh.

Another very good plan is to spray a small piece of succulent clover with Paris green, one pound to twenty-five gallons of water, cut the clover, and spread it on the land before it has time to wilt. This should be done about sun-down and such bait will be very attractive to the cutworms. It is almost worthless to attempt to poison cutworms after the crop is up, or if there is much grass or weeds on the land.

When tomatoes, cabbages and the like are to be transplanted fit the land several days in advance, let it remain untouched for two or three days, in order that the cutworms may become hungry, and then try poison bait for three nights in succession. Newly plowed sod land should always be treated in this way for reasons already stated. No rubbish or weeds should be left on land after the main crop is removed as it furnishes food for the cutworms during the fall months and protection during the winter.

As some people object to the use of poison bait on account of liability of poisoning poultry and other animals, bands of tarred paper are recommended for use around such plants as cabbage and tomatoes. This paper may be pushed into the ground around each plant to a depth of at least one inch so that the cutworms will not crawl underneath. This will protect the plants while small and the bands may be removed after a few weeks and used around other plants.

SQUASH BUG.

This is the rather large, flattened rusty black bug which injures squash and other cucurbits. This insect has a sharp, pointed beak, through which it draws the sap from the plant. Infested plants become yellow, and sickly and often die.

Remedy.—Hand picking of adults when they first appear is recommended. They may also be trapped under pieces of board, or leaves from the plant, laid on the ground and examined each morning.

The eggs are laid in masses on the under sides of the leaves and are readily seen owing to the yellow color. These egg masses should be found and destroyed. If any hatch, the young will be found feed-

ing in groups. These may be crushed between the fingers. Attention to these minor details will usually be the means of preventing serious injury.

Clean cultivation of gardens, keeping all weeds, trash and vines removed, will cause many squash bugs to succumb to the winter weather.

THE CUCUMBER BEETLE.

This is the little yellow black-striped beetle that feeds on the young cucumber and melon vines and damages them badly at times by eating small holes in the leaves. This beetle will be readily recognized by the following description: Beetles about one-fourth inch in length; head and antennae black; general body color yellow, with a black stripe on each wing-cover, and a third stripe where the wings meet along the back. Stripes run longitudinally.

These small beetles pass the winter under cover of leaves and trash around the garden. In the spring they come out and deposit eggs in the soil near the base of the food plants, and the larvae when hatched live on the roots. These larvae are slender little white grubs and when numerous they may do considerable damage. The principal injury is caused by the adults feeding on the leaves.

Remedies.—Clean cultivation of the gardens after the crops are off in the fall so as not to leave any rubbish under which the adults may pass the winter. Protecting the young plants with gauze netting while the plants are small. Where plants are protected for three or four weeks, or until they get well started, the injury from cucumber beetles will not be great. Two pieces of wire bent over the plants in the form of a double arch, and thrust firmly into the ground, will make a good frame for a netting to cover young plants. Sprinkling plaster on the plants while young will often serve to keep the beetles away, but protection with netting is the only sure prevention.

COLORADO POTATO BEETLE.

This troublesome pest of the potato plant is so common that it seems almost unnecessary to mention it. Still the fact of its being common seems to keep many people from learning how easily it may be controlled. It is a fact that our new insect pests often receive more attention and are fought with

more vigor than the ones that are always with us.

The Colorado potato beetle derived its name from its native home. Until about the middle of the nineteenth century this beetle was not conspicuous as a garden pest, for before that time it fed on weeds of the same genus as the potato plant.

Life History.—Late in fall the beetles enter the ground and hibernate until the warm spring sunshine brings them out. The females soon commence to deposit eggs on the under side of the leaves. These eggs are yellow, occur in clusters and are easily seen. In a short time the eggs hatch into larvae having enormous appetites, which they at once commence to satisfy. The soft-bodied larvae increase in size with alarming rapidity and when full grown, which is in from three to four weeks, they go into the ground and form a smooth cell in which the pupal stage is passed. There are several broods

Fig. 52.—Adult Potato Beetle.

in the South and larvae of all sizes can generally be found on a plant. Fig. 52 shows an adult beetle.

Remedies.—Paris green in any form is death to potato beetles. While the plants are small it may be applied as a dry powder mixed with ten times its weight of cheap flour, land plaster or air-slacked lime. This powder can be dusted on the plants while wet with dew early in the morning, or after sundown in the evening. The duster recommended for cotton caterpillar poisoning will be found useful. Or Paris green may be applied in liquid form, by mixing one pound of poison and two pounds stone lime in 125 gallons of water. The lime should always be used to prevent burning of foliage. It is even better to use the arsenical in connection with Bordeaux mixture. (See directions under Insecticides for preparing Bordeaux-Paris green mixture.)

FLEA BEETLES.

Cucumbers, tomatoes, melons, turnips and many other garden vegetables are often attacked early in

their life by little jumping beetles that make small round or irregular holes in the foliage, and from their ability to jump, they have been given the name of Flea Beetles. The damage from these little fellows is sometimes very severe, as they attack the plants while small and tender. The larvae are mostly leaf-miners, living in the tissue of the leaves and stems of the host plant, though seldom doing much damage.

Flea beetles vary in size and color, some of them being so small as hardly to be seen, while others, like the grape flea beetle, being nearly one-quarter of an inch long. All have thickened hind legs enabling them to jump readily. They will be recognized by this characteristic. Color ranges through steel blue, brown and black.

Remedies.—Clean culture of the garden is the very best thing to practice, as flea beetles hide in rubbish and trash through the winter. When they appear in the spring young plants may be sprayed with arsenical poisons, unless the plants are protected by a cover as recommended for the Cucumber beetle. It has been found that young plants covered thickly with ordinary Bordeaux mixture are not often severely attacked, the mixture acting as a repellent. Usually it is best to add Paris green or green arsenoid to the Bordeaux as it will poison some beetles. When the plants have attained some size they are seldom injured by these insects. Simply dusting plants with lime dust will drive some species of flea beetles away. However, it cannot be depended on in all cases and the best plan is to use an arsenical poison, or cover the plants.

CABBAGE WORMS.

Every one living in the country has seen the common white butterflies that usually appear early in the spring and love to hover around in sunny places, but many perhaps do not know that these butterflies are the parents of our most common cabbage worms that yearly depredate the cabbage patches. There are two common cabbage worms, one known as the imported cabbage worm, and the other as the native cabbage worms. The former was imported many years ago from Europe and the latter is indigenous to this country.

Imported Cabbage Worm.—The adult butterfly is

white in color with a faint creamy tinge; the males have one black spot and the females two similar spots on each front wing. In addition to this they both have the front wings tipped with black. The hind wings in both sexes bear a black spot near the front margin. These butterflies have a wing expanse of from one and one-half to one and three-fourth inches. Worms when grown are green in color, sometimes having an obscure longitudinal black stripe along the back. The worms or larvae when grown change to pupae on the plant, attaching themselves by a silken band. There are several broods and the winter is passed in the pupal stage.

Native Cabbage Butterfly.—Adult males of this species closely resemble the imported species in size, color and marking. The females, however, look quite different; though white in general color the wings are much marked with angular black spots. The worms show four longitudinal pale yellow stripes, two on each side of the body. In other respects the species are much alike.

Remedies.—Experiments show that cabbage worms succumb to any arsenical poison, but its use has not been generally recommended because of prejudice against the use of poison on account of danger of poisoning the consumer. It may be interesting to the reader to know that experiments have been made in which cabbage heads sprayed with Paris green have been subjected to chemical analysis to find out how much poison actually remained after the first few days. In every case there was only a slight trace, if any; certainly not enough to be dangerous. Besides, cabbages grow from the inside out and the outer leaves are always removed before cooking. It may be said that with ordinary care it is safe to spray cabbages with arsenical poison. We do not, however, recommend its use on full grown cabbage.

Paris green or green arsenoid may be used with lime and water, in the following proportions: Paris green, 1 pounds, stone lime, 1 pound, water, 150 gallons. Or arsenate of lead may be used at the rate of 2 pounds in 50 gallons of water.

Four sprayings through the season will usually suffice to keep the worms in check. When the plants are nearly full grown the use of fresh Hellebore powder is recommended. This should be dusted on the plants every two or three days. It soon loses its

poison property when exposed to the air, hence the necessity of repeating the application so often.

Poison for Cabbage Worms.

Prof. Williams of the Nebraska Experiment Station gives the following:

"I filled an insect duster, or dust bellows, holding about two quarts, nearly full of air-slacked lime, to which I added a teacupful of green arsenoid. This, after being well mixed by shaking and turning over of the bellows, was applied to our late cabbages in a fine dust that covered the center of the heads or wherever the worms were found. One dusterful was found ample to treat from 800 to 1,000 cabbage plants, just beginning to head. Two days after dusting there was hardly a live worm to be found, but the dead ones were greatly in evidence. On rows adjoining we used separate tests of clear lime dust, road dust. Bordeaux mixture with Paris green and rosin compound with Paris green. Neither of these gave any desired results and we went over these rows later also with the lime and green arsenoid mixture. Green arsenoid is a preparation very similar to Paris green, equalling it in the per cent. of arsenic, but differing in formation of crystals. Paris green or London purple would no doubt be equally as effective. The dust form has the advantage of the liquid solution of these poisons in that the former adheres more closely to the leaves. In the proportion used, one part poison to seven parts of lime, the dust can be distributed quite evenly and with no danger of getting an overdose of the poison. An ounce of the poison in this mixture would be distributed to 100 heads or more, and a person would have to eat ten heads or more—outside leaves and all to become poisoned.

PLANT LICE.

Several truck and garden crops are annually injured by small green, yellow or brown soft-bodied insects that live by sucking the plant juices. Plant lice are so small that they often pass unnoticed until considerable injury to plants has occurred, when the sickly appearance of the plants causes them to be examined. The lice usually occur on the under surface of leaves, when that is possible, though cabbages may be covered all over.

Melon Louse.—These lice may appear on melons

early in the spring, winged individuals coming from some of their many food plants in adjoining fields. The winged forms give birth to living young, and these in turn reach maturity in about eight days, and bring forth more young. The colonies thus formed live on the under side of the leaves and may soon cause small plants to turn yellow and die. The leaves soon become curled and mis-shapen. More colonies are established by winged individuals that fly from one place to another. These lice may continue to multiply all summer, unless checked by artificial means. The winter is passed in the egg stage, and possibly in hibernation.

Remedies.—Spraying with kerosene emulsion or whale oil soap solution. To do this thoroughly the vines must be turned over or else use a curved rod to carry the spray to the under side of the leaves. Spray as soon as the first lice appear because when the leaves become curled the lice are hard to hit. Carbon bi-sulphide may be used to good advantage when the plants are small. Carbon bi-sulphide is a liquid and can be purchased from any drug store. Dr. John B. Smith* recommends using one dram, which is about equivalent to one teaspoonful to each cubic foot of space. A practically air-tight cover must be placed over each plant to be treated. The cover can be made of heavy ducking stretched over a light wood or wire frame. Place the liquid in a shallow dish on the ground and let the plant remain covered for one hour. It is estimated that five doses will cost only one cent if the carbon bi-sulphide is purchased at wholesale prices.

Cabbage Lice.—For lice on cabbage we would recommend spraying with kerosene emulsion or soap solution. Oftentimes a strong soap solution made from common washing powder is found fully as effective as the kerosene emulsion. The thing to avoid is letting the lice multiply to great numbers before treating the infested plants. Furthermore, one spraying should not be expected to kill every insect, and as they increase with such rapidity, the second treatment should be given in four or five days after the first. Thoroughly controlling the lice while the plants are small is the best practice.

Plant lice on any crop may be controlled if taken in time. The insects are soft-bodied and easily succumb to any common contact poison.

*New Jersey Exp. Sta. Bul. 121, p. 10.

In cabbage fields all stumps should be pulled out and burned to destroy the lice remaining after the crop is gathered. Also keep down such weeds as mustard, shepherd's purse and the like, as cabbage lice flourish on such as well as on cabbage. Practice clean culture in gardens and along fence rows and walks near the garden.

INSECTS INJURIOUS TO TOBACCO.

The tobacco plant, fortunately, is not subject to attack from as many insects as might be expected, owing to the nature of the plant. The insects that are injurious are so on account of the fact that the plant is easily injured, particularly the leaf, for market purposes, on account of the holes in the leaves rendering them unfit to be used for wrappers. Furthermore the leaves that can be used for wrappers are usually comparatively few, and therefore expensive, rendering the slightest injury of considerable importance. The insects mentioned in the following paragraphs are the ones most liable to cause injury to the tobacco plant.

CUTWORMS.

The paragraph on cutworms included in the division "Truck Crop Insects," and the remedies given therein are applicable to the cutworm injury to tobacco. (See page 220.)

THE TOBACCO STALK WORM.

This insect is also known as the Corn-root Webworm, and was found by Prof. W. G. Johnson as a serious pest to tobacco in Southern Maryland, and is probably liable to occur farther South.

Injury.—The injury to tobacco is described by Prof. Johnson as follows: "The injured tobacco had a leaf-spread of from ten to twelve inches. A few rods beyond where the soil was not so gravelly and better, we found the larvae had literally destroyed the first and second planting. * * * * * So far as I could ascertain the attack is always at the surface or just below. In many instances the larvae had hollowed out the stalk from the base of the roots to the branches of the first leaves. * * * * * In the great majority of cases the larvae were found in a small mass of web near the plant, and sometimes within it."

Remedies.—This insect works its greatest damage to grass and clover and will usually be found in sod land. Tobacco growers should therefore avoid planting tobacco on freshly plowed sod land. If the land is used for cotton or potatoes for two or three years and then planted to tobacco very little injury will follow from this insect. If absolutely necessary to plant tobacco on sod land it should be plowed early in spring, and frequently rolled and harrowed, to starve and destroy the larvae that live over winter in the soil. By delaying the planting of tobacco, while keeping up frequently cultivation, most of the injury from this insect will be avoided.

The Spined Tobacco-Bug.

The stems of tobacco plants are sometimes injured by a true bug (a sucking insect) which punctures the stems to obtain food. Concerning the spined tobacco-bug, Prof. Garmen, of Kentucky, writes: "Occasional plants in tobacco fields are at times observed to have become suddenly wilted, the leaves hanging limp, much as if the stalk had been severed. After a time they recover again, and, beyond a temporary check on their growth, appear to have suffered but little injury. If such plants are searched carefully while still wilted, a flat, brown bug with each side of the body produced into an angle, or sharp spine, will be found upon the stalk along the base of the leaves. It is very shy and keeps out of sight, hence any brisk movement on the injured plants is likely to cause it to drop to the ground and conceal itself." These insects are about half an inch long, of a drab color above and greenish or yellowish below. Usually only one bug is found on a plant, so that the best way to prevent injury is to pick them from the plants, and keep down such weeds as thistles and mulleins, upon which these insects feed, in the adjoining fields.

Bud-Worms.

Young tobacco plants are sometimes attacked by bud-worms which eat into the leaves before they are unrolled, thus causing many holes in the leaf, these holes being very damaging to the full-grown leaf. The tobacco bud-worm is known also as Corn-worm, Tomato-worm, Cotton Boll-worm and by other names. (For description of this insect see the discussion of Cotton Boll-worm on page 214.)

Remedies.—Concerning the measures to be adopted to prevent injury to tobacco from this insect, Prof. E. D. Sanderson writes as follows: "Poisoned corn meal has been found to be a satisfactory remedy. Into a quart of finely ground corn meal, a half teaspoonful of Paris green is thoroughly mixed by stirring, and sprinkled on the buds from a can perforated like a pepper can. This should be applied frequently, especially after heavy rains. Large buds should be opened and a pinch of the poison placed within. When spraying with Paris green is practiced against the horn-worm, it will also be of service to hand-pick these worms from small patches of tobacco, as is done when the worms are abundant in ear-corn.

The Tobacco Leaf-Miner.

Injury to tobacco from this insect is caused by the young larvae eating irregular patches of the leaf-tissue, leaving only the upper and lower surfaces. These mines appear like blisters on the leaves. They are quite serious, rendering the leaves unfit for wrappers. Often a single larvae will destroy an entire leaf, as they do not remain in a single mine, but move from place to place over the leaf, entering wherever they wish to make a new mine. This habit is of importance, as it serves to give the grower a chance to poison the little worms.

Remedies.—Wherever plants are sprayed to destroy the horn-worm the leaf-miners will be generally controlled, as while entering the leaf to commence a mine they will get a fatal dose of poison. As a preventive the common horse—or bull—nettle (the original food-plant of this insect) and closely related weeds should be kept down around the tobacco fields.

THE HORN-WORM OR TOBACCO-WORM.

Of all the insects attacking tobacco this worm is the most to be feared. Tobacco plants may be entirely ruined unless this worm is kept in control.

Description and Life-History.

The large bluish-green worms, having a prominent horn at the rear end, and white or yellow lines or V-shaped marks on each side of the body, are familiar objects to all tobacco growers. These are

the true tobacco-worms. They may vary in color, some being brown or nearly black. There are two species, one called the "Northern Tobacco-worm" and the other the "Southern Tobacco-worm," though the latter is by far the most abundant in the South. The worms can be distinguished by the marks on the body. The Southern species have single light colored marks along the sides of the body, while the Northern species have V-shaped marks similarly located. The parents of these worms are big strong-bodied moths known as Sphinx moths. The adults are ashy-grey or brownish-grey in color, the body is long and pointed, and the size, though variable, averaging from four to five inches in wing expanse.

The worms as found on the tobacco plants change to pupae in the ground where they remain during winter, and moths emerge from these over-wintering pupae during April and May. There may be as many as four broods during a single season, the pupae of the last brood remaining in the ground over winter.

Remedies.—The best remedy on small patches of tobacco is to pick the worms off by hand, but this is a slow and tiresome process in large fields. Flocks of turkeys or guinea-hens will often keep a field free from worms. They seem to have a natural liking for these worms and will devour them in large numbers. Poison may be applied to the tobacco plants either in dry or wet form. Paris green or arsenate of lead may be used at the strengths usually recommended for using those poisons. Poison must be applied while the worms are small and its use must be continued throughout the season owing to the number of broods. In spraying, both surfaces of the leaves should be covered. Growers need not fear that the poison on the leaves will be dangerous to the consumer of the tobacco, as all the poisons used soon lose their most poisonous property and while strong enough to kill the worms the poison remaining will not injure the consumers.

INSECTS INJURIOUS TO STORED GRAIN.

Few farmers realize how much they lose each year on account of insects destroying their grain. It is estimated that Texas alone loses over a million dollars each year, and that 50 per cent. of her corn annually is destroyed by weevils and rats. But Texas is not the only State that loses on account of

weevils and rats, for Alabama loses 10 per cent. of the corn she raises. Estimating in the same proportions, the eight Southern States: South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas and Arkansas lose nearly \$20,000,000.00 each year, that is the amount lost on account of the corn destroyed. And then when we consider the amount lost on rice, oats, wheat, rye, peas, and other grains, the loss is enormous. The following descriptions of grain insects, and the remedies recommended are taken from Farmer's Bulletin No. 45 of the U. S. Department of Agriculture.

The Grain Weevils.

All the various species of insects that attack stored grain are indiscriminately called weevils, or simply "weevil," but the only true grain weevils are the granary weevil and rice weevil.

These two insects resemble each other in structure as well as in habit. They are small, flattened, brown snout-beetles of the family Calandridae. Neither is more than a sixth of an inch in length, but their rate of development is so rapid that they do an almost incalculable amount of injury in a short period of time. Their heads are prolonged into a long snout, or proboscis, at the end of which are the mandibles. Their antennae are elbowed and are attached to the proboscis.

The Granary Weevil. (*Calandra granaria* Linn.)—The granary weevil has been known as an enemy to

Fig. 54.—*Calandra granaria*: a, beetle; b, larva; c, pupa; d, *C. oryz.* beetle—all enlarged (author's illustration.) (Courtesy Board of Entomology U. S. Dept. of Agriculture Washington, D. C.)

stored grain since the earliest times. Having become domesticated ages ago, it has long since lost the use of its wings and is strictly an indoor species.

The mature weevil measures from an eighth to a sixth of an inch, is uniform shining chestnut brown in color, and has the thorax sparsely and longitudinally punctured, as indicated, much enlarged, at fig. 54. a.

The larva is legless, considerably shorter than the adult, white in color, very robust, fleshy, and of the form shown in the illustration (b.) The pupa, illustrated at c, is also white, clear, and transparent, exhibiting the general characters of the future beetle.

The female punctures the grain with her snout and then inserts an egg, from which is hatched a larva that devours the mealy interior and undergoes its transformations within the hull. In wheat and other small cereals a single larva inhabits a grain, but a kernel of maize furnishes food for several individuals.

The time required for the completion of the life cycle varies with the season and climate, and there may be, under favorable conditions, four or five broods and six or even more in the South.

This species is injurious in wheat, maize, barley, and other grains and attacks also the chick-pea (*Cicer arietinum*), a food product of the Tropics. Unlike the moths which attack grain, the adult weevils feed also upon the kernels, gnawing into them for food and for shelter, and, being quite long-lived, probably do even more damage than their larvae. This species is very prolific, egg-laying continuing over an extended period. It has been estimated that one pair will, in the course of a year, produce 6,000 descendants, and it will be seen that the progeny of a single pair are capable in a short time of causing considerable damage.

The Rice Weevil, (*Calandra oryza* Linn.)—A very similar insect to the preceding is the rice weevil, which derives both its popular and Latin name from rice (*oryza*.) in which it was originally discovered. It is conceded to have originated in India, whence it has been diffused by commerce until it is now established in most of the grain-growing countries of the world. It is a serious pest in the Southern States, where it is commonly, though erroneously, called "black weevil," but farther north is of less importance. It occurs, however, in every State and Ter-

ritory in the Union, and occasionally invades Canada and Alaska.

This species resembles the granary weevil in size and general appearance, but differs in being dull brown in color, in having the thorax densely pitted with round punctures, and the elytra, or wing cases, ornamented with four more or less distinct red spots, arranged as in the illustration (fig. 55, d.) Unlike the preceding species it has well-developed and serviceable wings. The larvae and pupae are also similar to those of the granary weevil, and in habits and life history these two species do not materially differ, except in that the rice weevil may often be found in the field remote from the granary, in the extreme South and in the Tropics lays its eggs in standing grain.

The rice weevil feeds upon the grain of rice, wheat, particularly the soft varieties, maize, barley, rye, hulled oats, buckwheat, chick-peas, and the cultivated varieties of sorghum known as Kafir, or Jerusalem corn, etc., and the adult beetles, when abundant in storehouses and groceries, invade boxes of crackers, cakes, and other breadstuffs, barrels of flour and bags of meal.

The Grain Moths.

The Angoumois Grain Moth, (*Sitotroga cerealella* Ol.)—This moth received its name from the province of Angoumois, France, where it is known to have been injurious since the year 1736. In this country, where it is familiarly but incorrectly called "fly weevil," it is said to have been recognized as early as 1728. It infests all the cereals, as well as buckwheat and the chick-pea, product of the Tropics. It has been estimated that in six months grain infested by this moth loses 40 per cent. in weight and 75 per cent. of farinaceous matter.

The adult insect resembles somewhat a clothes moth, for which indeed it is often mistaken. It is light grayish brown in color, more or less lined and spotted with black, and measures across the expanded fore-wings about half an inch (see fig. 55.) The hind-wings are bordered with a long, delicate fringe.

The moth deposits its eggs in standing grain and in the bin, singly and in clusters of from 20 to 30. The eggs shown, much enlarged, in the illustration, are white when first laid, but soon turn red and hatch in from four to seven or more days, when the minute larvae or caterpillars burrow into the kernels and

feed on the starchy interior. A single larva inhabits a grain of the smaller cereals, but maize affords sustenance for two or more individuals. A kernel of corn opened to show the larva at work is reproduced at fig. 55, b, and an ear of infested pop-corn is shown

Fig. 55.—*Sitotroga cerealella*: a, eggs; b, larva at work; c, larva, side view; d, pupa; e, moth; f, same, side view (original).

(Courtesy Board of Entomology U. S. Dept. of Agriculture, Washington, D. C.)

at fig 56. In three weeks or more, according to season, the caterpillar attains maturity, when it spins within the kernel a thin, silken cocoon and transforms to a pupa or chrysalis, the moth emerging a few days later, the entire period from egg to adult embracing in summer time about five weeks and in colder weather considerably longer. After copulation, the moth deposits eggs for another brood, and thus several generations are produced in the course of a year. In the warmer climate of the South, where the insect can breed uninterruptedly throughout the winter, it has been estimated that as many as eight generations may be produced.

Flour and Meal Moths.

Four or five species of moths, in addition to the one just mentioned, are injurious to grain in store, but are more prevalent in mill products, and are troublesome as well by their depredations in a variety of articles.

The Mediterranean Flour Moth, (*Ephestia kuehniella* Zell.)—The most important of all mill insects is the Mediterranean flour moth. This scourge of the flour mill, as it is called, has attracted much attention of recent years and has been the subject of

many articles and bulletins. Until the year 1877, when the moth was discovered in a flour mill in Germany, it was comparatively unknown. In later years it invaded Belgium and Holland, and in 1886 appeared in England. Three years later it made its appearance in destructive numbers in Canada. In 1892 it was

Fig. 56.—Ear of pop-corn showing work of Angoumois grain moth (from Riley in Ann. Rept. Dept. Agr., 1884). (Courtesy Board of Entomology U. S. Dept. of Agriculture, Washington, D. C.)

reported injurious in mills in California, and in 1884 in New York and Pennsylvania.

That the Mediterranean flour moth has become so formidable in recent years is due to the higher a

more equable temperature maintained in modern mills, a condition highly favorable to the development of the insect.

The adult moth has a wing expanse of a little less than an inch; the fore-wings are pale leaden gray, with transverse black markings of the pattern shown in the accompanying illustration (fig. 57, a); the hind-wings are dirty whitish, semi-transparent, and with a darker border. The caterpillar, illustrated at fig. 57 c, e, is whitish and hairy. The chrysalis, shown at fig. 57 d, is reddish brown.

The caterpillars form cylindrical silken tubes in which they feed, and it is in great part their habit of web spinning that renders them so injurious where they obtain a foothold. Upon attaining full growth the caterpillar leaves its original silken domicile and forms a new web, which becomes a cocoon, in which to undergo its transformations to pupa and to imago. It is while searching for a proper place for transfor-

Fig. 57.—*Ephestia kuehniella*: a, moth; b, same from side, resting; c, larva; d, pupa—enlarged; e, abdominal joint of larva—more enlarged.

(Courtesy Board of Entomology U. S. Dept. of Agriculture, Washington, D. C.)

mation that the insect is most troublesome. The infested flour becomes felted together and lumpy, the machinery becomes clogged, necessitating frequent and prolonged stoppage, and resulting in a short time in the loss of thousands of dollars, in large establishments.

Although the larva prefers flour or meal, it will attack grain when the former are not available, and it flourishes also on bran, prepared cereal foods, including buckwheat, grits and crackers. In California it lives in the nests of a wild bumble-bee and in the hives of the honey bee.

When a mill is found to be infested, the entire building should be fumigated, and in case a whole district becomes overrun the greatest care must be observed not to spread the infestation. Uninfested

mills should be tightly closed at night, and every bushel of grain, every bag or sack brought into the mill, subjected to a quarantine process, by being disinfected either by heat or bisulphide of carbon.

The Flour Beetles.

The Confused Flour Beetle, (*Tribolium confusum* Duv.)—The most important of the flour beetles is the one above mentioned. It is about the same size as the true grain weevils, is of nearly universal occurrence in grain of all kinds following the attacks of the latter species with which it is very often associated. Its principal damage, however, appears to be to flour and other patented articles of diet containing starchy matter; in fact, it is without doubt the insect most injurious to prepared cereal foods, if we except the Mediterranean flour moth, which fortunately is as yet confined to a limited territory.

Although known for many years in Europe as an enemy to stored cereals, seeds, and even as a pest in museums, it was not until the fall of 1893 that it was recognized in this country as a species distinct from others of its kind. In less than two years from the

Fig. 58.—*Tribolium confusum*: a, beetle; b, larva; c, pupa—all enlarged; d, lateral lobe of abdomen of pupa; e, head of beetle, showing antenna; f, same of *T. ferrugineum*—all greatly enlarged (author's illustration.)

(Courtesy Board of Entomology U. S. Dept. of Agriculture, Washington, D. C.)

time of its first recognition here, this insect had been reported as injurious in nearly every State and Territory. The divisional experience of a single year, 1894, shows that more complaints are made of injuries by this than of any other granivorous insect. As a mill pest it was the most troublesome species

of 1895, and annually costs the millers of the United States thousands of dollars by its presence in manufactured products.

The mature beetle is scarcely a sixth of an inch long, elongate, and flattened, brown in color, and of the form indicated in the illustration (fig. 58, a.) The head, with antenna, is shown, much enlarged, at e, and the general characters of the larva are illustrated at b, the pupa at c and d.

Among the many substances attacked by this insect may be mentioned, besides grain and its manufactured products, snuff, orris root, baking powder, rice chaff, red pepper, ginger, slippery elm, peas, beans, nuts, and seeds of various kinds, in all of which it has been found by the writer. It sometimes also invades cabinets of dried insects.

The Slender-Horned Flour Beetle, (*Echocerus maxillosus* Fab.)—The above-named insect should be mentioned here. It also feeds on flour and meal and is of frequent occurrence in the South and has been found as far north as the District of Columbia and southern Ohio in Indian corn, which appears to be its preferred food. The beetle resembles the two preceding species, but is lighter in color and a little smaller, measuring a trifle over an eighth of an inch in length. On the head, between the eyes, are two pointed tubercles, and the mandibles in the male are armed with a pair of slender, incurved horns.

There are several other flour beetles occurring in the South, but space will not permit of their mention here.

The Meal-Worms.

The Yellow Meal-Worm, (*Tenebrio molitor* Linn.)—The above-mentioned species is the meal-worm most often referred to in scientific literature, and as it is in the larval stage that it is best known, the name yellow meal-worm has been suggested to distinguish it from the other species, which is much darker in color. The larva is cylindrical, long, and slender, attaining a length of upward of an inch, and being about eight times as long as broad. It is waxen in appearance, resembling a wireworm. In color it is yellow, shading to darker ochreous toward each end and near the articulation of each point. The anal extremity terminates in two minute spines. The pupa is white, and the adult insect, as will be seen by reference to the illustration, resembles on a large

scale one of the flour beetles. It is considerably over half an inch long, somewhat flattened, shining, and nearly black. An enlarged antenna is shown at e.

The eggs, with a covering of meal, are white, bean-shaped, and about a twentieth of an inch long, and are deposited by the parent beetle in the meal or other substance which is to serve as the food of the future lava.

Methods of Control.

The measures to be employed in the control of insects affecting stored products are both preventive and insecticidal. As an insecticide nothing answers the purpose so well as the bisulphide of carbon, which is a nearly perfect remedy against all insects that infest the storehouse. The remedies that will be discussed in the present work, while intended primarily for use against insects in stored grain, have an almost equal value against all forms of animal life that occur in products that are dried and kept in storage.

Preventive Measures.—A limited number of insects, like the Angoumois grain moth in the extreme South, enter the grain in the field, and certain precautions are therefore necessary to prevent their access to the granary. This is accomplished, first, by harvesting as soon as the grain is ripe; second, by threshing as soon afterwards as possible.

In the process of threshing or cleaning much infested grain is blown out with the chaff and dust, and the moths and many adult weevils are killed by the agitation which the grain receives; but the immature forms of these insects, concealed in the kernels as eggs, larvae, and pupae, are apt to survive this treatment, and further measures are necessary for their destruction.

For this purpose a quarantine bin is desirable, to be as nearly air-tight as possible, in which the newly threshed as well as the infested or suspected grain can be fumigated with bisulphide of carbon, according to the directions given elsewhere.

Fresh grain should not be exposed to insect attack by being placed in bins with "weeviled" grain, or even housed under the same roof with such grain. If before storing in buildings that have been infested, the old grain be removed, the bins thoroughly cleaned, floors, walls, and ceilings brushed and scrub-

bed, the chances of infestation will be reduced to a minimum. If the storehouse has been badly infested, a fumigation with bisulphide is necessary.

The floors of the storehouse should be frequently swept, and all material that has no commercial value burned.

A certain amount of attention has always been given to the construction of the storehouse with a view to the exclusion of insects, and, with the advent of the flour moth, our modern mills are being fitted with reference to its peculiar habits.

sects. The floor, walls, and ceilings should be smooth, so as not to afford any lurking places for the insects, and it would be well to have them oiled, painted, or whitewashed for further security. A coating of coal tar has been strongly recommended for the latter purpose. Such measures are not an absolute necessity in cold and temperate climates, but in the more heated atmosphere of our Southern States whatever possible should be done to lessen the chances of damage.

Fig. 59.—An Orchard showing the effect of Leaf Curl.

The ideal farmer's granary, from the standpoint of insect ravages, should be built at some distance from other buildings and the rooms constructed so as to be as near vermin proof as possible. The doors should fit tightly, and the windows covered with frames of wire gauze to prevent the passage of in-

The Bisulphide of Carbon Treatment.—The simplest, most effective, and inexpensive remedy for all insects that affect stored cereal and other products is the bisulphide of carbon, a colorless liquid with a strong, disagreeable odor, which, however, soon passes away. It vaporizes abundantly at ordinary tem-

peratures, is highly inflammable, and is a powerful poison.

It may be applied directly to infested grain or seed without injury to its edible or germinative principles by spraying or pouring, but the most effective manner of its application in moderately tight bins or other receptacles consists in evaporating the liquid in shallow dishes or pans, or on bits of cloth or cotton waste distributed about on the surface of the infested material. The liquid rapidly volatilizes, and being heavier than air descends and permeates the mass of grain, killing all insects and other vermin present.

The bisulphide is usually evaporated in vessels containing one-fourth or one-half of a pound each, and is applied in tight bins at the rate of a pound to a pound and a half to the ton of grain, and in more open bins a larger quantity is used. For smaller masses of grain or other material an ounce is evaporated to every 100 pounds of the infested matter. Bins may be rendered nearly air-tight by covering with cloths, blankets, or canvas.

Infested grain is generally subjected to the bisulphide treatment for twenty-four hours, but may be exposed much longer without harming it for milling purposes. If not exposed for more than thirty-six hours its germinating power will not be impaired. In open cribs and badly infested buildings it may sometimes be necessary to use a double quantity of the reagent and repeat treatment at intervals of about six weeks during the warmest weather.

Mr. H. E. Weed, entomologist of the Mississippi Station, claims that 1 pound to 100 bushels of grain is amply sufficient to destroy all insects, even in open cribs.

Mills and other buildings, when found to be infested throughout, may be thoroughly fumigated and rid of insects by a liberal use of the same chemical. A good time for this work is during daylight on a Saturday afternoon or early Sunday morning, closing the doors and windows as tightly as possible and observing the precaution of stationing a watchman without to prevent anyone from entering. It is best to begin in the lowest story and work upward, to escape the settling gas. The building should then be thoroughly aired and the grain stirred early Monday morning.

For the fumigation of a building or a reasonably close room it is customary to evaporate a pound of the bisulphide for every thousand feet of cubic space.

In comparatively empty rooms, and in such as do not admit of being tightly closed, two or three times the above quantity of the chemical is sometimes necessary.

Certain precautions should always be observed. The vapor of bisulphide is deadly to all forms of animal life if inhaled in sufficient quantity, but there is no danger in inhaling a small amount. The vapor is inflammable, but with proper care that no fire of any kind, as, for example, a lighted cigar, be brought into the vicinity until the fumes have entirely passed away, no trouble will be experienced.

Bisulphide of carbon retails at from 20 to 30 cents a pound, but at wholesale, in 50-pound cans, may be obtained for 10 cents a pound. A grade known as "fuma bisulfide," for sale at the latter price, is said to be more effective than the ordinary commercial article.

At the rate used the cost of treatment is from 10 cents and upward for each ton of grain.

A FEW ORANGE INSECTS.

Insects injurious to orange and other citrus fruits include a whole class by themselves. An entire book devoted to the subject would be required to give this matter proper treatment. Only a few orange insects, however, cause a great amount of damage, but these are ever present and must be fought diligently and intelligently.

The White Fly.

This is probably the worst citrus insect in Florida and also occurs in all sections where the orange is grown. It is a common enemy of all plants related to the orange. The insect itself is very small, being only about one-sixteenth of an inch in diameter. The insect winters on the undersides of the leaves in various stages of development, mostly full grown. The adults sometimes appear early in February and commence at once to deposit eggs. These adults are so small that the average grower will never notice them, but the young insects on the leaves are easily found. Most of the flies appear in April and May. Egg-laying at once begins, the eggs being placed on the undersides of the leaves. The eggs hatch in about ten days and the young larvae crawl around to find a suitable place to commence feeding. The food is taken through a minute beak which is thrust

through the surface of the leaves. The adults while winged are not capable of long flight, but they undoubtedly spread from one grove to another. The young lice are easily carried by workmen and teams for long distances, thus making the possibility of spread very rapid.

The white fly does not kill a tree as quickly as most of the scale insects, but is very persistent in its attacks, saps the vitality of the trees, impairs the quality, flavor and keeping properties of the fruit and renders both trees and fruit unsightly because of the black, sooty mold, which invariably develops in the honey-dew excreted by the insects. Orange growers fear the attack of this insects as much as some which are really more quickly injurious in their attacks.

Remedies for the White Fly.

A resin spray recommended by the Florida Experiment Station is considered the most practical remedy. The following is the formula:

Resin pulverized 8 pounds
Caustic Soda, pulverized 3 pounds
Fish Oil 1 1-2 pints

Boil in a large iron kettle in six or seven gallons of water until the materials are all dissolved, which will usually be in twenty minutes. Strain into a barrel holding about 50 gallons and fill the barrel with water. It is now ready for use as a rather coarse spray.

The insects will be found on the under sides of the leaves so that when spraying care must be taken to strike the lower surface with the mixture.

This wash should be applied while the insects are in the larval (young) stage on the leaves. Three or four sprayings may be necessary each year.

Kerosene emulsion at 15 per cent. strength will also serve to control this insect. When using the emulsion only enough should be used to cover the leaves. Too heavy an application may injure the foliage.

Fumigation with Hydrocyanic acid gas is practised by some large orange growers for the control of the white fly. It is most practical on small trees.

The San Jose Scale.

This scale insect is often very serious in orange

groves. The remedy suggested for the scale on peach trees will serve also for the orange, only it must be remembered that the strength of wash used on peach can be greater as the trees become entirely dormant. The kerosene emulsion treatment for scale or orange trees has in many cases been successful.

Fig. 60.—Pear Blight. An Orchard showing the effect of Pear Blight.

THE COTTONY CUSHION SCALE.

This insect was at one time the most dangerous pest in California and did a great amount of damage. An Australian lady-bug was introduced from Australia and has succeeded in keeping the insect in control. If it had not been for this imported lady-bug the cottony cushion scale would probably have destroyed the orange industry in California. The insect is known to occur over a limited area in Florida.

The body of the adult female scale is dark orange-red, usually more or less covered with yellowish

white powder. The female secretes an egg-sac which is white and beautifully ribbed. This makes a very conspicuous object, one not readily over-looked.

Remedies.—As stated above this insect has been controlled in California by the lady-bug. It occurring in places where the lady-bugs are not present, spraying with resin wash or kerosene emulsion, as recommended for the white fly, will serve to control this insect, or at least keep it in check until the lady-bugs can be secured.

THE RED ORANGE-SCALE.

This is one of the most destructive of orange and lemon pests, and in California where it is abundant it is being fought by parasites and by the usual fumigation and spraying methods. The Red Scale is about the size and shape—generally speaking—of the San Jose scale with which most are familiar. The color of the scale formation covering the true soft-bodied insect, has given it the common name "red-scale."

The fumigation method, with hydrocyanic acid gas generated under tents stretched over the trees has for several years been the principal method of controlling this insect. This fumigation is quite costly, and for that reason experiments are being made to determine the value of liquid sprays. It will probably be found that modifications of the washes used against San Jose and other scales will serve to control this pest also.

SOME HOUSEHOLD PESTS.

Every housekeeper knows the trouble caused by certain insects both in the way of destroying clothes, books, carpets, etc. She usually has to fight some insect at all times of the year. A few of the most important pests, together with suggested remedies, may be useful in helping to aid the fight against these insects.

Bedbugs.

Owing to the fact that this pernicious bug can be carried about so easily it often finds its way to the beds of the rich as well as the poor but can usually be exterminated if noticed in time. Beds and bedding should be frequently examined for this pest and if discovered apply one or all of the following remedies.

Prof. C. L. Marlatt, of the Bureau of Entomology, Washington, D. C., recommends the following:

"The bedbug, on account of its habits of concealment, is usually beyond the reach of powders, and the ordinary insect powders, such as pyrethrum, are of practically no avail against it. If iron or brass bedsteads are used the eradication of the insect is comparatively easy. The most practical way to effect this end is by very liberal applications of benzine or kerosene or any other of the petroleum oils. These must be introduced into all crevices, with small brushes or feathers, or by injecting with small syringes.

Corrosive sublimate is also of value, and oil of turpentine may be used in the same way. The liberal use of hot water wherever it may be employed without danger to furniture, etc., is also an effectual method of destroying both eggs and active bugs. Various bedbug remedies and mixtures are for sale, most of them containing one or the other of the ingredients mentioned, and they are frequently of value. The great desideratum, however, in a case of this kind, is a daily inspection of beds and bedding and of all crevices and locations about the premises where these vermin may have gone for concealment.

A vigorous campaign should, in the course of a week or so at the outside, result in the extermination of this very obnoxious and embarrassing pest. In the case of rooms containing books or where liquid applications are inadvisable, a thorough fumigation with brimstone is, on the authority of Dr. J. A. Lintner, New York State entomologist, an effective means of destruction. He says: 'Place in the center of the room a dish containing about four ounces of brimstone, within a larger vessel, so that the possible overflowing of the burning mass may not injure the carpet nor set fire to the floor. After removing from the room all such metallic surfaces as might be affected by the fumes, close every aperture, even the keyholes, and set fire to the brimstone. When four or five hours have elapsed, the room may be entered and the windows opened for a thorough airing.'

FLEAS.

The common troublesome fleas which overrun houses are not human fleas as many suppose, but the common cosmopolitan flea of the dog and cat. The eggs of the flea are deposited between the hairs

of the dog and cat, but are not fastened, hence the eggs may be dropped wherever the animals lie or while moving about. By keeping all such animals out of houses this nuisance will generally be prevented. The eggs of the flea are small, white and oblong. When hatched the larvae are very small and active and readily find a hiding place in some crack where they are not easily disturbed. The use of matting and carpets favors the development of fleas by furnishing a hiding place.

sticky fly-paper to capture the adults seems to have found its most successful application in the plan followed by Prof. Gage, of Cornell University. He tied sheets of sticky fly-paper, with the sticky side out, around the legs of an office janitor, who was then instructed to walk around the rooms of a building for several hours. This resulted in nearly all the fleas jumping on his ankles where they were caught by the fly-paper. Another plan is to let the dogs stay in an infested house for a couple of hours at a

Fig. 61.—Rossette. Orchard showing the Effect of Peach Rossette.

Remedies.—The larvae can be destroyed by the liberal application of benzine or similar liquid in all cracks and crevices of the floor and applying the same to carpets and mats. The adult fleas are much harder to contend with. Their extreme activity and great hardiness render any but the most strenuous measures unsuccessful. The suggested plan of using

time and then kill the fleas that get on the dog by thoroughly washing the animal with a strong soap solution.

The Carpet Beetle, or "Buffalo Moth."

The adult insect is a small, blackish beetle, about three-sixteenth inch in length, and ornamented by a

red stripe along the back. The beetles generally appear in fall, but may be present all the year. The damage is caused by the larvae, which is brown with stiff hairs on the back and sides. It is about one-fourth inch long. When full grown it changes to a yellowish pupa from which the beetle develops.

Remedies.—Only the most thorough measures will eradicate this pest. All carpets should be taken up, thoroughly beaten out of doors and sprayed with benzine. Infested rooms must be cleanly swept, the floors washed with boiling water, and the cracks filled with kerosene or benzine, which should also be sprayed under the baseboards. It is best to avoid the use of carpets, or at least use rugs that can be cleaned each day. When the insects are in carpets that cannot well be removed, a hot iron and damp cloth can be used to steam the carpets, thus destroying many insects.

THE CLOTHES MOTH.

How to Destroy Clothes Moths.

One of the greatest enemies of the housewife is the clothes moth. It is very small and makes its way through the smallest crevices. The female moth finds its way in early summer among the clothes and furs, suitable for food for its young, and there deposits about fifty or more eggs. In about a week the eggs hatch and the young worms begin to eat upon the cloth upon which the eggs were laid. It spins a sort of case which it lengthens and enlarges. Not content with eating and making a house for itself upon the cloth upon which it lives, it cuts its way in various directions through the cloth and drags its case after it. As the weather gets warmer the little worm closes its case at the ends and in three weeks the perfect moth will make its appearance.

Remedy.—Beat the garments well early in the spring and occasionally during the summer. It is better to keep the articles in a large paper bag. Occasional airing is good.

For clothes packed in boxes or trunks, put a little oil of cedar on a piece of paper and roll up and wrap with other paper to avoid soiling the garments, and put several of these rolls into each box or trunk. Carbolic acid, turpentine or benzine is equally good, used in the same manner.

Black pepper, a piece of camphor gum, or a handful of snuff wrapped up with the clothes is excellent.

Caution.—Camphor should never be used in keeping seal skin, as it takes the color out of the fur.

A close closet lined with tar paper is the best for furs. It is also excellent for clothes.

Whole cloves are now used to exterminate moths, and some say they are much better than tobacco, camphor, or cedar shavings.

The repellents are of no use unless the clothes to be protected are first beaten and aired to remove eggs and larvae.

HOW TO EXTERMINATE SPIDERS.

Take a small common kerosene lamp and light it, and late in the afternoon or early in the evening look over the corners and places where spiders are commonly found, and when one is seen hold the lamp chimney directly beneath it, and it will fall at once into the chimney and be instantly destroyed. It is not difficult in this way to destroy all the spiders in the house in a few evenings. It avoids killing them by sweeping them down and staining the walls and carpet. Early in the evening is the best time.

HOW TO PRESERVE BOOKS FROM BOOK MOTHS.

The little Bristle Tail or Silver Fish has a little long, slender body covered with a delicate silver scale; it has no wings and passes through no changes. It feeds on the paste of the binding of books, devours leaves, eats off the labels in Museums, and is generally destructive to both books and papers.

Books are also eaten by the larva of a little bug that produces a ticking sound like a watch—it is called the "Death Watch," as it is usually heard in the night ticking like a watch.

Remedy.—A little rag saturated with benzine or carbolic acid placed along the back of shelves will help to clear the library of all insects. Insect Powder sprinkled over the books will destroy the little "Silver Fish" insect if used freely.

A CURE FOR BEE AND WASP STINGS, SPIDER BITES, ETC.

1. The cure for insect stings is very simple. Scientists have found that the poison injected by

the insect is an acid, and hence any alkali is an excellent remedy.

2. **Remedy.**—Apply ammonia or common soda and water. If there is much inflammation and redness, apply a solution of borax and warm water. Apply with rag saturated with the solution.

FLIES.

The Farm.

The Fly Nuisance.—Every farmer and live stock grower will freely admit that the presence of flies is a great drawback to the welfare and comfort of animals. Work horses are not able to do as much, and what they do is less satisfactory when they are continually tormented by flies and mosquitos, says "Twentieth Century Farmer." Colts and calves are greatly diminished in flesh and prevented from making healthy and thrifty growth when they are obliged to continually fight these pests. The yield from milch cows is greatly reduced by the same cause. Taking the whole matter into consideration, it is unquestionably to the interest of the farmer to do something with a view to relieving animals from the tortures which these insects inflict.

As a rule, farmers do not neglect this matter because they are not careful of their stock or because they are willing to permit them to suffer. The trouble usually lies in a lack of knowledge and understanding of the question. Many stock raisers would gladly spend time and money to bring relief from flies and mosquitoes if they knew of a good and reliable method of attaining these results. For the benefit of these well-meaning parties, whose sympathy is touched by the mute appeals of their animals, we wish to give our experience along this line. While treating colts with a standard coal tar preparation for lice a few years ago we discovered that the flies gave animals so treated a wide berth. The smell appeared to be very repulsive to them, and the colts enjoyed a perfect freedom from their bites. Acting upon this suggestion, we have continued to use this preparation for the sake of the freedom of flies which it gives us, even though no lice are present.

Since that time we have discovered that the addition of linseed oil or cotton-seed oil makes the application much more permanent in its effects. The proportions are about as follows: One quart of the

coal tar product, one quart of oil and fifteen quarts ter. Such a solution is very inexpensive and brings about a wonderful relief to the animals. Where it is desired to treat work horses or driving horses we make it a practice to omit the oil and make the application more frequent. A small sprayer, which can

Fig. 62.—Orchard showing the effect of Brown Rot in Peaches.

be purchased for 75c or \$1, is the ideal method of applying the solution to the animals. With precautionary measures so simple and effective, it is to be hoped that steps will be taken by the owners of live stock to give them relief from flies and mosquitoes.

PRACTICAL RECIPES.

Owners of horses will be interested in the method successfully pursued by Dr. A. T. Peters, veterinarian at the Nebraska Experiment station, for driving away flies. He took an ordinary oil barrel and put

into it a wooden spigot, using the barrel as a storage tank. Two and a half gallons of Zenoleum, with five gallons of cottonseed oil, were then placed in the barrel and enough water added to fill it. As required, the mixture thus formed was drawn from the barrel and sprayed upon the horses, or applied with a sponge or cloth as the occasion demanded. The control of the flies was not only perfect, but it had one marked advantage not possessed by most other mixtures for the purpose, in that the solution was not sticky, but left the coat of the animal in a fine condition. The mixture has the further advantage of being compounded at very small cost.

The Horn Fly.—(Bulletin 153, Virginia Experiment Station). Since the importation of the fly from Europe in 1885, it has spread throughout the American continent. Even the severe Northern winters do not effectually check it, for it as frequently appears in Canada as in the warmer sections of the South.

In appearance it is much smaller than the ordinary house fly, probably not over half as large, and about the same color.

The life history, as given by Newman, is quite simple, and is as follows: The fly makes its appearance during the middle or latter days of June, according to the season. The eggs are deposited in fresh dung about the pasture, and the larva hatch in about twenty-four hours. The young parasite then inhabits the superficial layer of the soil, and becomes fully developed in about fifteen days.

Of late years by reason of its rapid multiplication, general alarm has been created among stockmen on account of the peculiarly irritating character of the bite, in consequence of which the cattle do not thrive. When in large numbers they gather about the base of the animals' horns to rest, and are sometimes found covering them for several inches.

During heavy rains they collect on the under side of the animal's abdomen. They attack, by preference, the upper parts of the body, usually selecting those parts which are most out of reach, namely, over the back; and in contrast to most other flies, they remain upon the animal day and night, inflicting their torture constantly. In the feeding attitude the fly may be noticed with wings spread ready for flight.

No accurate estimate can be made of the injury resulting from the pest in cattle-raising sections.

Beef cattle increase in weight slowly, if at all, while milch cows fall off in their milk from one-fourth to one-half during their presence.

Various remedies have been recommended from time to time, some not wholly wanting in merit, but lacking the most essential features so necessary for complete success. Among them might be mentioned the daily treatment of fresh droppings with fresh lime, thereby destroying the larva, also the application to the cattle of substances calculated to disgust the fly, and prevent or modify their attack, the latter being the universal custom.

Kerosene emulsion after the following formula has proven the most effectual remedy yet tried:

Yellow Soap	1-2 pound
Soft Water	1 gallon
Kerosene Oil	2 gallons

Shave the soap fine and dissolve in the water at boiling temperature. Place kerosene oil in a barrel containing a spray pump, to which should be added the hot soap solution. The mixture is now churned vigorously through the pump for fifteen or twenty minutes, or until the mass becomes like thick cream and is fully emulsified. One gallon of water (or in this proportion) is now added to prevent the solution from becoming thick, curdy and troublesome to be dissolved. This is to be kept as the stock solution and diluted in the proportion of one part to five of water, and thoroughly mixed by agitation through the pump just prior to using. Only the required amount must be mixed in the pump for one application, as it tends to separate and gives unsatisfactory results. Too severe and continued agitation is to be avoided, as it tends to cause the solution to foam, in which condition it will not spray satisfactorily, and requires a few minutes to settle.

One of the simplest preparations is one of about two parts of lard and one of pine tar. Mix thoroughly together and rub on the neck and behind the shoulders, where the flies are most numerous. This mixture seems to be especially effective in preventing attacks from the fly which produces the screw-worm in open wounds.

The United States Department of Agriculture recommends the following:

"Take resin, 1 1-2 pounds; laundry soap, two cakes; fish-oil, 1-2 pint; enough water to make three

gallons. Dissolve the resin in a solution of soap and water by heating; add the fish-oil and the rest of the water. Apply with a brush. If to be used as a spray, add one-half pint of kerosene. This mixture will cost from 7 to 8 cents per gallon, and may be used on either calves or cows. One-half pint of this mixture is considered enough for one application for a cow; a calf, of course, would require considerably less. It will be more economical to apply this only to the part of the animal not reached by the tail. At first it will perhaps be necessary to give two or three applications per week, until the outer ends of the hair become coated with resin; after that, retouch those parts where the resin is rubbed off.

A bulletin of the Mississippi Station recommends a mixture made with two parts cottonseed oil, lard or any other cheap oil, and one pint of pine tar. Apply with a paint brush or swab. The writer of the bulletin states that he treated 350 head of cattle with this mixture in about six hours, using four gallons of oil and two gallons of tar, the cost of the materials used being \$2.20, or about three-fourths of a cent a head.

"Gnat oil," used so largely in the Yazoo Delta region, is made by mixing 1 ounce of crude carbolic acid, 1 ounce of pennyroyal, 1-4 pound of sulphur and 1 gallon cotton-seed oil, and seems to be equally effective.

Whatever application is used must be renewed every ten days or two weeks, or as soon as the flies become troublesome again. Kerosene should not be used in the place of other oils, and coal tar is not a safe substitute for pine tar.

THE SCREW WORM.

Its Ravages on Horses, Cattle, Sheep, Hogs, etc.

Description and Cure.—The mature insect is a fly a little larger than a common housefly, and lays its eggs in wounds, sores, and in the natural openings of man and animals. Young calves are almost invariably affected in the navel, and frequently in the mouth, causing teeth to fall out. Young colts are affected in the same way. Barb wire injures to horses and cattle are the most common sores in which the screw worm is found. Hogs are very liable to become affected by castration and other wounds.

History.—After the egg is laid it becomes a small maggot, which soon buries itself in the flesh of the wound. The maggot grows steadily in size, and eats

more and more every day of the soft flesh around the wound or sore. The worm is full grown in about a week. They then leave the sore and fall to the ground, and in about 12 days become flies.

Symptoms.—A swollen, gaping condition of the wound, and the constant discharge of blood. While the sore is unhealed new eggs are constantly being laid, and if the worms are not destroyed, they eat deeper and deeper and often kill the animal.

Remedy.—Cresylic ointment, calomel, chloroform, or a little carbolic acid in water. In some cases bandages are useful. In others the sores can be filled with oakum and a few stitches taken. All treatment should be supplemented by daubing the margins of the wound with pine tar to ward off the fly.

SPRAYING, INSECTICIDES, AND FUNGICIDES.

Great advancement has been made within the last few years in the matter of spraying. The practice of spraying trees and vegetables is just now in its infancy. In the older section of the South, there is no doubt about it paying to spray. In fact, it has reached that place where it is necessary to spray in order to produce perfect fruit and vegetables. Most people are afraid of the subject of spraying, because they think that they must learn all about insects and a great many hard names. But one should not be afraid of the subject, for it is necessary in order to make a success of growing fruit. If you have never tried spraying, make a thorough test of it, and see the good that will result. Spray the trees thoroughly, and be sure that all parts are sprayed. Better waste a little material and time than leave a portion of the trees untouched. It seems hardly necessary to tell the advantages derived from spraying, as every one knows that there are insects and diseases that must be killed by spraying, if they are killed at all.

Insects are of two classes, as regards the spray remedies. The biting insects, that may be killed by eating poisoned foliage or fruit, are most easily destroyed by arsenic in some form, and those that live by sucking their food must be killed from the outside and with something that will coat them or their coverings in some such way as to smother them to death.

Of the first class are canker worms, cut worms, caterpillars, codling moth, larvae and all the rest that

live by eating the leaves or fruit, except those which do it in such ways as so far to have baffled the ingenuity of scientists and practical fruit growers and gardeners. Paris green has been the form of arsenic most in use, but the preparations of white arsenic have been found to be cheaper and more effective. They can be made at home by mixing it with lime and salsoda, and almost any of the State or government bulletins on insecticides give full directions for making them. One that is thought to be the best is made by putting one pound of white arsenic and two pounds of salsoda in one gallon of water and boiling it for fifteen minutes. One quart of this will poison fifty gallons of water, or Bordeaux mixture. If water alone is used, there should be two pounds of lime dissolved and put in with it to prevent the arsenic from injuring the foliage. In the Bordeaux mixture, which contains lime, that is not necessary.

Of the second class, such as the scale insects, which live by sucking the juices through tiny beaks which they insert into the tender bark, living under tents, which we call scales. They must be coated with oil or something that will keep the air from them 'till they die. The lime-sulphur-salt mixture is of this class, and, strange to say, this has been found a good fungicide as well.

The basis of about all of the fungicides is sulphate of copper. This is the killing part of Bordeaux mixture.

DIRECTIONS FOR PREPARING THE MOST IMPORTANT INSECTICIDES.

Lime-Sulphur-Salt Wash.

No. 1.

Formula

Lime	20 pounds
Sulphur	16 pounds
Salt	5 pounds
Water	to make 50 gallons

Boil for about 40 minutes, or until all sulphur is in solution. More detailed directions for making and applying this wash will be found on another page. This wash is effective against nearly all scale insects. It is also a good fungicide, taking the place of Bordeaux mixture for spraying to prevent leaf-curl of peach; also effective as first treatment against such diseases as apple scab, brown rot, bitter rot, and fungus diseases that can be reached by spraying when the

trees are dormant; that is, before the leaves push out in spring.

Kerosene Emulsion.

No. 2.

Formula for Stock Solution:

Kerosene	2 gallons
Hard soap, (soft soap, 1 qt.)	1-2 pound
Water	1 gallon

Dissolve the soap in boiling water, then remove from the fire and add 2 gallons of kerosene and agitate violently for at least ten minutes. The emulsion is prepared best by using a small force pump, having direct discharge, and pumping the solution back into itself for ten minutes. When properly mixed the emulsion will last for several weeks.

For convenient reference the proper amounts of water to use in diluting the stock solution for certain strengths is given herewith:

- For 5% emulsion dilute with 37 gallons of water.
- For 10% emulsion dilute with 17 gallons of water.
- For 15% emulsion dilute with 10 1-3 gallons of water.
- For 20% emulsion dilute with 7 gallons of water.

Kerosene emulsion is used against nearly all soft bodied insects, such as plant lice, currant slugs, small cabbage worms, etc.

Paris Green.

No. 3.

Paris green is used at many different strengths but as a general formula we recommend the following:

Paris green	1 pound
Lime	3 pounds
Water	100 to 200 gallons

When Paris green is used without lime it is liable to scorch the foliage. The same amount as above is used in Bordeaux mixture.

Paris Green-Bordeaux Mixture.

No. 4.

Made by mixing Paris green in the Bordeaux after the latter is ready for use. An excellent way to apply poison for potato bugs, tomato worms, etc., and

for spraying fruit trees to destroy the canker worm, codling moth, and all chewing insects.

Arsenate of Lead.

No. 5.

This may be made from the raw materials or purchased in prepared form under such trade names as "Disparene" or "Swifts" Arsenate of Lead. Formula for making is as follows:

Lead acetate (sugar of lead,) 11 ounces
Arsenate of Soda 4 ounces
Water 50 gallons

To prepare, dissolve each in 2 quarts of warm water. When dissolved pour them together in a barrel of water and stir. This solution gives a very light precipitate, requiring little stirring in the spray tank and has an advantage over the other arsenicals in that it will usually adhere better on the trees or foliage.

This preparation is not liable to burn the foliage of plants and is very cheap, if prepared at home. Even the manufactured products are not very expensive. A valuable insecticide.

Hellebore.

No. 6.

Used in dry form, 1 part to 4 or 5 of flour or fine air-slacked lime. Kills both by contact and by being taken internally. Hence may be used against chewing insects and sucking insects. Not nearly as active a poison as the arsenicals, but sometimes useful on plants like cabbage which are nearly ready to be eaten.

Pyrethrum.

No. 7.

Is used both in dry and wet form. As a spray use one pound in 3 gallons of water. Use dry the same as hellebore. This material acts only as a contact poison for soft bodied insects; especially useful against currant worms and plant lice.

Tobacco.

No. 8.

Tobacco is often a useful insecticide. It will some-

times take the place of kerosene emulsion against plant lice and can be easily prepared and applied.

Tobacco stems or leaves 1 pound
Water 2 gallons

Boil for 2 hours and use without dilution except to add water to make up the full 2 gallons. Especially useful against the aerial form of woolly aphids.

Tobacco is used in dry form as stated in discussion of apple woolly aphids; also used as repellent for cucumber beetles and other garden insects.

Whale Oil Soap.

No. 9.

For insects, such as plant lice and scale insects, whale oil soap may often be used to advantage. It was once considered the best remedy for San Jose scale until the Lime-Sulphur wash came into use. It is, however, valuable for other purposes. This material is purchased for about 5 cents a pound in barrel quantities, and sometimes less. It is best to purchase from some large firm rather than buy from local dealers. Good's potash whale oil soap No. 3, sold by James Good, Philadelphia, Pa., and the Anchor Brand sold by Leggett & Brother, New York, are both good soaps.

For plant lice and soft bodied insects use about one pound to 5 gallons of water; for scale insects use a stronger solution, depending on the hardness of the plant under treatment.

Potash Lye.

No. 10.

Is sometimes used to spray dormant trees to destroy insects and fungi. In late years it has been found that the Lime-Sulphur wash is better adapted for all winter treatment, and that wash is rapidly taking the place of lye. Lye may be used 1 pound to 5 gallons of water on perfectly dormant trees. It is very caustic and must be handled with care.

People should not be deluded by the glaring advertisements of new patent insecticide manufacturers. The old standard sprays are often much more effective and cost less.

FUNGICIDES.

Standard Formula for Bordeaux Mixture.

No. 11.

5 pounds fresh, unslaked lime,

5 pounds bluestone (sulphate of copper),
50 gallons water.

The above formula is designated by the symbol (5-5-50.) Four pounds bluestone and 5 pounds lime would be written thus: (4-6-50,) and other proportions in the same manner.

Slake the lime carefully with just enough water to reduce it to the consistency of thick cream and dilute to 25 gallons; dissolve the bluestone in 25 gallons of water also. Then in a separate barrel mix the two solutions, first pouring in a bucket of one and then a bucket of the other, or better still, pouring them in simultaneously. After thoroughly stirring the mixture and allowing it to stand for a few moments, it will be ready to spray.

When thus prepared Bordeaux is at its best, consisting of a fine, flocculent, pale blue precipitate suspended in the water. If either or both of the ingredients should be in concentrated solution when the mixing is done, the resulting Bordeaux is coarser grained, settles much more quickly and is less effective as a spray.

Bordeaux mixture is used against nearly all fungus diseases and is also frequently used as a carrier for Paris green and other arsenical poisons. It is particularly useful in this form by serving a double purpose and often avoiding the necessity of spraying once for an insect and again for some disease, when both occur on the same plant as is often the case.

Copper Sulphate Solution.

No. 12.

Copper Sulphate 3 pounds
Water 50 gallons

This solution is sometimes used in early spring on dormant trees. It must never be used on foliage. Not generally in use.

Liver of Sulphur.

No. 13.

Valuable for powdery mildew upon gooseberries, grapes, etc., acting as a direct remedy. Especially useful after the fruit is set.

Liver of Sulphur 1 ounce
Water 3 gallons

This mixture is not poisonous, hence can be used on fruit which is nearly ready to gather.

Ammoniacal Copper Carbonate Solution.

No. 14.

Copper Carbonate 5 ounces
Ammonia 3 pints
Water 50 gallons

Dissolve copper carbonate in the ammonia and dilute when used to 50 gallons. As the ammonia is very volatile, the solution until ready to use must be kept in a tightly stoppered bottle or jug. The solution is used in place of Bordeaux mixture on nearly ripe fruit, as it does not show so as to injure the selling property of the fruit. Frequently used for grape anthracnose. Sometimes also for brown rot of peaches and plums. This mixture is somewhat liable to injure foliage and must therefore be used with care.

Formalin or Formaldehyde.

(40 per cent.)

No. 15.

For Potato Scab.—

Formaldehyde (40 per cent.) .. 1 pint
Water 25 gallons

Seed potatoes may be treated before planting with the above strength of Formaldehyde solution, recommended by the Wisconsin Experiment Station.* The solution is placed in a barrel or other vessel and the potatoes tied up in loose sacks, submerged for 2 hours. They should afterward be spread out to dry.

For Oat and Wheat Smut.—For smut submerge the wheat or oats, tied in sacks, in the solution for ten minutes. Then remove and spread out to dry. Or the grain may be piled in heaps on a tight floor, sprinkled with the solution and shoveled over to insure wetting every kernel; then cover with an oil-cloth for two or three hours. Dry the grain afterward. It may be found necessary to treat seed oats three or four days before they are wanted for planting, otherwise they may not be thoroughly dry and will cause trouble in the seed drill. This treatment will cause the seed to enlarge slightly, and the germinating period may be shortened, hence seed grain should be treated only a few days previous to planting.

Formaldehyde solution may be used several times so that 25 or 30 gallons will treat a number of bushels of either potatoes or oats.

*Wisconsin Agricultural Experiment Station, Bulletin 98.

Corrosive Sublimate. (Mercuric Chloride.)

No. 16.

For Potato Scab.—

Corrosive Sublimate 2 ounces
 Water 15 gallons

Dissolve the corrosive sublimate in hot water in an earthen or wooden vessel, and dilute to 15 gallons. Mix thoroughly to insure a uniform solution. The potatoes should be washed and tied in sacks and submerged for 2 hours. Remove and spread out to dry. After this the potatoes may be cut and planted as usual.

Caution.—Corrosive sublimate is a deadly poison internally, but the solution may be handled with perfect safety. It acts as a disinfectant for the hands and will benefit scratches or sores.

Carbon Bi-Sulphide.

No. 17.

This is a very useful insecticide for fumigating grain and other seeds to destroy weevils, and other insects. It is also used to fumigate houses to destroy rats, cock-roaches, bedbugs, carpet-beetles and many household pests. Ants in lawns and moles are often killed by this process.

Carbon bi-sulphide is a clear, colorless, volatile liquid, the fumes of which are highly explosive, and very disagreeable to smell. The fumes are deadly poison to all animal life if taken in sufficient quantity. People are safe while using it, as the smell is so repulsive that there is no danger of getting too great a dose unawares.

The fumes of carbon bi-sulphide are much heavier than air, so that fumigation with it is rendered easy. Grain may be treated in boxes or bins having tight sides and bottom by simply placing the liquid in shallow pans on top of the grain and covering all with a blanket or boards to prevent a circulation of air. Use from three-fourths to one and a half pounds of carbon bi-sulphide to each 1,000 cubic feet of space, or in round numbers, one pound to 100 bushels of grain or other seed. Let the bin remain covered for

at least 24 hours. Grain or seed treated in this manner is not impaired for planting purposes, its germinating power not being affected. For corn, oats, beans, peas and the like which will not be used for seed it will often pay to use 2 pounds of carbon bi-sulphide to each 100 bushels.

To destroy underground forms of insects use two to three ounces of carbon bi-sulphide per square yard, placed in little holes in the earth made with a sharpened stick, and closed by pressing with the heel after pouring in the liquid. This liquid must be used with care around growing plants, but may be used in small quantities on lawns to destroy ants and moles.

When fumigating houses remove all chance of fire and use about three to four pounds of carbon bi-sulphide per 1000 cubic feet. Allow the house to remain closed for 36 hours.

Caution.—Never expose carbon bi-sulphide in a room with a lighted lamp or any form of fire. Remember that the fumes are highly explosive.

For convenient reference in connection with the following **SPRAY CALENDAR** the list of insecticides and Fungicides are given below. The numbers are the same as the numbers appearing before the various formulas in the preceding pages.

- No. 1..... Lime-Sulphur-Salt wash.
- No. 2..... Kerosene Emulsion.
- No. 3..... Paris Green.
- No. 4.. Paris green Bordeaux mixture.
- No. 5..... Arsenate of Lead.
- No. 6..... Hellebore.
- No. 7..... Pyrethrum.
- No. 8. Tobacco, (dry and as decoction)
- No. 9. Whale Oil Soap.
- No. 10..... Potash Lye.
- No. 11..... Bordeaux Mixture.
- No. 12.... Copper Sulphate Solution.
- No. 13..... Liver of Sulphur.
- No. 14.... Amm. Cop. Carbonate Sol.
- No. 15.... Formalin or Formaldehyde.
- No. 16..... Corrosive Sublimate.
- No. 17..... Carbon bi-sulphide.

SPRAY CALENDAR

Insecticides or fungicides in preceding pages. For explanation of symbols (5-6-50) or (6-6-50) see directions for making Bordeaux mixture (No. 11.)

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT				REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH	
Apple	Borers	Cannot be reached by spraying.	Remove borers in Oct. or Nov.	Look again for borers in spring.			Plant for borers in trunk near ground. Remove with knife.
Apple	Aphis (on leaves) or lice	Tobacco decoction or No. 2	Just as buds open if lice appear.	5 days later, repeat.	Spray when necessary.		Tobacco decoction recommended, but kerosene emulsion at 15 or 20 per cent. may be used.
Apple	Red Worm.	No. 4, using 6 ozs. Paris green in 50 Gal. Bordeaux	When leaf buds are opening.	Repeat one week later.			Female moths may be prevented from crawling up trees to lay eggs by wrapping trunks with loose cotton.
Apple	Canker Worms . .	No. 4, using 6 ozs. Paris green in 50 Gal. Bordeaux	When worms first appear.	10 days later if worms remain.			Important to spray just after petals fall, before fruits turn down. No. 5 may be used in place of Paris green, using 3 pounds in fifty gallons
Apple	Fooding Moth (Apple Worm)	No. 4, Using 6 ozs. Paris green in 50 Gal. Bordeaux	Just after petals fall off.	Repeat before calyx closes.	Repeat 12 days later.	Six weeks after fruit is set for second brood.	
Apple	Fall Web Worm Tent Caterpillar .	Arsenicals.	No. 3 or 5 when worms appear.	10 days later.	8-10 days later. . . .		Spraying will not be necessary if all nests are removed and worms destroyed.
Apple	San Jose Scale . .	Lime-Sulphur Wash. .	During Nov. or Dec. .	Repeat during Feb. .			Thorough spraying necessary.
Apple	Woolly Aphis . . .	No. 2 or Tobacco Wash. .	No. 2 in spring for aphids on roots.	Repeat in June if necessary.	Aphis on limbs best controlled by using tobacco decoction.		Use 10 per cent. kerosene emulsion for root aphids. Apply by first removing top soil.
Apple	Bitter Rot	Bordeaux Mixture. . .	No. 11 (4-5-50) 5 or 6 weeks after blooming. .	2 weeks later repeat. .	2 weeks later.	2 weeks later	Spray even oftener during warm, rainy seasons. .
Apple	Crown Gall	Never plant nursery trees affected by this disease.					Close to surface of ground
Apple	Leaf Blight	Bordeaux Mixture. . .	When leaves are fully expanded.	10-12 days later. . . .	10-12 days later. . . .		Spraying for bitter rot should prevent this disease.

SPRAY CALENDAR.—Continued

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT				REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH	
Apple	Rust (on leaves and stems)	Same as leaf blight. .	Same as leaf blight. .	10-12 days later. . .			Rust is different from blight, but is controlled in the same manner. Rust starts on cedar trees, hence they ought to be removed.
Apple	Scab (leaves and fruit)	Bordeaux Mixture. . .	No. 11, strong (6-6.50) before leaf buds open.	No. 11 (1-6.50) just before blossoms open.	Repeat after blossoms fall	10-14 days later.	Additional sprayings every two weeks sometimes necessary.
Asparagus . .	Beetles	Pyrethrum in spring .	Air-slaked lime & No. 7 when young appear. .	Repeat every three or four days while young are present .			After cutting season use No. 5 in weak solution. Shake beetles and grubs on hot soil.
Asparagus . .	Asparagus rust (Leopard Spot)	Bordeaux Mixture. . .	After cutting season use No. 11 (2-6.50)	8-10 days later. . . .	8-10 days later. . . .	8-10 days later.	Clean out and burn all diseased brush in fall. . .
Bean.	Leaf Beetle	Arsenicals	Nos. 3 or 5 when beetles appear	10 days later.	Repeat when necessary		No. 4 may be used and control leaf diseases also.
Bean.	Bean Weevil	Carbon Bi-Sulphide . .	When beans are stored in fall.	Repeat once during winter			Read discussion under No. 17.
Bean.	Anthraxnose	Bordeaux Mixture. . .	No. 11, weak solution on young plants.	10-12 days later. . . .	10-12 days later. . . .		No. 4 will control biting insects also. . . .
Beet	Leaf Spot	Bordeaux Mixture. . .	No. 11, weak solution on young plants.	10-12 days later. . . .	10-12 days later. . . .		
Cauliflower. .	Aphis (Green Lice) . .	Contact poisons	No. 2, 8 or 9 when lice first appear	Repeat 5 days later.	Repeat if necessary.		Tobacco decoction (No. 8) probably best.
Cabbage	Cabbage Worm	Arsenicals and Pyrethrum	No. 3 or 7 at first appearance.	5-10 days later. . . .	Repeat if necessary.		Use only number seven when heads are nearly grown.
Cabbage Collards. . .	Harlequin Bug	Contact poisons	Same as lice.	Same as lice.			Plant kale and mustard as trap crops. Destroy bugs in these plants with pure kerosene. Trap bugs under shingles, etc.
Cabbage Collards. . .	Club Foot or Club Root	Lime in soil					Rotate crops. Avoid stable manure.

SPRAY CALENDAR.—Continued

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT				REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH	
Cantaloupe and Watermelon	Melon Couse	Contact Poisons or No. 17	No. 2, 8 or 9 when lice appear.	4-5 days later	Repeat as necessary		No. 17 is used in tight boxes placed over young plants. One spoonful to cubic foot. Sprays must be directed to under side of leaves. . .
Cantaloupe and Watermelon	Striped Beetles, Flea Beetles, etc. . . .	Arsenicals and Repellants	Lime dust, or No. 4 on young plants. . . .	Repeat in few days. If necessary			Land plaster, Tobacco dust etc. are used as repellants.
Cantaloupe and Watermelon	Squash Bug	Hand-picking and repellants	No. 4 as repellent on young plants.	Spray with No. 2 or 8 when young appear.	Repeat as necessary.		Land plaster, Tobacco dust, etc. are used as repellants.
Cantaloupe and Watermelon	Blight, Mildew . . .	Bordeaux Mixture. . .	No. 11 (3-6-50) on young plants.	10-12 days later. . . .	10-12 days later. . .	10-12 days later	Pull out and burn dying plants. Rotate. . . .
Carnation	Leaf Spot, Rust . .	Bordeaux Mixture. . .	No. 11 (3-6-50) on young plants.	Repeat at first sign of disease	10-12 days later. . .	10 days later. If necessary	Do not spray when plants are nearly grown. . .
Celery	Leaf Spot, Blight . .	Bordeaux Mixture. . .	No. 11 (3-6-50) on young plants.	10 days after first . . .	Repeat when plants are set in field . .	Repeat 10 days later	Use healthy plants for cuttings.
Chrysanthemum	Leaf Spot	Bordeaux Mixture. . .	On young cuttings. . .	10-12 days later. . . .	10-12 days later. . .	Repeat if necessary	
Cranberry	Fruit Worm	Arsenicals or No. 2. .	When worms first appear.	10-12 days later. . . .	Repeat if necessary.		
Cucumber and Squash	Squash-Vine Borer .	See insects and diseases of Cantaloupes and Watermelons.	Remove borers from stalks and burn all old vines as soon as crop is gathered.				Watch trees as buds open. Destroy lice before leaves become curled. .
Cherry	Aphids (Lice). . . .	Contact Poisons. . . .	No. 2, 5 or 9 at first appearance.	5-6 days later.	Repeat if necessary.		See discussion of jarring method under peach insects.
Cherry	Cureulio	Jarring and Arsenicals	No. 3, 4 or 5, when leaves first open.	Just after fruit is set, repeat	Repeat 10 days later		A fifth and sixth spraying sometimes necessary. All mummified fruit should be removed during winter. Destroy all fallen rotting fruit. Prune out dead twigs. .
Cherry	Brown Rot	Bordeaux Mixture. . .	No. 11 (5-6-50) before buds open.	before No. 11 (3-9-50) when fruit is set	Repeat in 10-12 days	10-12 days later. If necessary	

SPRAY CALENDAR.—Continued

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT			REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH
Cherry . . .	San Jose Scale . .	Lime-Sulphur Wash .	During Nov. or Dec. .	Spray again in Feb. .		
Cherry . . .	Slug on Leaves . .	Arsenicals and Contact poisons.	No. 2, or 3 when slugs appear.	10 days later.	Repeat if necessary.	Tobacco decoction is good remedy.
Cherry . . .	Black Knot . . .	Cut out diseased limbs	Free use of Bordeaux for rot will prevent this disease.			
Cherry . . .	Leaf Spot, Blight	Bordeaux Mixture. . .	No. 11 (3-9-56) when leaves are 1-2 grown. .	Repeat 10-12 days later	Repeat in 12 days.	
Corn	Wire Worms and White Grubs . .		Plow deeply, and thoroughly disc harrow in late fall and winter. Avoid sod land. . . .			
Corn	Chinch Bug . . .	Pure Kerosene. . . .	If bugs appear on few plants	When bugs are numerous and migrate, plow deep furrows and kill bugs that congregate in them		
Cotton	Cotton Lice . . .	Contact Poisons . . .	No. 2 or 8 when lice appear.	Repeat in few days. .	Repeat if necessary.	Spraying not often practiced.
Cotton	Boll Worm	Arsenicals.	Lime and Paris Green when bugs appear. . .	8-10 days later. . . .	Watch for brood in Aug.	See method of dusting poison on cotton under subject of cotton insects.
Cotton	Caterpillar	Arsenicals.	Lime and Paris Green when bugs appear. . .	8-10 days later. . . .		See method of dusting poison on cotton under subject of cotton insects.
Cotton	Anthraxnose	See Remarks.				Must depend mainly on selection and breeding of resistant plants. Destroy all diseased plants and boll by burning. Rotate.
Cotton	Black Root, Wilt	Remove diseased plants				Rotation of crops, selection of seed, crossing varieties, etc., must all be practiced to fight this disease.

SPRAY CALENDAR—Continued

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT				REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH	
Current and Gooseberry	Worm or Slug . .	Lime, Pyrethrum or road dust	Inst leaves when worms appear.	Repeat in few days. .			Look for worm on under sides of leaves. . . .
Current and Gooseberry	Leaf Spot	Bordeaux Mixture. . .	No. 11 (3-6-50) as leaves open	10-12 days later. . . .	10-12 days later. . . .	Repeat if necessary.	Poison may be applied in dry form.
Egg Plant	Potato Beetle, Flea Beetle	Arsenicals alone or No. 4	When insects first appear	10-12 days later. . . .	Repeat if necessary.		
Egg Plant	Leaf Spot	Bordeaux Mixture. . .	No. 11 (3-6-50) when the plants are young. . . .	10-14 days later. . . .	10-14 days later. . . .		Do not spray mature fruit.
Fig	Mealy Bug	Contact poison.	No. 2 or 8 when insects are first seen.	Repeat in 8 days. . . .	Repeat when necessary.		Spray with great force to wash off insects. . . .
Grape	Grape Flea Beetle . .	Arsenical or repellent .	No. 3 or 4 as buds open.	Repeat when beetles appear	10-12 days later. . . .		Larvae on leaves may be killed with lime dust or pyrethrum.
Grape	Grape Sling	Arsenical or Contact Poison	Spray when slings appear	Repeat in 5-6 days. . .			These insects arrange themselves in groups. Easily destroyed. . . .
Grape	Anthracnose	Bordeaux Mixture. . .	No. 11 (4-6-50) just before buds open. . . .	Repeat before blossoms appear	No. 11 (4-6-50) when fruit is set	Same 2 weeks later.	Use No. 14 in place of Bordeaux as fruit nears maturity
Grape	Downy Mildew . . .	Bordeaux or No. 13. .	Just before blossoms appear. (4-6-50).	When fruit is set. . .	10 days later.		
Grape	Rots	Bordeaux Mixture. . .	Same as for mildew . .	When fruit is set. . .	10 days later.	10 days after third.	Continue every 10-14 days until fruit is nearly grown. Toward last use No. 14.
Grass Insects	Grasshoppers.	Poisoned Bran Mash.	Poisoned bran mash made by mixing one pound arsenic in 40 pounds bran with one quart molasses and water . .				
Grass Insects	Army Worms	Arsenicals.	Spray strip of grass with strong Paris Green mixture (1 lb in 100 gals. of water) in path of worms.				
Hot-house Plants	lice	Tobacco dust or decoction	(Tobacco smoke is very effective against most plant lice. To fumigate houses must be airtight).				

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT				REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH	
Hot-house Plants	Red Spider	Liver of Sulphur. . . Liberal Moisture. . .	Use No. 13 when insects are observed.	Repeat as necessary .			Frequent syringing with water with strong presure is best remedy. .
Nursery Stock	Leaf Disease	Bordeaux Mixture. . .	No. 11 (4-6-50) on apple and pear (weaker for peach) when leaves first appear.	Repeat in 10-14 days	Repeat if necessary.		Young pear seedlings may need six or seven treatments.
Onions	Smut	See No. 15.	Treat seed grain	2 weeks later repeat.	Repeat if necessary.		
Orange and Citrus Fruits .	Cottony Cushion Scale	Kerosene Emulsion 15 per cent. or No. 9.	When fruit is 1-4 grown.				
Orange and Citrus Fruits .	San Jose Scale	Lime-Sulphur Wash. .	When trees are dormant	No. 2, 15 per cent. in summer	10-14 days after second		Depend on winter spraying if possible.
Orange and Citrus Fruits .	White Fly	Contact Poisons. . . .	About last of April use No. 2 or 9.	10-12 days later. . . .	Same when second brood appears . .		
Orange and Citrus Fruits .	Scab	Bordeaux Mixture. . .	No. 11 (3-6-50) just after blossoms fall. . .	Repeat 14 days later.	14 days later	Repeat if necessary.	
Orange and Citrus Fruits .	Sooty Mole	See Remarks.					Lives on honey dew secreted by White Fly, which must be prevented by spraying.
Pea	Louse	Contact Poisons. . . .	No. 2 or 9 for spraying small areas.	Repeat in 5 days. . .	Repeat if necessary.		For large fields lice are brushed off vines into pans containing kerosene.
Pea	Weevil	Carbon Bi-sulphide. .	See bean weevil				See bean weevil.
Peach	Black Aphid or Lice on Leaves	Contact poisons. . . .	No. 8 or 9 when lice appear.	5-6 days later. . . .			Spray before leaves curl. For root-form use liberal applications of tobacco dust
Peach	Borers	Removal by hand and repellants	See remarks.				See discussion of peach-borer.
Peach	Curculio	Jarring or Arsenical in Bordeaux	Commence jarring and use No. 3 or 5 as petals fall.	Repeat spraying, 8-10 days later	Repeat 8-10 days later	8-10 days later	Jarring must be done every day for best results. Continue for 2-3 weeks.

SPRAY CALENDAR—Continued

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT				REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH	
Peach	Peach Twig Borer	Lime-Sulphur Wash. .	During winter.	Not usually necessary.			Winter spraying catches young borers in their winter cells.
Peach	San Jose Scale, West Indian Scale, Peach. Lecanium .	Lime-Sulphur Wash. .	During Nov. or Dec. . .	Repeat in Feb. on badly infested trees . .	No. 2 at 20 per cent. for summer spraying		Make use of summer treatment only as last resort.
Peach	Brown Rot and Mildew	Bordeaux Mixture. . .	No. 11 (2-6-50) before buds open in spring. .	No. 11 (3-9-50) when fruit is well set . .	In 12 days later repeat second	Repeat third in 12 days . . .	Continue same spraying every 12-14 days until two weeks before ripening
Pear	Leaf Curl	Bordeaux or Lime-Sulphur wash.	Spray one month before buds open.	Touch up unsprayed spots at once			One thorough spraying will answer.
Pear	Bud Worm	Arsenical in Bordeaux.	(Same as for apple bud worm)				See apple bud worm. . . .
Pear	Fooding Moth	Arsenicals.	Same as apple.				See apple.
Pear	Slug	Arsenicals.	Same as cherry				See cherry slug
Pear	San Jose Scale. . . .	Lime-Sulphur Wash. .	During Nov. or Dec. . .	Spray again in Feb. . .			See under peach insects. .
Pear	Leaf Blight	Bordeaux Mixture. . .	No. 11 (4-6-50) when leaves are full-grown.	Repeat 2-3 weeks later	Same 2 weeks later.		Young pear stock may be sprayed 5-6 times every two weeks. . . .
Pear	Twig or Fire Blight	Remove affected limbs.	Cut out twigs during summer, and prune thoroughly during winter. Disinfect all pruning implements . .				
Pear.	Pear Scab	Remove affected limbs.	Same as apple scab. . .				See apple.
Plum			(Aphis, curculio, scale, borers, brown rot, etc. same as ones affecting peach. See under peach).				
Plum	Plum Pockets	Bordeaux Mixture. . .	Before buds open				
Plum	Shot Hole Fungus	Bordeaux Mixture. . .	No. 11 (3-6-50) when leaves are nearly grown.	No. 11 (3-9-50) two weeks later			Disease similar to peach leaf curl.

SPRAY CALENDAR—Continued

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT				REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH	
Potato (Irish)	Colorado Beetle . . . Blister Beetles . . .	Arsenical in Bordeaux or Dry Poison . . .	When beetles or young ap- pear.	8-10 days later if li- quid is used . . .	If insects remain		Dry poison dust must be applied after each rain; No. 4 is most efficient.
Potato (Irish)	Flea Beetles	Repellant or Arsenical.	When beetles appear use lime, plaster or No. 4.	5-8 days later repeat.	If necessary.		Bordeaux acts as repellant and when poison is com- bined it is most valua- ble
Potato (Irish)	Blight	Bordeaux Mixture. . .	When plants are 4 to 5 inches high.	Repeat same in ten days	10-14 days later. . .	Repeat if necessary . .	
Potato (Irish)	Potato Scab	No. 15 or 16.	Soak seed potatoes. . .				See use of No. 15 and 16 for scab.
Potato (Sweet)	Golden Bugs, Flea Beetles, etc.	Arsenicals.	Use No. 4 while plants are in seed bed. . .	Drop plants in No. 4 or No. 5 just before planting	Spray 10 days after planting	Repeat if necessary . .	Protect plants until they are well started in the field.
Potato (Sweet)	Root Borer or Weevil	Feed or destroy infest- ed tubers	Or fumigate with carbon bi-sulphide.				Weevil does not occur in So. Eastern States Mostly in Texas. . . .
Potato (Sweet)	Black Rot	Avoid diseased tubers.	Select healthy tubers for seed bed				Never use affected plants.
Potato (Sweet)	Leaf Spot, Leaf Mold etc.	Bordeaux Mixture. . .	No. 11 (4-6-50) when plants are set out. . .	Repeat at first sign of disease.	10-12 days later. . .		
Onion	Slug	Contact Poisons or Ar- senicals.	No. 2, 3 or 5 when slugs appear.				See also under cherry. .
Quince	Leaf Blight.	Bordeaux Mixture. . .	Same as for pears. . .				See under pear.
Quince	Rust.	Bordeaux Mixture. . .	No. 11 (4-6-50) when leaves are 1-2 grown. .	Same after blooming.	Repeat 2 weeks later		See apple rust.
Raspberry, Blackberry, Dewberry	Rose Scale San Jose Scale . . .	Lime-Sulphur Wash. .	When bushes are dormant.				Cut out and burn worst in- fested canes.
Raspberry, Blackberry, Dewberry	Slug	Contact Poisons. . . .	Fresh lime, or No. 2. . .	Repeat 4-5 days later.			Arsenate of lead may be used as poison.
Raspberry, Blackberry, Dewberry	Anthraxnose	Bordeaux Mixture. . .	No. 11 (5-6-50) before growth commences. . .	No. 11. (3-6-50) soon after growth com- mences	8-10 days later. . .	8-10 days later.	

SPRAY CALENDAR—Continued

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT				REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH	
Raspberry, Blackberry, Dewberry . . .	Orange Rust		Cut out diseased canes. . .				Spraying for anthracnose may prevent.
Rose	Rose Beetle or Rose Chaffer	Hand picking and arsenicals	Commence by hand picking each day.	Spray with No. 3 (1 lb. in 100 gals.)	Use No. 5 (1 lb. in 25 gals.)		Very hard to combat. . .
Rose	Rose Slug	Arsenicals or Contact Poisons.	No. 2, 5 or 8 when slugs appear	4-5 days later.	Same four days later if necessary. . .		Often advisable to use both arsenical and contact poisons.
Rose	San Jose Scale	Lime-Sulphur Wash. .	In winter				Destroy badly infested sprouts.
Rose	Rose Scale	Bordeaux Mixture. . .	No. 11 (2-6-50) when leaves appear.	Repeat in 10-14 days	Repeat as necessary.		
Rose	Leaf Spot	Arsenicals.	No. 3 or 5 at first sign of damage.	Repeat spraying in 10 days.	Repeat as necessary.		
Shade Trees . .	Caterpillars		No. 1, when insects appear, or earlier as preventive measure. . . .	Same 6-8 days later	Repeat as necessary.		
Strawberry . . .	Leaf Roller, slug, etc.	Arsenical in Bordeaux.					
Strawberry . . .	Tarnished Plant Bug	Kerosene Emulsion. .	No. 2, at 15 per cent. on young plants.	Same before fruit is ripening.	Use No. 7, when fruit is ripening. .	Repeat third if necessary. . .	No. 7 should be used in form of spray.
Strawberry . . .	Leaf Blight or Rust .	Bordeaux Mixture. . .	No. 11 (2-6-50) when growth commences. . .	Repeat in 10-14 days	Use No. 14 when fruit is ripening	Repeat third if necessary. . .	
Strawberry . . .	Mildew	Liver of Sulphur. . . .	When growth begins.	6-8 days later if mildew appears.	Repeat as necessary.		When Bordeaux is used mildew is not likely to appear.
Sugar Cane . . .	Borer	Burn tops and stubble	(Burning is the only practical remedy known).				
Tobacco	Band-worm	Poisoned Bran	Sprinkled in opening buds	Repeat in 5-6 days . .	Repeat as necessary.		See directions for making poisoned bran under grass-grass-hoppers. . .
Tobacco	Cut Worms	Poisoned Bran	Spread on land before planting.	Place spoonful at base of plants	Repeat in 2-3 days.		See directions for making poisoned bran under grass-grass-hoppers. . .
Tobacco.	Horn Worm	Hand Picking and Arsenicals	No. 3 or 5 when worms appear, and hand pick each morning.	Repeat poison in 6-8 days	Same when second brood appears. . . .		Hand-pick the large worms. Thatchers may be trained to devour many worms.

SPRAY CALENDAR.—Continued

NAME OF PLANT	DISEASE OR INSECT	WITH WHAT TO SPRAY	WHEN TO SPRAY OR OTHER TREATMENT				REMARKS AND CAUTIONS
			FIRST	SECOND	THIRD	FOURTH	
Turnips and Radishes . . .	Cabbage Web-worm	Arsenicals.	No. 3 or 5 when worms appear	5-6 days later.	8-10 days later.		Worms must be poisoned when first present, before webs are formed over the plants.
Tomato	Potato Beetle, Flea Beetles, etc.	Arsenicals in Bordeaux	Same as for potato.				See potato.
Tomato	Tomato Worm Fruit Worm	Hand picking and arsenicals	Pick off large worms Spray with No. 4.	6-8 days later.	Repeat as necessary.		No. 5 may be used with success.
Tomato	Blight or Wilt		(Sprays are not effective. Trouble caused by germ which may be spread by insects, hence desirability of destroying insects).				Constant spraying combined with tying branches up well above ground and good cultivation are all necessary.
Tomato	Blossom end rot	Bordeaux Mixture.	No. 11 (3-6-50) when plants are first set.	Same when fruit first appears	Repeat 5-8 days later	5-8 days later.	Turn all diseased leaves and plants.
Violet	Leaf Rust or Spot	Bordeaux Mixture.	No. 11 (3-6-50) when plant are first set	10-12 days later.		Repeat as necessary	
Vegetables	Cutworms	Poison Bath.	See under Tobacco.				
Wheat	Chinch Bug	See under Corn.	(Burn over all infested areas in fall or winter to destroy hibernating insects).				
Wheat	Hessian Fly	Late Planting	(Wait until after heavy frost before planting. Also destroy all volunteer wheat during summer and fall. Plow stubble land during Aug. and Sep. and cultivate thoroughly.				
Wheat	Smut.	See No. 15 for treatment of seed	Soak seed before planting.

APPEARANCE OF IRRIGATION CANAL WHEN FIRST COMPLETED.
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BOOK VI.
IRRIGATION AND DRAINAGE.

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IRRIGATION AND DRAINAGE

Irrigation and drainage are more important in the South than most people suppose. The watering of land is irrigation, and the taking away or withdrawal of the water that is not evaporated is drainage. You will readily observe that the two are directly opposite. On account of the importance of these two subjects we will treat them separately.

IRRIGATION.

A great many farmers are of the opinion that it is not important in the South to irrigate the land. They say that the annual rainfall is so much greater than in the western arid regions, and that while it is necessary to water land there, that it is not necessary to water it here, where the rainfall is so bountiful. If we could control the water that falls in the South, and have it just at times when we needed it most, there would be no necessity for irrigation. But the water does not come at the time that the crops need it most. Drouth ruins many crops, and has caused the Southern farmers to lose thousands and thousands of dollars. It is not contended that irrigation will always pay, for such is not the case. There are some soils, when certain crops are planted on it, that do not need irrigation. Some crops do not require as much water as some other crops. And there are some lands that hold the moisture better than other lands, and therefore do not require so much water as other lands. You can readily see that when you think of irrigation that you think of a great subject. There is an effort on the part of some writers on this subject to minimize this subject. It is a subject that will require thought and attention. It will require study to understand it. In agriculture there are no cheap methods or crops. If irrigation required no study, and no expenditure of money, it would be worthless to the farmer. But it requires a good expenditure of both money and brain. It will be money and brains well spent, on the subject of irrigation. Irrigation

we said is watering land, so let us see the importance of water to the production of crops.

There are some cases on record where crops seem to flourish and produce fair yields with very small amounts of water, yet these are exceptions, and not the rule, and few of us would be willing to risk a crop on a small amount of water, were we able to obtain more water. In the soil are a great many germs which re-act upon dead organic matter in the soil converting this dead organic matter into ammonia and then converting this ammonia into nitrous acid and then germs transform this nitrous acid into nitric acid, which is the real nitrogen supply of nearly all the higher plants. These germs must have the right amount of moisture. If the water supply is cut short these germs do not do their work, and the plant suffers. And then there are other germs, whose business it is to take the nitrogen from the air, and transform it into forms that can be used by the plants. These germs must have water, or they will not do their work. There is another very important part played by water, and that is the development of root hairs. These root hairs supply the water to the plant, and unless they are developed, the plant suffers. Give the plant plenty of water, and root hairs will be developed, and the plant can receive a plenty of water. A very important work of water is to change the solid minerals that are used as plant food from a solid insoluble form to a soluble form, so that the plant can absorb them. This work is quite important, for unless the minerals become soluble, they are absolutely worthless as a fertilizer. Few people realize the amount of water that is used by plants. The amount that is required to mature crops of different kinds under various field conditions varies between wide limits. This amount is dependent upon the seasons, whether humid or dry; whether the temperature is high or low; whether the wind velocities are strong or light; also upon the amount of sunshine. There are many other matters that affect the amount of water used by plants. Among these is the treatment of the soil itself.

The annual rainfall for the Southern States according to the United States Weather Bureau is as follows:

Alabama	49.50 inches.
Arkansas	49.20 inches.
Florida	58.38 inches.
Georgia	51.45 inches.
Louisiana	54.18 inches.
Mississippi	50.71 inches.
N. Carolina	52.00 inches.
S. Carolina	48.98 inches.
Tennessee	49.13 inches.
Texas	31.94 inches.

It is contended by some that the rainfall in some of the Western States is so much less than the Southern States that it is not necessary to irrigate land. While it is true that the rainfall of the Southern States is greater than that of the Western States, still it is contended that irrigation will pay here in the South. As stated above, the great trouble is that the rain does not come at the time it is most needed. When corn begins tasseling, it needs more water for the next few weeks following, than at any other period during its growth. But as a rule this is a dry season.

If water could be furnished the crop just at this time, many times the crop would be doubled several times. As an illustration that irrigation does pay in the South, in Louisiana, which has the greatest rainfall of any Southern State, a farmer had a field of some fifty acres which produced 55 bushels of corn per acre. He placed a pump in and watered this land, and made 110 bushels of corn per acre. And yet this was situated in a State that receives more rain than any other Southern State. Mr. F. J. Merriam, Editor of the Southern Ruralist, of Atlanta, Ga., has had quite a little experience with irrigation, especially in garden truck, and he says: "As I have told you, we had a very nice little pond and our irrigation was working beautifully. With its help we had been able to sell \$115 worth of cucumbers from 250 hills; also something over \$350.00 worth of tomatoes from half an acre, and the land was not very rich either." This was in Georgia, which has a very heavy rainfall. Other instances can be given showing that irrigation, where done right, does pay right here in the South. It is not contended that irrigation will pay in every case, or such is not the case, nor will it pay in a majority of cases, for the farms have not been brought up to

that point. A great deal of the land cannot be profitably irrigated. But there is a great deal of land here that should be irrigated. Celery can be profitably grown here in the middle South by the use of irrigation. In some parts of the South it is now yielding large returns where irrigation is practiced. Much of the land will and is producing large returns in rice. Onions yield good returns where planted and irrigated. A great many garden crops, and some field crops, will pay to be irrigated in larger yields. In many Western States farmers are entirely dependent upon irrigation. If they can make farming pay, where their water is expensive, it seems that the Southern farmer should be able to make irrigation pay where water is abundant.

One great advantage in irrigation is that you have your water at your command. It is true that you cannot control the rains and prevent floods, but you need never have any fear of drouths. There is more loss throughout the South from drouths than there is from floods. To have water at your command is a great advantage. A great many crops suffer on account of the parching Southern winds. The effect of these winds can be overcome by irrigation.

But perhaps nowhere in the South is irrigation so important as around our cities. Here land is valuable, and one has to raise as much as possible on the land that he cultivates. This is especially true with regard to gardening. If the gardener is out in the country where land is plentiful and no object he may be justified in not irrigating, but the successful truck farmer near the city must irrigate his land to obtain the best returns. Intensive farming must be practiced, and this can only be done when the land is irrigated. Hon. H. M. Wilcox, Editor of the Field and Farm, also Editor of "Irrigation Farming," is one of the best authorities on the subject, says: "There is scarcely an acre of land under cultivation in North America, that would not produce more and better crops if there were at hand an abundant water supply. There are seasons now and then in which the rains come just right and irrigation might not be needed even once, but they are rare. Usually there are several dry spells during each year that cause serious injury to crops, and were irrigation possible all harm from this source might be prevented. A very little water at the right time would make all the difference with the crop and turn into success what otherwise would have been a partial or total failure. The work already put

on the land would be saved as well as seeds and plants. Satisfaction and plenty would take the place of disappointment and scarcity."

RELATION OF SOIL TO IRRIGATION.

The relation of soil to irrigation must be understood by the man who expects to irrigate. According to physical characteristics there are several classes. However, all of these might be classed as clays or sand. Sand is made up of small grains of silica or quartz. It is not a plant food and cannot be used directly by the plants. It does not stick together, but on the other hand, acts as a divider in the soil. It makes the land easy to work and enables the roots of the plants to work their way down deep into the earth in search of food. Sand absorbs very little moisture, and hence cannot stand a drouth well. It retains heat better than any other soil. Clay is a compound of silica and aluminum. It is very rare that we find it pure, for it generally contains potash, lime, ammonia and other minerals in small quantities. The potash, ammonia and other minerals are valuable as plant foods, but the clay in itself has no value as a plant food. Clay absorbs moisture very rapidly. It absorbs heat more rapidly than does sand, but it does not retain it as well as sand. Clay lands are usually rich in phosphoric acid, potash, ammonia, etc., and hold moisture well, withstands drouth, but it is difficult to work. When irrigated in the summer it is liable to bake. Loam soils, or gumbo soils is the name given to the soils in the South having a greasy feeling, and a soapy or waxy appearance. This class of soils require less irrigation than most any soil. Really the loam soil is a medium between a clay and sand. If the sand predominates, it is called a sandy loam, and if the clay predominates, it is called a clay loam. The peat land and muck are very much alike, having in them a great deal of decayed vegetable matter. The darker the land the better. It contains all the elements needed in plants.

WATER-SUPPLY.

The greatest question to the man who contemplates irrigation is the question of the water-supply. Indeed, this is the greatest difficulty in the way of irrigation. There is no use of making preparations to irrigate the farm or garden until you have arranged

for your water supply. In many Western farms, the supply of water is in the hands of large corporations, and the farmer has little to do with arranging this matter. But here in the South each farmer who proposes to irrigate his land, must solve this problem himself. If your land is so situated that you can secure your supply of water from a creek, or branch you are fortunate indeed. It is frequently the case that you can go above the land you wish to irrigate a short distance and by throwing a small dam across the stream and by running a ditch nearly on a level, you can have the water at sufficient height by the time you reach your land. Mr. F. J. Merriam, of Atlanta, gives his experience as follows:

"Sandy Creek runs through the bottom lands of our farm, a distance of 1-2 a mile. The bottoms are narrow and lie mostly on the north side of the creek. At the upper end the hills on either side come nearly together, and here we decided to build our dam, some ten years ago. We first constructed a box 20 feet long and 1 foot square, which we placed on one side of the creek for the water to run through while we built the dam. We then piled in the soil from either side, hauled in clay with a mule and scraper, and were getting on famously when there came a big shower of rain and washed the whole thing away. We had failed to cut a waste ditch and the 1 foot box would not carry the water.

"Well, we went to work again, and this time we cut a waste-ditch at the opposite end from where our irrigating ditch started. The bottom of the waste ditch was about 1 ft. higher than the bottom of our irrigating ditch and the top of the dam was about two feet above this. We put a sliding gate in the upper end of the box in the creek bed, piled a lot of mud against it, and very soon had a nice pond. The water was let into the irrigating ditch by means of a 1 ft. box running through the dam, and having a gate so as to shut it off when not needed. The main irrigating ditch was cut around the base of the hill almost on a level and having every 400 or 500 yards an escape box emptying into a cross-ditch through the creek. This is necessary in order to let the water off whenever it rains, to keep the ditch from overflowing. These boxes are, of course, kept close when the ditch is in use. I may remark in passing that this main ditch has been worth all it cost in keeping the surface water from the hills off our bottom lands during heavy rains. There has been also

lutely no washing from this source except once when we neglected to pull out the gates."

Among other means of irrigation is the steam pump, gasoline engines, windmills, artesian wells, hydraulic rams and the like. The gasoline engine has come to the front in the matter of irrigation in the last few years. A three and a half or four horse power engine will deliver 60 gallons of water per minute through a two-inch pipe, or enough water to irrigate an acre of land in three hours, or four acres per day of twelve hours. This engine should keep forty acres well supplied with water, for the land will not have to be irrigated more than once in ten days. The water is forced by the engine to the highest point in the field, and is distributed from there by means of small furrows made by a plow for that purpose. In using a gasoline engine you will not have to use a storage tank. A hydraulic ram where you have a large stream, and cannot get the water elevated by natural means, will do good work, but it does so at a great waste of water. There are creeks that are very low, and the water to be available for irrigating purposes will have to be raised by some artificial means. A hydraulic ram will run with less attention than any water lifting machine that we know of. In using a ram, you will have to have a storage tank, for the ram will work night and day. In many sections artesian wells can be used to an advantage. The well runs on all the time, and to use the water economically, will require the use of a storage tank. In the Western sections canals are dug to the river, and the water used for irrigation secured from the river. There are no objections to this plan, except that the people of the South are not ready for it. There are some cases where a man may wish to canal the river, but they are few. If you contemplate using a canal, you had better employ an engineer to lay it out for you. To do the work yourself is to fail in almost every case. Mr. Hal Runnels, of Caldwell, Texas, is well posted on the question of irrigation here in the South, and we cannot perhaps do better than quote from him. He says:

"Irrigation gardening is a subject that is interesting to many who every year lose money by drouth more or less protracted. I have for the past 12 years been engaged in irrigating, so will attempt to give a few ideals that may benefit some brother farmer or gardener.

"Look after water supply first if you have a place where can build a storage reservoir to be filled from a spring, and that reservoir is higher than the land to be irrigated you can convey the water in gravity ditches to the highest point on your land cheaper than by any other means. The centrifugal pump run by means of a gasoline engine if your lift for the water is not more than 35 or 40 feet is the next best method. The amount of water supply will be next thing to consider. Cabbage will require more water than any other vegetable to force the growth and make large compact heads. It is computed that for one acre of cabbage, irrigating by allowing the water to flow in furrows, it requires 40,000 to 60,000 gallons of water for one irrigation. From this you can approximate the amount of water needed for any given area. You can test your land by allowing a small stream to flow through an open furrow. If this stream holds up well and runs a given number of feet, say 20 to 40, down the furrow and percolation is sufficient to carry moisture laterally to the roots of the plants growing on either side, your best method of irrigating will be by furrows. But if it is absorbed rapidly with little lateral pressure you will have to flood. This method requires the throwing up of small ridges upon the land it will pass over the entire surface of the soil. The flooding system is used on the Rio Grande in West Texas, as that soil drinks water like a sponge. For flooding more water is required. I prefer the furrow system for several reasons, it takes less water, it does not leave the soil in which small seeds are in a puddled condition to crack or bake, it carries the moisture directly to the roots of the growing plants, thus preventing scalding, it leaves the ground in better condition to cultivate after irrigating, which must be done thoroughly to get best results from the moisture.

"A three inch pump (centrifugal) with a five horse power engine can put three hundred gallons per minute with a lift of 25 feet directly upon the land with which 10 to 15 acres can be irrigated without a storage reservoir, with reservoir of 10,000 gallons capacity much more land can be brought under the ditch, as a constant pumping can keep the reservoir full when not irrigating.

"Now we will consider your plant all complete. The next thing will be the preparation for pumping the water on hand. This will require surveying, first to find the highest point from which to run your main ditches from which to carry your lateral ditches. A

surveyor of competent ability will charge you about \$5.00 per day and it will take him two days to survey the levels and make you a map or chart showing the levels so you can read them and work accordingly. My advice is get a Bostrom's Improved Farm Level, and do your work yourself. You can get for \$5.00 a level without telescope. This level is good for 200 feet. \$10.00 with telescope, this one is good for 500 feet or more with perfect accuracy. Prepare you a lot of stakes, have plenty. Set your level at your highest point on your land, and let your assistant take the staff and target down the line you think is the way you wish the main ditch to go, and a boy to carry the stakes. Let him step off 35 steps which will be near 100 feet, place his staff and run up or down the target, as you may direct, to get it upon a level with your instrument, drive a stake and number it 1, you setting down the figure on the staff proceed to stake 2 in the same way, and so on down the entire line, writing down the levels for each stake. Come back to the starting point and survey the levels from stake 1 at right angle every hundred feet, numbering your cross sections 1-1, 1-2, etc., then at stake two cross again and so on until you have the levels of your entire field in squares of one hundred feet each. By this you know where there is a rise to be leveled down or a depression to be filled. I prefer to have my ditch to have a fall of not more than three inches to 100 feet, and the water to flow through furrows not more than six inches to 100 feet, less if possible. 1 inch to 100 feet is plenty for the best results.

"We have now the levels and can tell just where to scrape down and fill in. With turn or disc plow, plow the land broadcast, leaving the stakes in position. Then with a plat or map of your land upon which you have your levels marked, go over your field with your scraper and double team and driver.

"You get between the handles of the scraper, (a 1x12 board, 6 or 8 feet long, fastened to a sweep stock with lower edge beveled to make it cut into the earth.) Scrape down the high place and hold the scraper full until you get to depression, then gradually raise scraper, dropping the dirt evenly. Keep this up 'till your land is on even or perfectly inclined plain and graded to suit. Now that this is all complete and you know which way you wish your main and lateral ditches to flow and your rows to run, we consider the water supply and how to run to make your ditches. The highest point is the one at which the water

is delivered, that is the head. Many try building their ditches above ground. This method is a failure in many cases, and it never gives satisfactory results. Mice, toads, crawfish and bugs burrow or make holes in the banks, and some soils crack when drying, hence when water is turned into the ditches after 8 or 10 days' disuse, it will keep one man busy fixing up the breaks. Wooden flumes are too expensive.

"My plan is to stake off the ditch, then with turn plow I throw two furrows in opposite directions 2 feet apart full length of ditch. Then turn and break out center, then with hoes pull out the dirt, half on one side and half on the other, forming a well-rounded wall on either side. This ditch with a fall of 3 inches to 100 feet, will carry 1,000 gallons of water per minute. With less fall less amount. It requires work to keep up the walls of the ditch, so I never allow a horse or wagon to pass over the main ditch except where it is fixed for the purpose. I have a turn road along the main and opposite side of which I have a small ditch made by two furrows of turn plow of a sixteen inch sweep run along the ends of the rows. Along this main every twenty or thirty feet I put a gate made of board with dirt placed around the edges to keep back the water. Running across the turn road is a small ditch or box of 1x6 plank covered up in the trench which extends from main to the small ditch. The rows in the field run right up to the small ditch and the furrows at the lower end open into a small or waste ditch to carry off any surplus water.

"We want now to turn on the water to-morrow. So to-day we take a hoe and long pointed shovel and go to work to get ready. Scoop all the loose dirt out of the mouth of each furrow the full length of the small ditch, put this in a pile just opposite mouth of furrow. Be sure and have plenty in a pile if you have to get two or three shovels full extra dirt. You have, as before stated, openings from the main to small ditches either branches dug out or boxes. Between each of these put a dam across little ditch, full length of ditch. In main ditch if it has not more than three inches fall, place a dam. I use 1x12 boards with ends sawed off on a bevel to suit the sides of my ditch. I drive a stake in center of ditch to support the weight of water. Place board in front of stake. Then with my shovel I dig dirt from bottom of ditch and throw in front of board, pack it with shovel. This holds water well. Place these dams all along main at about 100 feet apart, and open all the gates that allow water to pass into small ditch.

"We are now ready for water and recollect that it is absolutely necessary to a successful handling of the water to thus prepare ahead. If you are not, your water will get the best of you, if you have only a small amount, and you will find yourself having to wade around in the mud, greatly to the detriment of your land, to say nothing of the annoyance and extra exertion you have to put forth to gain control of the water again.

"With land and ditches fixed as I have described, I can, with less exertion handle and keep control of 2,500 gallons of water per minute, than a green hand, not properly fixed before hand, can handle 250 gallons per minute. I can use 2,500 gallons of water per minute and never get my feet wet, and sit down and read *Tilling the Soil*, too.

"We will now go to the head and turn the water down our main. It's on....now let's go down to the first dam and watch it, as the water strikes. If any little stream or seep goes beneath the board, we will have to put a few shovels full of dust if we can get it to stop the leak, else in a short while the whole dam will be washed away. Well, it holds. Now let us step along to the gates and see if the walls of our main are standing the strain, for this being the first time, they may get soft and slough into the ditch or the water may break through them. Watch them closely. The water is flowing nicely through each furrow except for a clod or a little trash; we get ahead of the water with a hoe and remove the obstruction. We turned on a small amount of water this time to test our ditch and to get a little use to handling the water so that we needed only two of our gates open from main ditch. These two ditches water about 12 to 14 furrows. These are about through, some of them run through before the others. These are always to be filled at the mouth with the loose dirt that was piled up in turn road opposite mouth of furrow, thus cutting off its supply of water and accelerating the other. As soon as the first 6 or 7 rows of 1st gate are through, close the gate and open the third, and so on. When all is about watered above the first dam in the main, just pull up the board and the water will go through the dirt and take it down and fill any holes with. Keep this up until the whole is watered.

"Keep open enough rows to let your water run slowly in furrows, so there will be no washing, and moisture has had time to reach from side to side of bed."

IRRIGATING THE ORCHARD.

"In this article, which will be short, we will give some directions for preparing to irrigate the orchard. My experience teaches me that an orchard irrigated gives fruit far superior to one that is not so treated, and by the proper use of water one can have a full crop of fruit every year without fail.

"You frequently hear men say they do not know why it is that trees bear heavily one year and very little the next, and that they cannot count on a full crop each year.

"My theory is this: After a tree has borne a heavy crop, the hot, dry weather of summer is upon them, evaporation is great and the proper plant food is non-available for the tree, hence its growth is stopped and exhausted. Nature compels the tree to sleep or become dormant, and the formation of fruit buds is stopped to some extent, and those which are formed are imperfect and fail to fertilize properly in spring, hence a failure of the crop. And so it takes a whole year for trees to recuperate.

"With irrigation this is changed, for when the fruit is taken from the trees, give a liberal supply of water, get your subsoil thoroughly wet and the trees will 'leap for joy,' and put on a big growth of new wood, form fruit buds that are perfect in construction, and last, but not least, by this method of keeping them growing late in the fall—right up to frost—you can set back the time of spring blossoming from two to three weeks, thus obviating and lessening the danger of late frosts.

"While the young fruit is in the growing stage, push it along by copious draughts of water and cultivate after irrigating, not deep, to put a dust mulch upon every part of the ground where the sun strikes it. Two or three weeks before the fruit begins ripening, be wonderfully surprised at results, in both beauty of appearance and flavor.

"Last year I had at San Marcos, Tex., Elbertas and Mamie Ross, irrigated that were exquisite and delicious, while just 500 feet distant the same varieties not irrigated could no more be compared than a dollar to a dime. They were being forced vastly earlier, having sold the Elbertas before June 1st. So you see the advantage as an early market catcher.

"Now take the plan that I have in the orchard. There are dikes on the level or comparatively level land. These dikes surround as

much as a quarter of an acre, on less level land throw them up around one or two rows of trees. Notice that the dikes run up to the ditch from which the water may be turned into the space between dikes. I let the water run in until it will stand about six inches deep at the first irrigation in spring, while trees are in bloom. Unless, of course, there has been a very wet winter, and lighter applications later will suffice. This will apply to grapes and berries as well as fruit trees. I am thoroughly convinced that the bearing time of nut trees could be cut down one or two years by irrigation. Thus if it takes ten years to bring a young grove into bearing under ordinary circumstances, by irrigation, eight would suffice."

IRRIGATION OF CELERY.

Celery requires more water than any other crop we know of. The irrigation of celery at the New Jersey Experiment station more than doubled the yield, and increased its market value more than eight times. As soon as the plants are transplanted into their permanent bed, water should be allowed to run down the rows, and give the plants a good soaking. If the weather is very dry the plants should be irrigated at least once a week. Many growers water the plants as often as three times a week. Some growers use tiling to irrigate their celery, placing a row of tiling under the ground beneath the surface. These rows are placed about twelve feet apart. The tiling is supplied by a long ditch, the ditch being filled by a pump. The water comes out at the joints of the tiling and waters the celery.

IRRIGATION OF ONIONS.

The successful onion grower irrigates his onions. There are two ways of irrigating onions,—by flooding and by furrows. There are some growers who object to flooding, while there are other growers who claim that flooding has no disadvantages. The ground should be laid off in beds ten, fifteen or twenty feet in width and ten rods in length. The beds should be level, especially should they be level lengthwise. If there is any fall, let it be from one side to the other and not from end to end. Water can be turned on until it stands an inch deep all over the bed. Immediately after irrigating, that is, as soon as the soil becomes dry enough, it should be gone over with the wheel hoe to keep it from baking. If the soil is well

supplied with moisture when the seed are planted, it may not be necessary to irrigate for a month after the plants are up. We cannot lay down a definite rule as to when the water should be applied in each case. The first application in the spring should be light.

For furrow irrigation, the rows should be on a level an about fourteen inches apart. Run a Planter Junior cultivator between each row, which will leave the ground in excellent shape for the water. Through each one of these furrows run a very small stream of water, not enough to overflow the banks, but just enough to keep running. One great advantage in using the furrow system over flooding in the South, is that a great deal of the land is not level enough to flood, while the rows can be run on a level even if the land is rolling. Onions should not be irrigated more than once a week, and not that often if you have had any rain. Too much water causes a yield of scullions, and the onions will prove poor keepers.

IRRIGATION OF RICE.

This subject is treated under the head of Growing Rice in another part of this book.

The following, taken from the address of F. J. Merriam, of Atlanta, Ga., which address was delivered before the Farmers' Institute, at Clemson College, August 12th, 1903, while a repetition in some matters will not be irrelevant at this juncture:

METHODS OF APPLICATION.

"There are as many different methods of applying as there are of supplying water for irrigating purposes. Of these, flooding is probably the most effectual; but unless one's land lies comparatively level this method is out of the question. Moreover, lands so treated must be thoroughly underdrained, else it will become too wet, and damage result. It also requires an enormous quantity of water at one time, such as it would be difficult to obtain without a very large outlay, unless one happened to be exceptionally situated.

"Irrigation in the South is very different from that in the West, where there is little or no rainfall during the summer months. Here a severe drouth is likely to be broken at any time by a heavy downpour of rain, and if this follows immediately after irrigation, the land is liable to become puddled and run to-

together. This not only injures its physical condition, but often results in permanent injury to the crop as well. I remember once I had just finished irrigating a field of cabbage and was congratulating myself upon having done an extra good job. The ground was so wet you could not walk on it without miring up. Well, that night it rained hard, and rained a portion of the next day. The land remained saturated with water for several days and the cabbage simply wilted down and died. At least the majority of them died, and the patch was practically ruined. The land was what would be called naturally well drained, but that was not sufficient. It needed artificial drains as well to carry off the surplus water. We have put several ditches through there since and have had no more trouble, but we have also been more careful in applying the water.

When irrigating we run a furrow across the upper end of our rows into which the water is turned from the main irrigating ditch. From this furrow it is allowed to run down between the rows of growing vegetables. Where the rows are very close we turn the water down between every other row; where wider, between every row. If the rows are very wide we run a furrow alongside the vegetables for the water to flow in, our rows being laid off so the water will flow through slowly without washing.

"We have injured clay land by running the water over the surface and keeping it there too long at a time, causing the land to puddle and run together. To obviate this, we have found it best to open a deep furrow for the water to run in, and even running a small subsoil plow through before the water is turned in. Such deep working might injure a crop if the furrows were allowed to dry out, but where water is turned in immediately it is beneficial. The water being let into the subsoil acts in a measure like sub-irrigation, the moisture rising to the plant from below. Enough water is turned into these furrows to run through to the end, thoroughly wetting the soil without puddling, and is then turned into a fresh row. I have found this to be the most practicable method of applying water to my land.

"Undoubtedly better results can be obtained from a system of sub-irrigation than by any of the methods of applying water on the surface. As usually practiced, this method consists in laying lines of tile about a foot below the surface, directly under where the row of vegetables is to grow, and keeping them filled with water during dry weather. This, how-

ever, is very expensive and only practicable for persons of abundant means and on a limited scale.

"A friend of mine who has a piece of very rich bottom land tried a system of sub-irrigation by means of open ditches. His land was a loose alluvial loam underlaid with pipe clay. He dug narrow ditches through his field 2 feet deep and 30 feet apart. These ditches were run on a level and he filled them with water and succeeded in raising the water table of his land to correspond with the water in his ditches, as it percolated through from ditch to ditch. He grew some very fine celery on this system of irrigation. During wet weather the water was turned off, and the ditches served as drains. Any system of irrigation or drainage by open ditches, however, is open to serious objection, not only because of the loss of land occupied by the ditches, but because it is an endless job to keep them cleaned out and control the weeds and grass that accumulate on their banks.

"The market gardener who must bring his vegetables on at a certain time in order to meet the demands of his customers, finds it necessary to plant at a certain time, whether the weather is hot or dry. For him, irrigation is often necessary in order to bring up his seed. I have had considerable experience along this line and find that the best plan is to apply the water to the land before the seed are sown. If you wait until afterward your stand will be very irregular. We prepare our land, lay off our rows, run the water through them, let it settle, then plant our seed. It is sometimes necessary to cover with a hoe, but we get a stand every time."

DRAINAGE.

Thousands of acres of land lie idle every year, not producing enough to pay the taxes on it, simply because it is not drained. While water is important, yet there is such a thing as overdoing the matter. A great many of the river bottoms are the most fertile, yet on account of lack of drainage are unproductive. These lands would need practically no fertilizer, and would make a great deal more than the hills. The great question with many of our farmers, is how to drain these lands. And it may not be out of the way to digress enough to say, that there is no subject upon which the farmers know so little as the drainage of land. The U. S. Agricultural Department has taken this matter up, and has done a great deal to enlighten the farmers on the subject of drain-

ing land. But its mission has not been completed, for many are ignorant on the subject yet. There is a great deal of land that needs draining. For instance, the hill sections of the Southern States are literally washed away because they are either improperly or insufficiently drained. We shall not attempt in a brief treatise of this kind, to give the necessity for drainage. Most every one realizes that land should be drained, and that if it is not properly drained, that good crops cannot be produced. There are two classes of land that should be drained; the low bottoms that are constantly too wet for cultivation, and the hillsides that must be drained in order to prevent them from washing away. We will treat each separately.

The Bostrom-Brady Co., of Atlanta, Ga., issued a treatise on Drainage from which we take the following:

"The little drainage practiced in the South is so inefficiently done that but slight opportunity is afforded to illustrate the benefit and profit accruing from the proper execution of the work. Many acres of land that could be drained with but little cost are now allowed to lie idle, the owners preferring to cultivate the less fertile upland. Many of these wet lands will pay the cost of drainage the first or second year and give double the yield per acre that is being gathered from areas believed not to be in need of drainage.

"The benefits of drainage were very forcibly illustrated during the present year on the Southern Branch Station, Arkansas. There were gathered from one and one-fifth acres 39 bushels of corn. The land had never before been in cultivation and a portion of it remained under water during the entire summer. The whole area was boggy and covered with a growth of such plants as are commonly found growing in and around marshes. About 10 cords of willow, sweet gum, and blackgum were taken off and the coarse trash either removed or burned. A small, open ditch was first dug to drain the surface water. A main and two lateral ditches were staked off, the total length of which was 135 yards. These ditches, where stumps and roots did not interfere, were opened to a depth of from 12 to 18 inches with a large turning plow and further deepened to 30 or 36 inches with shovel, giving a fall of about 5 inches to every 100 feet. Into these ditches were placed inverted V shaped troughs, made of cypress plank, 6 inches wide, 1 inch thick and 16 feet long. The ditches were then filled part-

ly with shovel and partly with turning plow. The total cost of the ditch, including digging, plank, nails and filling, did not exceed \$10. Not one-tenth of the land thus drained (1 1-5 acres) could have been cultivated at all without drainage, but underdrained it produced 39 bushels of corn the first year without fertilizer, while upland not 200 yards distant failed to yield 10 bushels fertilized with 200 lbs. of cotton-seed meal and given twice the amount of cultivation. No water now remains on any portion of the drained area referred to more than an hour or two after the heaviest rain. In fact, it is the driest ground on the Station property after a heavy rain and the most moist during drouth.

Indications of the Need of Drainage.

"The roots of all cultivated plants extend down to a depth of 3 or 4 feet and under favorable circumstances deeper. The roots will not, however, grow in water. If the soil remains saturated to within 12 inches of the surface the roots will not penetrate to a depth greater than 12 inches. The roots of cultivated plants must be in air as well as the tops. Unless excluded by water, air will penetrate the earth to a depth greater than that attained by the roots of any cultivated plant. That cultivated plants may be profitably grown the water should not remain for any length of time nearer the surface than 3 feet. The depth of a water table (or the height to which water stands in the soil) can be determined in several ways and when found to remain nearer the surface than 3 feet the soil will be greatly benefited by drainage.

"Among the indications of the need of drainage are:

- (a) Swamps.
- (b) Certain plants that grow on wet ground.
- (c) Wide cracks on surface in dry weather.
- (d) Water in pits or standing on surface.
- (e) Soil remaining wet long after rain.
- (f) Stagnant water within three feet of surface.

The presence of any one of these indications is sufficient evidence of a decided need of drainage, and as a rule it would be profitable to drain land with the evidence of the presence of even one of these indications. It has been written "that all lands which are worth plowing, which is not the case with all lands that are plowed, would be improved by drainage. But it does not necessarily follow that all lands worth

plowing may be profitably drained. It is a fact, however, that thousands of acres of cultivated lands would, if properly drained, give double their present yield, and thousands more not cultivated, on account of their being too wet, would, if drained, yield double or treble as much as the average acre now in cultivation."

The draining of bottoms is a very important subject throughout the South. A great deal of land is not in cultivation on account of the great amount of water. There are several methods of draining bottoms. The one that has been practiced more than any other throughout the South to drain bottoms is by means of open ditches. This method of draining has a great many objections, and should not be practiced. The underground drain is really the only successful method of draining wet lands. You have several advantages in using the underground drains over the open ditch. One great objection to the use of the open ditch is that you lose the use of the land that is occupied by the ditch, and this is a large consideration, for it will require a great deal of land used as ditches to properly drain land. The underground drains more successful than the open ditch. The writer is acquainted with a farm in Jackson County, Georgia, that had been attempted to be drained by open ditches. The farm is just between a river and a creek. The effort to drain with open ditches proved a failure. Another party bought the farm and placed underground drains made of tiling in and since that time has had the bottoms in cultivation, making good crops each year. Before this land was drained with the underground drains, it did not produce anything at all. And taking it for granted that you desire to use underground drains, which you should do by all means, several questions come up for solution.

DEPTH OF DRAINS.

Drains should not, as a rule, be placed lower than four feet, for ordinary farm crops. The level of the ground water changes with the seasons. In some cases land that must be drained only to allow the land to be cultivated in the early spring, and it is only desired to draw the water down enough to allow cultivation in the early spring. In such cases, the tiles can be placed 2 1-2 or 3 feet deep. If you place the tiles deeper than this, the water bed will be permanently lowered, and the crop caused to suf-

fer in the summer for water. And the nature of the soil effects the depth the drains should be placed. Fields that are underlaid by sandy subsoils, for the water bed should be as near the surface as possible. Water is raised to the surface of the ground by what is known as capillary action, i. e., the water comes up through the small holes that are between the grains of soil, and the distance that it can be raised in sandy soils is not so great as in other soils, hence drains for sandy land should not be placed as deep as in clay lands.

DISTANCE BETWEEN DRAINS.

The distance between the drains is also an important consideration. According to F. H. King, author of *Irrigation and Drainage*, three factors determine the proper distance between underdrains: (1) the freedom with which water may flow through the subsoil toward the drains, (2) the depth at which the drains are placed, and (3) the intervals of time between rainfalls sufficiently heavy to produce considerable percolation. The character of the subsoil determines the rate at which the water moves towards the drains. There are several other matters that effect the rate with which the water flows towards and into the drains. It is the practice to place drains anywhere from 30 to 100 and sometimes as much as 200 feet apart. The most successful tile drains laid in Georgia are those on the farms of Dr. L. G. Hardman. Dr. Hardman places his drains anywhere from 50 to 150 feet apart, and claims to have received great benefit from them.

KIND OF DRAINS.

As to the material with which drains should be made, opinions vary. There are several different materials. Small pine poles were once used, placing one pole upon two others. Some split large pine poles, and lay them in the bottom of the ditch side by side with their faces upwards. And then some have nailed two boards together V-shaped and placed in the bottom of the ditch.

Stones have been used in various ways for the purpose of draining. Sometimes the bottom of the ditch is covered with small stones, and these covered with dirt. Then two flat stones placed on edge to form a V opening downward is a plan that has been used

a great deal. Another plan is to place two flat stones on edge, and one on top of these two, forming a rectangular box, using the dirt for one side, has been used. This is the most successful plan of using stones, and where the stones can be secured at a reasonable price, this kind of drainage is perhaps to be preferred above all others.

Boxes made of boards about seven inches square make an excellent drain as long as they last. Since the box at times becomes dry it is subject to decay, and is not as lasting as some other materials. There is another very serious objection to boards, and that is when you wish to make any repairs, or should the drain become filled, you will have to take up a much longer section than when tiling or stones are used. As a rule when plank boxes are used, they are made twelve, fourteen or sixteen feet long. Tiles are, as a rule, eighteen inches long, and it is not necessary to dig up so much should repairs be necessary.

There is no better drain made than tiling. It costs more to put in a tile drain than it does any other material, but it is far more satisfactory. It costs more to put them in, but they never decay, and on a whole give much more satisfactory results. There are a great many erroneous impressions concerning tile draining. Some people believe that a considerable space should be left between the ends of the tiles so that the water can enter. But this is not true. The tiles should be placed as close together as possible. The water will enter through the joints, and through the pores of the tiles in sufficient quantities, and it is therefore unnecessary to make any provision for the entrance of water. Collars should not be used at the joints to prevent the trash from entering, for if you will place the tiles as close as you can get them, you should experience no trouble in keeping trash from entering. The collars will retard the entrance of the water.

There are several shapes of tile on the market, but you will find that the round tile is better than any other shape. There is less friction, and less danger of moss growing in the drains if they are round, than when they are square or octagon in shape.

THE FALL FOR DRAINS.

The matter of laying the drains with the correct amount of fall is the most important part of tile

laying. Indeed, this matter is of so much importance that you had better get some one with instruments to do the work for you, for you will make a miserable failure, nine cases out of ten, if you depend on guess work. While it is true that it will cost something to secure the services of a competent man, yet if you have it done as it should be, you are through with it, but on the other hand, if it is not properly done, you will be worried about it as long as you live. Really when you consider that you are placing tile drains in for life, and that you want to be troubled with them just as little as possible, you can readily see the importance of doing the work as it should be. Reference has been made once or twice to the drainage done by Dr. L. G. Hardman, who sent to a tile factory for a man to come to his farm and place the drains in. The man came without levels or instruments of any kind. It was seen at once that the method of guessing would not do, so Dr. Hardman sent to Iowa for a man that knew how to lay drains. It was expensive, but a man was secured that knew his business, and the drains that were laid in 1898 are giving perfect satisfaction now, while the drains that were laid by guess have had to be taken up and repaired. If you can secure a fall of 2 inches to every 100 feet of drains, the results should be favorable. In many cases, however, much less fall than this has to be accepted. If you have to use less fall than two inches it should only be after careful surveying of the ground, and after you are satisfied that you cannot possibly get more fall. Care should be observed to have the most uniform fall for the whole drain, or any lateral possible, and then the tiles should be laid true to grade after the grade has been secured. It may not always be possible to maintain a uniform grade throughout the entire main or lateral, and when such is the case, that is, when you have to change the grade, it should be changed from a less fall to a greater one, for then any sediment which should be carried in the upper part of the drain will also be carried in the lower part of the drain, but if the fall is reversed this does not always follow.

Should it be necessary to change from a greater fall to a less fall, a silt basin should be used. It is best to make silt basins of brick or stone, and they may be two or three feet square, or larger, and should be a foot deeper at least than the lowest drain. All sediment that comes from the drains will fall in this, and can be removed at any time. Silt basins should be covered to prevent accidents.

SIZE OF TILES TO USE.

It may be laid down as a safe rule that tiling smaller than two inches in diameter should not be used. The larger the tiles are the better. Mr. C. G. Elliott, one of the best posted men in the United States on drainage, says: "For drains not more than 500 feet long, a 2-inch tile will drain two acres. Lines more than 500 feet long, should not be laid of 2-inch tiles. A 3-inch tile will drain five acres, and not be of greater length than 1,000 feet. A 4-inch tile will drain 12 acres; a 5-inch 20 acres; a 6-inch 40 acres, and a 7-inch tile 60 acres."

TERRACING.

The question of how best to construct terraces is an important one here in the South. Many farmers, on rolling land get along without any terraces at all, and their land does not wash away either. But there are few farmers that can get along without terraces. A farm in middle Georgia was very badly washed. An enterprising farmer came into possession of it, and began by deep cultivation. He broke the land deep and plowed on a level. That same farm to-day has not a single wash in it, and neither has it a terrace in it. Most farmers do not break their land deep enough for anything like this, nor do they plow on a level. They will have to continue the old method of building terraces.

"The theory of terraces, which has been sustained by experience, is that it prevents the water which falls on the land from collecting in rivulets having force enough to do mischief, and causes it to remain longer on the soil, as the terrace spaces become gradually leveled by successive plowings; and compels that which does not flow off to spread in sheets as from the eaves of a house roof, instead of in collected quantities as from the valleys of the roof. The water that does not soak into the earth is carried from the field spread uniformly over its surface and with a checked velocity, thus decreasing its washing effect geometrically as its velocity is retarded and geometrically again as it is uniformly spread. Some give a slight fall to the terrace line and others throw up a bank with a ditch above. Both are objectionable and totally inconsistent with the fundamental idea of the terrace. The bank proves terribly destructive and has caused much prejudice against terracing. The mischief done by

the breaking of the bank and turning loose the pond which has collected above. Such a so-called terrace is nothing more or less than a hillside ditch improperly constructed.

To Lay off a Terrace.

"A starting point is selected either above or below any comparatively level part of the hillside so as to cut such level as little as possible. If there is no such level to be protected it matters little where the starting point is taken. Absolutely level lines are laid off around the hill and staked, placing the stakes nearer if the curve is sharp to preserve the level when plowing. If the slope is uniform and the curvature slight the stakes may not be so near each other. If there are old gullies or other decided local depressions or elevations to be crossed by the terrace, let stakes be placed near the edge on each side to avoid sudden bends in the line. These gullies and other sharp local depressions must be filled and the terrace line where it crosses them be strongly fortified before plowing commences. This is greatly facilitated by plowing up one side and down the other with turning plow throwing the furrows into the ditch. After plowing and replowing several times in this manner the gullies can be greatly leveled, even when originally 3 or 4 feet deep. The terrace lines, which are designated by the rows of stakes, are at no time to be broken, but soil not less than the width of the plow slice must be left with the stakes. In plowing the spaces between the terrace lines begin one furrow width above the lower line, throwing the plow slice upon the unbroken space. Continue returning upon the furrows, throwing each plow slice down hill with hillside or reversible plow until the next terrace line above is reached, leaving the last furrow below the next terrace line open. Unless the two adjacent terrace lines are parallel, which is rarely the case, there will be short furrows to break below the terrace line. Before plowing these short furrows it is well to plow the first furrow above the next terrace line that it may be used as a guide in plowing out the short furrows and that the terrace line may not accidentally be broken. This is only necessary when the terrace is being plowed the first time. If there is unterraced land above from which the water will flow upon the land being terraced, its flow must be arrested by a ditch so laid off and constructed as to collect and carry this water around the terrace,

otherwise gullies may be cut across the terraces by the first washing rain.

"The fall between two terrace lines, or the vertical elevation of one terrace line above the line below, should be three feet, and this fall will be accurately preserved when the terraces are laid off on a perfect level, as should invariably be the case.

"After the terraces are once correctly formed and grass grows upon them, they are of no further trouble, but take care of themselves. If the terraces are made in fall or winter, it will be of very great advantage to sow terrace line thick with rye, or with oats if they are made in the early spring. This covering of vegetation will be valuable for holding the terrace lines until they become covered with the native grasses and weeds which appear later and serve the same purpose. German clover may be substituted for rye if planted in late summer or early fall. In sowing the seed, whether rye, barley, oats, or clover, it is a good plan to first sow thickly on the unbroken terrace line. This sowing will be covered by the first cover with the second furrow. Alfalfa and melilotus will answer the above purpose where these plants thrive without much attention and on strong soil would afford protection both summer and winter.

"Terrace lines serve as a valuable guide in laying off rows for planting. These lines will not be equidistant throughout their lengths and there must be short rows in the terraces. Lay off the rows alternately from the upper and lower margins until they meet at the narrowest part and then finish the space with short rows, laying them off alternately as before. Rows thus laid off are themselves miniature terraces and materially aid the regular ones in performing their function. The objections to terraces are the greater difficulty in the use of improved machinery, in hauling and the increased number of short rows, all of which is insignificant when compared with their benefits.

"In portions of Georgia and Alabama where the proper system of terracing is largely practiced, immense areas that once were considered 'worn out' and incapable of profitable yield, now produce crops as large as were gathered when the same areas were 'new ground,' and in many instances where a judicious system of crop rotation and proper culture are practiced, the yield is greater than ever before.

"To avoid trouble and disaster to those who may construct terraces or hillside ditches, this cautionary statement is made—that the work must be properly

and thoroughly done. This statement applies to all kinds of farm drainage.

"Mr. J. S. Newman, vice-director and agriculturist, South Carolina Agricultural Experiment Station, says:

"It has been estimated that eighty per cent. of the injury to the cultivated soils of the cotton States as the effect of tillage, is attributable to surface washing."

"Clean culture and hillside ditches are responsible for the present wasted condition of the soils of the cotton States. Clean culture, by leaving the land exposed to washing and leaching during the fall and winter months, has impoverished not only the hill sections, but the sandy, level lands as well. In Northern latitudes, where the surface soil freezes in the fall and remain frozen for from three to five months all decomposition is arrested, and no waste from leaching can take place. In our climate decomposition continues, with slight interruption, through the winter. The meager supply of vegetable matter left upon the soil, decomposes during the winter, and the plant food which results (there being no covering of vegetation on the surface and no feeding roots in the soil to arrest the products of the decomposition) is either carried off in the surface water or leached through the soil beyond the reach of the roots of the spring crops. If grain of some kind was sown in the fall upon all fields which had been subjected to clean culture during the current year, not only would the surface covering prevent the waste by washing, but the roots filling the soil would take up and conserve the plant food, becoming available during the winter, for the use of the crops to be planted in the spring following. In the grain and grass growing sections the soil is never without some covering vegetation, and consequently there is less liability to waste (even if climatic conditions were the same,) than under our system of husbandry.

"More than half century ago the land owners of the cotton States realized the rapidity with which their soils were being wasted, and recognized the most conspicuous cause in surface washing. Mr. Hardwick, a planter in Hancock County, Georgia, is said to have devised and put into practice the first system of what has been since known as hillside ditching, as a supposed preventive of the wasteful surface washing, which was rapidly carrying the soil from the hills into the valleys and streams. This system was generally adopted by planters owning roll-

ing lands in all of the older cotton States, and some are even now using this most efficient method of hastening the transfer of the soil of the hills to the adjacent swamps and streams. The history of hillside ditches is written in unmistakable language in the gullied hillsides from the Atlantic to the Mississippi—in the barren, corrugated surfaces, red with the flushes of mother earth at the rude exposure of her bosom, and the prodigal waste of her resources.

"The theory of the hillside ditch looked to the protection of the land from surface washing by collecting the descending water at intervals, and conducting it by gentle grade to the creeks. They proved in practice, however, a deception and a snare. They not only did not prevent the removal of the surface soil, the humus and the soluble plant food, but hastened it, even while the banks of ditches remained intact, and all obstructions were regularly removed.

"Under the tenant system, which has prevailed for the last thirty years, these neglected ditches have become the most effective engines of destruction.

"The neglected ditch has conferred one blessing

upon the landowners of the cotton States, which compensates in some degree for the sins it has committed. An observant farmer in Chambers County, Alabama, noticed that where the old ditches had little or no fall, they had filled with the soil washed from above, and formed against the lower bank a terrace. Acting upon this suggestion he laid off his entire farm with horizontal lines, giving a perpendicular fall of three feet between them, and plowing the surface in imitation of the agencies which had converted the ditch into the terrace, and such success crowned his experiment that terracing is now adopted as the most and, in fact, the only reliable means of preventing injurious surface washing upon cultivated hill sides. The theory of the ditch is to collect the water which falls upon the hills and carry it off. The theory of the terrace is to prevent the water from collecting, and to cause it to sink into the soil of the hill, where it is needed. The ditch carries off the water, and with it the soluble plant food, leaving the soil dry and hungry.

BOOK VIII.
ENEMIES TO THE FARM

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ENEMIES TO THE FARM

The farmer has many enemies in the shape of mice, rats, moles, Johnson grass, Bermuda grass, nut grass, etc. These pests do a great deal of damage, and it is important to the farmer that they do their best to rid the farm of as many of these pests as possible.

MICE AND RATS.

There is hardly a farmer that is not bothered with mice. They are a great nuisance, cutting into bags and boxes causing a great waste. There are several methods of disposing of or getting rid of mice. There is nothing better than an old-fashion cat, provided she will do her duty. However, this method sometimes proves a failure, other methods will have to be resorted to. There are many traps on the market and many of them are first-class. But rats will learn these traps, and you will have to make a change. A very simple plan is to take a large bucket or lard can, something which has slick sides so that they cannot crawl up, and fill it about one-half full of water, and place some cotton seed, or grass, chaff, or something that will float over the water. The rats and mice will jump into this can, and drown, not being able to stay upon the water, and the sides being so slick that they cannot run up them.

Scatter a few grains of copperas about the mice holes, and it is said that you will not be bothered with them.

There are many poisons for rats, but as a rule it is best not to use them. It is a sure method, but other things are liable to get hold of the poison. And then the rats are liable to get into the walls and die, and the odor will not be very agreeable.

A mixture of two parts well bruised common squills and three parts finely-chopped bacon is made into a stiff mass with as much meal as may be required and then baked into small cakes, which are put down for the rats to eat. This plan while simple, is said to be very effective.

RABBITS.

Rabbits do a great deal of harm by cutting down the garden and gnawing the fruit trees.

If the rabbits are gnawing your trees, wrap them with screens or wood veneering. But if you have none of these at hand, and do not care to buy, you may use any kind of cloth or old rags, or even corn-stalks. Newspapers will do for one season, using several sheets to the tree. Wrap closely and tie securely with twine, about two feet high or more. Before wrapping, examine for tree borers; you will find them usually near the ground. Look carefully wherever you find a hole or worm meal and be sure to cut out the worm or kill it with a wire. It will be a good idea to rub the trunk of the tree well in order to clean it of eggs of insects and fungous. Rake away all trash and grass around the trunk of the tree to prevent mice from making nests there. Mice will bark fruit trees near the ground, if permitted to winter there.

MOLES.

Moles are small animals easily distinguished by their soft dark fur, long pointed nose, and large, strong developed front feet, which are used to throw aside the dirt in making their burrows. The moles live on insects almost altogether, and do very little harm in eating the roots of fruit trees, and seed that are planted. However, the mice that go in the runs of the moles do a great deal of harm, and the responsibility for the loss of seed should be given to them, and not to the moles. However, if the moles did not make the runs, the mice would do no harm, so far as destroying the seed that are planted. The moles are a benefit in that they destroy a great many insects. If you desire to get rid of them, there are several very simple methods of getting rid of them.

Pour kerosene oil in their runs, and you will not be troubled with the mole any longer.

Another remedy:

Soak the seed in kerosene before planting, and you will not be troubled with moles. This remedy causes the corn to be later in coming up, as the oil prevents the moisture from entering, and therefore the grain does not germinate so soon.

Another remedy:

Pour carbon bisulphide into the runs. Place it at

different parts of the run so that the fumes will be sure to get to the mole.

Another remedy:

Make a small hole into the run and place castor beans in, and then cover up the hole. These should be placed every few steps.

JOHNSON GRASS.

Many farms have been ruined by Johnson grass. While it has some value as a hay, yet it is very expensive hay, for when the land has once been infested it is a very difficult matter to get rid of it. If the land be very poor, persistent and continuous cultivation from early spring until late fall will do much to rid the farm of it. However, if the land be fertile, it will withstand this treatment. Some one has recommended the summer plowing of fallow land during the hottest and driest months of the summer as the best means of killing it. The first plowing should be two inches deep, and the second plowing should be four inches deep, and crossways the field.

Some one has recommended pasturing to kill it out, but this is not effective. The roots remain alive, and when the land is brought back into cultivation, the grass appears very luxuriantly.

Salt has been recommended to kill it, but it has little value.

Killing Johnson Grass.

We quote the following from a recent bulletin on "The Extermination of Johnson Grass," by W. J. Spillman, of the United States Department of Agriculture, just issued to the public:

"In the autumn, at a time when the land is in good condition to cultivate, plow to a moderate depth with a turning plow, being careful to cut and turn every inch of the soil. A good disk plow so set as to cut every inch of the soil would answer as well. Harrow the land immediately so as to get it smooth and well pulverized. It is perfectly useless to try to use

the root digger unless the land is brought into excellent condition and is free from clods. The next treatment is to run over the land with some implement which acts on the same principle as the root digger. First, run crosswise of the furrows and then lengthwise.

"The roots left on the surface by this treatment may either be removed from the field, or left to decay during the winter. In the spring, plow the land again with the turning plow and then put it in cotton in the usual way and give the cotton ordinary good tillage. Pay no attention to the Johnson grass until the first sprigs get to be about six inches high, then go carefully over the land and pull out every bunch of Johnson grass visible. By doing this work carefully it will be possible to remove every sprig, root and branch, because the grass sprouts come from small loose pieces of roots in the soil. By repeating this operation, never allowing a sprig to get more than six inches high, the grass can be completely eradicated during the summer, and the amount of labor required will not be excessive."

BERMUDA GRASS.

Bermuda grass, once established is very hard to get rid of. It can be eradicated, however, by persistent effort. In October turn your land over, and allow it to remain until the spring. Then plant corn or cotton, or some crop requiring clean cultivation for two or three years. It ought to be turned over not later than October. Another recommends the following method:

"To kill out Bermuda grass break your land shallow, very shallow, when it is dry; the drier the better. Always remember that deep plowing and lots of moisture is the life of the plant; therefore, govern your licks accordingly. Plow often, use the harrow freely, and strike while the sun shines hot. If you plow deep, using a turning plow you will never get rid of it."

One Way of Growing Corn, Chipley, Fla.

A Busy Day at Chipley, Fla. One Car Load of Mowing
Machines Unloaded in One Day, Six Years After
the Above Picture Was Taken.

BOOK IX.

IMPROVED FARM MACHINERY.

EDITED BY

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EDITOR SOUTHERN CULTIVATOR, ATLANTA, GA.

IMPROVED FARM MACHINERY AND TOOLS.

THE IMPORTANCE AND USE OF FARM TOOLS.

Man has been designed as "A tool using animal," and his ability to make and use tools has been one of the principal influences that has forged our civilization; and every nation now upon mother earth is removed from barbarism just in proportion to its advance in the use of improved tools. It is very strange that while agriculture is the oldest of all the arts, and forms the very foundation of all of them, and while the first rude tools were made to help till the soil, yet advanced progress was made in all other tool-using trades much earlier than in agriculture. However, as this state of affairs could not continue, as all mankind must be first fed and clothed, the Nineteenth Century witnessed rapid strides made in the invention and use of tools upon the farm; and the movement continues until now we have many varieties of tools to perform every step in our varied farm operations. The progressive farmer now uses his muscle and brain to guide the many farm tools that accomplish his every form of work, from preparation, through cultivation and harvesting, with greater thoroughness and rapidity than he could possibly accomplish them with his hands. All of us are to some extent familiar with many of the improved farm tools, yet others are slow to appreciate their value and usefulness in rendering our work so much more effective. Our soil can be plowed so much deeper by the use of the disc and two-horse plows; pulverized so much more thoroughly and rapidly by the use of improved harrows; our seed put in more evenly and thoroughly by the use of weeders, harrows and cultivators; and our harvesting done so much more effectively and rapidly by the use of mowers and binders, —that the whole process of farming becomes a continued using of suitable tools. For every phase of work and for each different crop we have special tools; so that it becomes very important for the farmer to learn the excellent features of the many kinds

of tools manufactured, and to become skilled in operating them.

Improved tools have become A POWER, and such a power in our farm world that the main question left a progressive farmer is, What kind and how many tools shall I have? Then as the world progresses, the labor problem becomes more and more a feature to be dealt with in our farming. Our people

Cutting Ensilage Corn, Belmont Farm, Smyrna, Ga.

are becoming and will become more intelligent, can use tools to a better advantage and will naturally need and demand better wages than were formerly paid; hence another imperative demand for more and better tools upon the farms. Then those using them are given so much the advantage in economical production over those who do not use improved farm tools, that it becomes a universal necessity. We feel safe in saying that by an intelligent use of all the necessary tools upon a farm the cost of production can be lessened fifty per cent.; while on an average with the most improved tools one man can do the work of three men. But as it costs something to buy these tools and the power to run them, we count on-

ly on a clear saving of fifty per cent. in the cost of production.

For the most effective use of tools we must clear our lands of stumps and rocks. To get our land in the best mechanical condition becomes our first duty. Here dynamite, the stump pullers and the two-horse plows come to our aid. In our succeeding chapters we will have something more definite to say about many of our most important tools and their specific use. We will only add in this connection that the South is far behind the Northern and Western sections in the intelligent use and care of labor-saving tools. It was our privilege many years ago to visit a magnificent farm in the North-west of seven hundred and fifty acres. This farm was yielding as great a net cash income as any cotton plantation of equal area, yet this farm was operated by the owner

ed with cultivators that cleaned a row at a time; no hoeing was done. The corn was cut by a corn harvester and shucked and put into the barn by a shredder. Many people think that we cannot afford to buy so many tools, while the fact is, we cannot afford not to buy them, since they double our producing capacity, and if we do not have the tools our competitors who do use them will have the advantage of us.

TOOLS TO BE USED IN THE PREPARATION OF LAND AND IN CULTIVATING THE CROPS.

It is a matter of vital importance in successful farm operations that we become familiar with, and learn to use the very best tools made in the preparation of our lands; also in the cultivation of our crops. The

A Good Disc Harrow.

and two hired men. When they went out to break their land they used a sulky turning plow each drawn by three twelve hundred pound horses, and they plowed well, nine acres per day. They put in their grain with a drill covering eight or ten acres per day, and cut it with a binder. They planted their corn with a corn dropper, which opened, dropped and covered the corn at one operation. This corn was plow-

deep and thorough preparation of the soil lies at the foundation of all truly successful farming. It has been said that this is more than half the battle. It is certainly true that no amends can be made for a deficiency in this respect. The deep soil holds and furnishes more than double the amount of water; it has available more than double the amount of plant food; and the plant roots can penetrate it more read-

ily. The ideal soil should be as fine as dust, and when reduced to this state furnishes one thousand times the water surface for the plant roots to feed upon, as when left coarse. The plow constitutes our first and most important farm tool. There are many kinds, that will do effective work in the lines in which they are intended to be used. In no way has the South suffered so much as from shallow and imperfect plowing. The one-horse plow used to scratch the surface of the soil has been made our curse. Hence so much of our lands are seamed with gullies and our virgin soil has been washed away. We are certainly thankful that the two-horse and disc plows are now fast coming into general use. No farm is complete without one or the other. Every farmer

Filling Silo, Aug. 17, 1903.
Georgia Experiment Station, Experiment, Ga.

should break at least one-third of his land with one of these plows each year; if he could turn it all in the fall and winter it would be so much better, but our winters are so wet as to render this difficult.

It is not within the scope of this article to give special mention of any make of plows, but we can truthfully say that there are many good ones on the market; and good work can be done with almost any of them, when hitched behind a strong team, and guided by competent hands.

When the land has been properly broken, then you want to use your harrow until you get it smooth and very fine. We Southerners do not appreciate the full value of the harrow, and its province in producing fine tilth. This fine tilth is essential to the maximum yield. Mr. J. B. Terry, of Ohio, says he has increased his yield of wheat one bushel per acre for each

harrowing given the land before sowing, up to sixteen times. Any crop will germinate quicker, come up earlier, grow off better, and yield more where the land is well harrowed after breaking. There are many makes, but a disc, a cutaway and a smoothing harrow are a necessity upon every well equipped farm. There are some classes of work that each kind does best, and with tools you want the one especially adapted to the kind of work you wish done.

TOOLS FOR PLANTING AND CULTIVATING.

As soon as the soil has been properly plowed and harrowed, then the work of putting in fertilizers, planting and cultivating our crops commences. The distributing of fertilizers and the planting of cotton seed is nearly universally done with distributors and planters. But the manure spreader is still too rare a tool in our Southland; also the corn dropper and the grain drill. Since the cotton planter, the grain drill, the guano distributor and the corn dropper are all four combined in one machine, there is no excuse for our farmers not possessing such a machine. As we become more prosperous, we should become more progressive, and should make use of all the distributors, planters and grain drills that do the work more rapidly and satisfactory.

Just as soon as planting is over, cultivation begins, and then comes the necessity for rapid shallow culture. Here the weeders and wide light harrows come into play and are fast winning that appreciation they so richly merit. Crops are now being made without so much expensive hoeing, and the amount of laborers needed is reduced by nearly half. Mr. W. H. Morton, one of the best farmers of Clark County, Georgia, in 1905 cultivated sixty acres with 2 mules and two hands. He never used a hoe in his cotton or corn and made quite a fine yield of both.

After getting the crop started off, then the walking and riding cultivators come into use. Here we are much behind, on account of the stumpy and rocky condition of our lands; but these obstacles must be removed so the most improved tools can come into general use. Rapid, level, shallow cultivation is certainly the ideal; and the tools that will accomplish this most effectively for our growing crops are the ones we farmers should use. The choice of a tool and the proper operation of it, will mean much in the result of our crops and the profit they will yield us,

which are the main things all of us are after. By the use of such tools farming not only becomes remunerative, but the work ceases to be such drudgery. The intelligent man finds a demand for his skill, a reward for his efforts and his physical forces are not over-taxed.

TOOLS TO BE USED IN SAVING AND UTILIZING THE FARM PRODUCTS.

The tools for gathering and saving our varied crops are wonderful labor savers, and the scale of our farm operations now, could not be continued without them. Take for instance, the item of hay; what could we do without the mower, the self-dumping rake, the tedder, the hay loader, the hay fork and the hay press. Every step in the saving of this valuable crop can be performed with great rapidity and efficiency by the use of these now indispensable tools. In the case of grain we have even a more effective

Breaking Land on Farm of Southern Ruralist,
Atlanta, Ga.

tool in the binder. With corn, we have the corn harvester; and the fertile brains of inventors are now trying to perfect a cotton picker. While we doubt this last ever being made an economical success, yet fifty years ago the binder would have been deemed equally impossible. However this may be, it behooves every farmer to procure and to use the best harvesting machines made. A gentleman wisely put it the other day this way. "We can no longer buy or control labor, but we can both buy and control machinery, and have it do our labor in producing and harvesting our crops."

This branch of farm tools is fairly appreciated in

the South and is daily gaining ground. The music of the mower and the reaper is heard in our land, though not half to the extent it should be. We need these tools it is true, but we need far more to grow greater quantities of grass and grain to save with them.

Our Southern farmers are just upon the threshold of this important department of farm tools,—tools for utilizing our farm products. To make a crop is an important matter: to utilize it to its greatest advantage becomes a much greater matter. Since here the true profit lies, and this profit is what we are mainly after. The manufacturers have ever reaped larger and surer profits than the producers of raw material. The farm should be both a producing and a manufacturing plant, with the proper use of horse power, the wind, water power, gasoline engines and electricity. All farm products should leave the farm as finished products as nearly as possible. The shredder, the cutter and the mill should prepare our food right at home so as to yield its highest nutritive value and be fed to our stock in only its most digestible form. Because we formerly did a certain way is no reason for our continuance. We must be ever reaching out for the best. Our motto should be No Waste: the full value from every crop. But few of us know the full value of our corn crop, and we cannot know until we feed stalk and all. The stalk cut up or shredded and the corn and cob ground together into meal, then and not until then can our stock receive from it its full value. The writer now has a gasoline engine and outfit and never dreamed of their usefulness or convenience before. He often cuts up two loads of corn and pumps water for a week's use in an hour's time, doing all the work himself.

CARE OF FARM TOOLS.

Here three-fourths of the Southern farmers are at fault. Thousands of dollars are annually lost by buying expensive machinery and leaving it out in the rain and weather. No farm is complete without an adequate tool shelter. There are enterprising farmers who always carefully clean and wipe dry every shovel, spade, plow, cultivator; in fact, all kinds of tools that they use in the dirt, before they lay them down, and in most cases immediately place them under a shed. Farm machinery, such as plows and cultivators, should be wiped clean and covered with a coat of wagon grease, which will absolutely prevent

them from rusting. Tools thus treated will always be in fine shape, and much more satisfactory work can be accomplished.

Mr. T. B. Terry, (a very successful farmer) never allows a tool left out for an hour when not in use. He has a manure spreader he has been using for

twenty years. He declares that it is worth within five dollars as much as new. Lumber for sheds is much cheaper than machinery, besides every farmer prefers using machinery that does not look weather beaten. This careful and methodical way should be practiced by ourselves and certainly taught to our children.

Gasoline Threshing Outfit.

BOOK X.
BEE DEPARTMENT.

EDITED BY
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W. S. HART'S APIARY, HAWKS PARK, FLA.

BEE DEPARTMENT.

"The bees are humming, humming,
And the honey crop is coming—
In the fall.

If you are in a position to give a portion of your time and attention to bee keeping, there is no reason why you should not make money out of the business. Of course it is not all profit, and you need not expect to get rich without labor and trouble, but there is a very fair profit in the business. It is not claimed that the business will pay from the start, for you know now that it is an exception for any business to pay from the very start. There is one thing that it requires to succeed in the bee culture, and that is determination. You cannot hope to be successful with-

if you are on the farm, or live in a village, you should keep a few hives of bees. One reason why bee culture is so little engaged in, is on account of ignorance. Most of us are densely ignorant concerning bees, although we have seen them most of our lives. Some people speak of bees gathering honey. Bees do not gather honey. This only shows the ignorance of people. Bees no more gather honey, than dairy-men milk butter. What the bee does is to gather the nectar from the flower, and then converts this nectar into honey. Just how this is done is not known. The honey is very thin and is deposited into cells, and it is then evaporated by a process of the bees' wings to nearly one-half of what the original amount was. It

Apiary of J. F. McIntyre, near Ventura, Cal.—Looking Westward.

t determination. Make up your mind that you will succeed despite difficulties. At present not as many farmers are engaged in bee culture as there should be. Every farmer should have a few hives of bees, for they will prove a present help in the time of trouble. Most every one can look after bees if they have enough will-power and patience. The bee is very mild in disposition, and rarely becomes angry. So

is one of the sweetest articles produced without the agency of man, and it therefore commands a good price.

"All honey, when gathered by the bees, is placed in little wax cells of a hexagonal form, and, after being filled up by the bees, the comb is capped over by them in the same fashion as the housewife seals the preserves which she puts up in the summertime.

"So infinitesimally small and delicate has been this wax film placed over as a sealing to these delicate cells, and the walls of these being also exceedingly delicate, it has been absolutely impossible for man to duplicate the product. So much interest has been created in the past that there are now two rewards, one from Ohio and another from Wisconsin, of \$1,000 each, for any one who will invent a machine, or otherwise manufacture a full comb of honey which is a duplicate of the product made by the bees. While this offer has been widely spread throughout the country, as yet there has never been a suggestion by any one of even attempting to claim to imitate the original.

"The public, when they buy these pieces of comb in the center of these jars, want to be exceedingly care-

Comb building in the open air.

ful that the capping of these cells is still on the comb, and if so, they can feel entirely at rest in knowing they are getting the pure article. One thing we can feel sure of—that all honey sold on the market in little section boxes, or in any way in the comb, capped over is the genuine production of the honey-bee."

MONEY IN KEEPING BEES.

"Whether there is a profit in keeping bees depends upon two factors—it must be made a business, not a side issue, and the keeper must know his business. A

writer says that five colonies should yield 250 pounds of fancy comb honey each year. The annual cost will be about \$2 for honey boxes and comb foundation. Such honey should sell for 22 cents per pound. Half of the yield may be first quality—sections snow white, well capped and filled. The No. 1 quality, 125 pounds at 22 cents, nets you \$27.50. The No. 2 quality, 125 pounds at 16 cents, nets you \$20. Here at an annual outlay of \$2 five colonies of bees return \$47.50. Do not try to realize these prices from the stores, but sell to those who buy your butter and eggs—sell to the best families and do not be afraid to ask a good price. I will try to give you an estimate of the cost of a modest venture.

"If you have never handled bees or have kept them in old boxes, a first-class work on bee-keeping should head the list of purchases and be carefully studied. Hives are generally crated in lots of five. Examine all the catalogues you can find and secure the best hive made. If your winters are severe extra protection is needed, such as cellar storing or, better, a close end frame. Having decided on the hive, order five. You will need a smoker. The following articles will equip you for a start in a moderate way and at the same time you will acquire the much-needed experience: Five 1 1-2-story hives, \$9.75; five extra supers, \$3.75; one bee book, \$1.25; one smoker, large size, \$1.25; one spool tinned wire, 10 cents; one foundation fastener packer, 25 cents; five pounds extra thin brood foundations, \$3; two pounds extra thin comb foundations, \$1.25; 500 No. 1 honey boxes, \$2.50. Total, \$22.55.

"In ordering insist on brood frames being pierced for wiring. Tall sections sell better than square ones and the bees work in them quicker. A section, 4x5x1 3-8 is now acknowledged to be the best. A bee veil may be made at home.

"During the winter hives, frames, etc., may be assembled, the hives painted and all in readiness for the summer campaign. Do not buy hives of some local dealer, no matter how well recommended, until you have investigated them, as he may be anxious to secure fixtures of more modern make. If you do not own any bees, buy or swap something for two or three swarms in any old tub or box. Buy your stock early in the spring and place them on a stand a foot from the ground in some shady spot facing the east. These must stand where your new hives will

be placed later in the season. Just as the early flowers begin to bloom your first lesson in bee culture is due."

BEGINNING WITH BEES.

Before beginning with bees you will find it to your advantage to visit some one who keeps bees and learn all from them that you can. If possible, I would advise that you visit some one who is up-to-date, and

very small scale. Remember that you are ignorant concerning bees, and that you must learn largely from experience. You should also remember that experience is quite a dear teacher, and if you have a great many hives you will have to pay dearer for your experience than you would otherwise have to do. A few stands will be enough for you to commence with. They should cost anywhere from \$2.00 to \$6.00 per stand. It is advisable to get them in your own community if possible. In starting with bees it is well

Extracting-house of J. M. Jenkins, Wetumpka, Ala.

not be satisfied with a visit to some one who does not know their business. If you expect to go into bee culture as a business, you can afford to go some distance in order to find that man who knows bee keeping. This is a small matter, but it is quite important. You can get more information from a talk with an up-to-date beekeeper than you can from a great deal of reading.

In starting in the business you want to start on a

enough to get them in the hives that they are to remain in during the year, for unless you have had experience, it will prove quite troublesome to transfer them from one hive to another. Also get strong hives, for your experience will not be so bright if you have to feed them the first spring. After you have secured a start do not invest any more in the business until they have yielded a return. After you have started in the business the bees should pay their way

the rest of the time. If they will not do this, of course, excepting some extraordinary accident or catastrophe, you do not care to bother with them.

HIVES.

The questions of hives is one of importance to the man who has bees on his place. Unless you are so situated that freight rates are high, and unless you are a good mechanic, it will pay you to buy your bee hives, and not try to make them. There are companies that make a specialty of making bee hives and they can make them much better than you can. And then when you consider the whole thing, hives that are made in factories by machinery made for the business, operated by skilled workmen are cheaper in

View of J. M. Jenkins' Yards, Wetumpka, Ala.

the long run than home-made hives. Of course there is some advantage in making hives, for there are many rainy days when you will not be able to work on the outside, and you can without any practical outlay of money make the hives. But no matter how well made the hives are, or how perfect they are in every respect, hives in themselves cannot make honey. P. H. Elwood, of Starksville, N. Y., who has over 1000 hives of bees said in *Gleanings in Bee Culture* in 1891: "A good hive must fill two requirements reasonably well to be worthy of that name. 1. It must be a good home for the bees. 2. It must in addition be so constructed as to be convenient to perform

the various operations required by modern bee-keeping. The first of these requirements is filled very well by a good box or straw hive. Bees will store as much honey in these hives as in any, and in the North they will winter and spring as well in a straw hive as in any other. They do not, however, fill the second requirement; and to meet this, the movable-frame hive was invented." The Langworth hive, which is the standard in the United States, has a frame 17 5-8 long by 9 1-8 deep. As to the width, that depends on the number of frames that you desire to use. Some use eight frames, some ten, and some twelve. Where one runs for extract honey, ten frames, is perhaps best, but where one runs for comb honey, eight frames are best. There are now in the United States two styles of hives, the square, and the oblong. There are advantages with each class of frames. Let us consider some of these advantages, looking at the square hive first. Bees have a tendency to make a brood nest in the form of a sphere. Therefore a circular hive would be better than a square, but since this would be impractical, the square comes nearer filling that requirement than an oblong hive. It is also claimed that the square hive is better on account of holding the heat better, in that it gives the greatest amount of cubical contents for a given amount of lumber. These reasons are more theoretical than practical, and most of those that have tried the square hives have abandoned them for the oblong hive. But what are the reasons for favoring the oblong hive? By using a shallow frame it permits the use of low, flat hives that can be tiered up to two, three and four stories high. This is quite an advantage when one is operating for extract honey, for when the bees require more room, all he has to do is to add another story to his hive. And then the long frame permits of being uncapped more easily than the square hive. The blade of the uncapping knife can reach clear across the oblong hive, which it could not do in the square. The shallow frame is more easily lifted out of the frame than a deep frame. But you will have to get a hive that suits your convenience. As a rule I believe that the oblong hive is the better of the two. It will be hard for you to learn how to make a hive from what is given in a book. If you are going to make your hives, it will be better to send to the factory and get one of the kind that you wanted in the flat, all complete. With the several pieces to use as patterns you will know just how to make one.

SWARMING OF BEES.

One of the most interesting features connected with bee culture is the swarming of bees. As to why they swarm, there are several reasons given. When bees have filled the hives, and have no more room to store honey, they begin looking out for new quarters. And then they have a great many more bees in the hive than can be used successfully. In other words, too much honey, and too many bees cause swarming. Excessive heat will also cause the swarming of bees. Sometimes they swarm without any apparent cause whatever. It is the old bees and queen that leave

day, but will be at rest. Very few bees can be seen going in and out the hive. Bees as a rule do not swarm until they have the hive pretty well filled, and multitudes of bees hatching out daily. The presence of queen cells is a pretty good sign that they are beginning to swarm. When the bees are beginning to swarm, or before, one should have everything in readiness to hive them.

"Have empty hives in readiness, and when a swarm is cast off if possible mark the hive from which it came. Ordinarily the swarm will soon settle, when it can be secured and placed in an empty hive. As soon as this is done, take the new swarm and place it where

Worker.

Queen.

Drone.

the hive to the young ones. They usually begin swarming in May, and will keep it up until July. It depends, of course, upon the section they are in, as to the time they swarm. It sometimes happens that they will swarm in August, but this is an exception, and not the rule.

Sometimes we are able to tell in advance when bees are going to swarm, but I do not believe that we can always do so. When the bees are clustering around the outside of the gum, they will go in the hive the day they intend to swarm, but this does not always work. When a hive of bees intend to swarm, they will not be working like the rest of them that

the old one stood, removing the old hive to as long a distance as convenient. Should the bees in the old hive have started work in the super give it to the new swarm; should the bees in the new swarm appear restless and uneasy, the indications are that they have lost their queen. In such cases give them a fresh brood that has some newly laid eggs, when they will begin the construction of a queen cell, and usually commence work. In all cases it is well to examine the new swarms in about nine days and should there be no indication of laying it is best to give a frame of new brood. After the old hive is removed to a new place it is well to examine it carefully and destroy all

the queen cells but one of the best, or if there be any colonies in the yard that are queenless the extra cells may be used in requeening them. At the close of the honey season always shut up the entrance to the hive to about two inches, so that the bees may be able to protect themselves from outside robbers. About October 1st begin preparing your bees for winter by placing burlap over the top of each hive, putting on an empty super and filling it with chaff straw. It is well to place two half inch strips on top of the frames under the burlap, so that the bees may have space to travel over the top of the frames. Fasten the lid securely by weight or otherwise. Before putting on the

Louis Scholl and his Texas Bee-Yard. Evergreen Shade on the left, and Prickly Cacti on the right.

burlaps see that each hive has about twenty-five pounds of honey for winter use."

It is a difficult matter to lay down specific directions for hiving bees. There are so many methods, and so many circumstances that alter these methods that you will have to use a great deal of common sense and tact. There are many automatic hivers on the market, and some of them good too.

Sometimes it is desired to prevent bees from swarming. It is claimed by some that by preventing them from swarming, and making them use all their efforts in the manufacture of honey, that they will produce a larger crop of honey than by swarming.

Whether this contention is true, is an open question. This is done by not allowing the queen bees to raise. Excessive swarming is generally brought about by a large number of queen bees, that are not fertilized. By catching the queens and removing them, or by preventing the queen cells from hatching out. To keep the hive well shaded, or having the walls entirely protected from the sun will do much to prevent bees from swarming. Also give them plenty of room, and they will not be so apt to swarm.

FEEDING OF BEES.

The feeding of bees is a poor business. It is practiced for two purposes. The first purpose is to stimulate brood rearing at times of the year when there is no honey coming in from natural sources, and to supply them with food when the winter supply is short. But it is a bad job, and is liable to cause the bees to rob other hives. Not only is it a messy job, but it is expensive. It is frequently true that feeding is made necessary on account of extracting the honey too close. It may be that in certain cases, you will find it necessary to feed bees. If such is the case, there is nothing that is better to feed with than granulated sugar converted into syrup. There are certain forms of molasses and sorghum that may be used, but as a rule it is best to buy first-class sugar and make a syrup out of it. There are two processes of making syrup. One is the old-fashion method of making it by artificial heat.

When feeding bees to stimulate brood-rearing, place boiler on the stove and into it pour a mixture of sugar and water, using one-half sugar and one-half water. The heat should be applied slowly while the mixture is stirred. It should not be heated higher than 180 degrees, as it is liable to scorch, and burnt sugar is death to a colony of bees in the winter. Continue to stir the syrup until every particle of sugar is melted. Sometimes it is simply mixed well together, but no heat applied on account of the liability of burning. When this is the case, it will have to be stirred vigorously.

But we would advise that you avoid feeding if there is any possible chance of doing so, as it does not pay. There are many patented devices for feeding.

STINGS.

Most every one knows that bees sting. And they

know that it is not very pleasant to be stung either. The bee cannot kick like horses, nor can they hook like cattle, they cannot bite like other animals, but they can sting. And most people dread to be stung. However, much of the pain of stings is imaginary. One can bear a bee sting with a great deal of ease if they will not allow themselves to think of it. The mind has no little to do with the body. I do not mean to say that you can remove all pain by not thinking about it, for such is not the case. When a bee stings you, you are to a certain extent poisoned, and no amount of thinking or not thinking by the mind can remove that poison. As a rule bee stings should not stop one from their work. It is much better to keep on at work, for your mind will not be on

which contains the bag of poison. Many recommend removing all parts, but this is based on theory and not on practice. Many remedies are recommended for bee stings, but they are as a rule no good. In fact, the best thing to do after removing the sting is to forget all about it. Indeed, most remedies are positively harmful. The poison enters the flesh through a very small puncture,—one so small that the smallest cambric needle could not enter where the sting did, and there is no means of getting the remedy for stings in, except by rubbing, and this causes more trouble than it is worth, for it causes the poison to spread faster. It sometimes happens that a great many bees sting a person or animal, and unless something is done death results almost instantly. If you

Scene in apiary of W. L. Womble, Raleigh, N. C.

the sting. Pay just as little attention to the matter as possible, and do not rub or irritate the stung portion. The sting should be removed as quickly as possible. There is a wrong way of removing the sting, and there is a right way. With the sting there is a bag of poison. To pull out the sting between the finger and thumb means to push the poison out of the bag into the wound. On the other hand, to remove the sting by running a knife blade under the poison bag and lift the sting out, does the work so nicely that no more poison gets into the wound. If a knife is not convenient, take the nail of the finger and push it out. The sting should be removed as quickly as possible. Sometimes the sting separates, in which case I would advise just to remove the part

or your animal is stung a great many times, cover the affected parts with blankets or cloths dipped in boiling hot water. If you cannot possibly get the hot water, use real cold water, but the hot water application is better.

HOW TO AVOID BEING STUNG.

It is not very pleasant, to say the least of it, to be stung. In working around bees, I would advise that you never stand directly in front of the hive. Above all things don't let the bee know you are scared, for bees will do more harm when they find that you are afraid of them than otherwise. A single bee never follows one into a house. A whole colony that is very much enraged may do so.

FOOD VALUE OF HONEY.

"It is estimated that the food value of honey is equal to that of butter, and it is a typical sweet and universal luxury. The sources of honey come through nature's bounty on all fields and forests, and may be utilized at less expense than any other commodity of equal value. It is reasonable that the occupants of all rural homes are entitled to all of their products. People who rent the land pay no rent on the honey crop. Yet the vast flow of nectar is permitted to go to waste on the greater number of farms. Since the forests have been filled, and the fertility of the soil largely exhausted, bee pasturage has become too

pily combined, so that the family apiary will be easier kept up than a stock of chickens for home supply, and really more profitable, when the expenses and attentions are fairly weighed up.

"This is only one of the several small industries home comfort and independent living.

"It is a reflection on Southern industry to see a family coming from more congenial climates and living in luxury on what is neglected or wasted by those who toil the year round to make cotton pay for guano!

"While concentration of energies is essential to success, diversity of resources is the only chance for

As bees are kept in the South.

scant to warrant an effort to make honey for marketing purposes by the collective masses of inhabitants.

"Failures on this line have been so common that many have abandoned the business entirely in discouragement, or gone back to the primitive plan of using 'gums' and killing out the weak colonies after the fall crop has been stored. Much as this plan is deprecated, it remains true that more honey is obtained on it than by unskilled use of modern hives, and uniting weak colonies.

"The only families who keep up small apiaries and have honey on their tables every day in the year, that I know of, still keep shy of advance scientific schemes.

"The practical plan lies in the exercise of inventive thought, by which the good features in improvements and the simplicity of ancient methods may be hap-

the masses of people to make an independent living, and it will be found that there is no well beaten trail to a state of general prosperity for the population of the whole country."

Let the beehives and chicken coops be in close proximity and ants will not annoy the bees, for the chicks will devour the little pilgrims as they wend their way to and from their homes.

White Dutch clover is very desirable as pasturage for the bees, and the seed may be sown any time in March or April. It resists drouth much better than most of the grasses and forms a close green turf for the lawn if kept cut after it is well rooted.

When feeding bees to stimulate brood-rearing, the difference in localities should be considered. In some parts, feeding the first of March would be all right.

In other localities, they are not through the winter at this season and should not be disturbed.

Bees, like all other creatures, relish salt and should have it placed before them occasionally in a diluted form. To give bees access to salt, just sprinkle some on the sawdust in front of the hive. The rain will dilute it properly and the sawdust will retain it for them.

During winter queens stop laying eggs and often shrink so much in size that they look almost like the worker bees themselves, and a beginner looking through the hive might conclude that the bees are queenless. Of course, if you know that the queen is dead, then the sooner you can introduce another to the bees, the better it will be for them. Queens can be procured from the South as early as April.

THE QUEEN BEE.

The queen bee is the most important bee in the hive. She is the mother of all the bees in the hive. In fact, the queen is so important that should the hive be deprived of the queen the workers go to work and raise another, if they have any worker larvae in the hive with which to do it. There are some cases where there is no queen bee, but these cases are very rare. It is safe to say that there is always a queen in every hive. The queen is the only perfect female bee in the hive. She is longer than either of the other species, and is dark in color. She never leaves the hive except to meet the drone. She is treated with great affection by the bees. The average age of the bee is three years, and no one should be allowed to become any older than that, for after that age they become barren, or if they do deposit eggs they only produce drones.

A PAIR OF GOOD ONES OWNED BY OLTMANN'S BROS., NORTH FT. WORTH, TEXAS.

DISEASES OF THE HORSE

—BY—

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INTRODUCTION

These chapters on the diseases of the horse are written that they may help farmers and horsemen who are not within reach of qualified graduate veterinarians. They may help the ordinary man who has not the technical knowledge of the graduate veterinarian. The more the farmer or the stockman knows the better he is able to see the necessity for employing a specialist or one who is expert in operating and treating live stock. Much of the following pages is written in terms that are not considered scientific. But it has been my aim to leave out all technical terms as far as possible in order to make the meaning plain to the average man. The treatment suggested for the different diseases is not the only one that might be employed; but is one method selected, oftentimes, as the one that may be used with the least difficulty and expense, by the farmer.

C. A. CARY,

Auburn, Ala.

EXPLANATIONS OF FIGURE 1.

n.—nostril.
 en.—end or extremity of nose.
 cn.—chin.
 mb.—maxillary border.
 ch.—cheek.
 t.—throat.
 pa.—parotid region.
 Te.—temple.
 so.—supra-orbit.

Fd.—forehead.
 Fa.—face.
 Nk.—neck.
 Jf.—jugular furrow.
 W—Withers.
 bk.—back.
 lo.—loins.
 H.—haunch or hip point.
 Crp.—croup.

rb.—rib region.
 Flk.—flank.
 abd.—abdomen.
 st.—stifle.
 Th.—thigh.
 but.—buttock.
 lg.—leg or gaskin.
 hk.—hock.
 can.—cannon.

Ft.—fetlock.
 Pn.—pastern.
 Co.—coronet.
 Ct.—chestnut.
 sh.—shoulder.
 am.—arm.
 fm.—forearm.
 k.—knee.

EXTERIOR ANATOMY, OR THE OUTER FORM OF THE HORSE

This consists in a study of the good and bad points of a horse as indicated by his outer form or conformation. In order to get a clear idea, we must first know and study the various parts or regions of the surface of the horse's body.

The surface of the horse may be divided for convenience into—

1. Head,
2. Trunk, or body,
3. Limbs.

1. HEAD. (17 Regions.)

Front Surface	Back Surface.	Side Surfaces.	Lower End.	Upper End.
1. Forehead.	4. Lower Jaw.	7. Ear.	14. Mouth.	15. Poll.
2. Face, or Nose.	5. Space between the	8. Temple.	(a) Lips.	16. Parotid Region.
3. End of Nose.	branches of	9. Supra-Orbit.	(b) Teeth.	17. Throat.
	lower jaw.	10. Eyebrow.	(c) Bars.	
	6. Chin.	11. Eye.	(d) Lingual Canal.	
		12. Cheek.	(e) Tongue.	
		13. Nostrils.	(f) Palate.	

2. BODY. (20 Regions.)

Upper Surface.	Lower Surface.	Side Surfaces.	Front End.	Back End.	Genital Organs.
1. Neck.	6. Xyphoid	8. Ribs.	11. Chest.	14. Tail.	(Male.)
(a) Mane.	region.	9. Flanks.	12. Interaxilla.	15. Anus.	17. Testicles and
(b) Forelock.	7. Abdomen	10. Groin.	13. Axillae.	16. Perineum.	envelopes.
2. Withers.	(belly).		(arm pits).		18. Sheath and Penis.
3. Back.					(Female.)
4. Loins.					19. Vulva.
5. Croup.					20. Mammary Glands.
					(Bag or udder.)

3. LIMBS. (15 Regions.)

Front Limb.	Hind Limb.	Regions Common to Front and Hind Limbs.
1. Shoulder.	6. Thigh.	10. Chestnut.
2. Arm.	7. Stifle.	11. Cannon and Tendons.
3. Elbow.	8. Leg, or gaskin.	12. Fetlock and Ergot.
4. Forearm.	9. Hock.	13. Pastern.
5. Knee.		14. Coronet.
		15. Foot.

HEAD.

Front Surface. (See cut for location of regions.)

1. **Forehead.**—This region should be wide, rather long and nearly straight. A large forehead indicates large muscles and large brain. When narrow, very convex or depressed, it is defective.

2. **Face or Nose.**—This region presents for study a middle part and two latteral parts. The middle part should be straight and rather wide. If very convex or concave it is defective. The latteral parts slope downward and backward. The right and the left latteral parts are usually full and round in the colt or young horse. In the old horse they are more or less flat or depressed. This is due to the variation in the length and size of the molar teeth in the young and the old horse. When the root of a molar tooth is diseased the part over that tooth will become enlarged; this will occur usually on one side. In bighead both sides may be equally enlarged. A wide middle part of nose or face is an indication of large respiratory capacity.

3. **End of nose** lies between the nostrils and above the upper lip. It should be large and free from injuries.

4. **Lower jaw.**—This corresponds to the borders of the lower jaw. These borders are thick in the young animal and thinner in the old animal; the variation here is also due to the difference in size of teeth.

5. **Space between the branches of the lower jaw.**—This space should be concave, covered with thin skin, fine hair, and be free from swellings or enlargements. Abscesses form here when the horse or colt has distemper or strangles. Good width between the branches of the lower jaw is another indication of great respiratory capacity.

6. **Chin.**—It corresponds to the place upon which the curb strap or chain presses. It should be free from injuries and harmonize with surrounding parts.

7. **Ear.**—The ears should be relatively wide apart; neither too long nor too short; relatively thin; covered with fine hair and thin skin; and possess freedom of movement. A very short ear indicates nervousness; a long, heavy ear signifies sluggishness. Defective ears are sometimes classed as lop-ears, swine-ears, restless and "walking ears." The last name means that the ears move in unison with the walk of the animal. The ears may be broken, torn, cropped, split, or show scars from the action of the twitch. To hide defects

dealers clip the coarse hair, apply hoods or nets, or use other means to deceive the buyer. A deaf ear is hard to detect; such a horse does not respond to the voice of the driver and its ears do not move readily or remain relatively fixed.

8. **Temple.**—This region should be free from blemishes and harmonize with surrounding parts.

9. **Supra-Orbit.**—It lies just above the eye; is full and round in the young animal and sunken or depressed in old horses; this is due to the variation in the quantity of fat and muscle in the Supra-Orbit. In very poor animals it may also be hollow or sunken. Jockeys sometimes blow air under the skin to fill up this depression and make the animal look young.

10. **Eyebrows.**—They are not distinct in old horses and only visible in very early life.

11. **Eye.**—The eye is located in the orbital cavity. The eyeball or globe is surrounded by muscles and pads of fat which help fill the cavity and also protect the eye. The eyes should be wide apart; fill the cavity full; stand out fairly well, but not too much; they should be equal in size; the pupil dark—nearly black in color. The cornea, which is usually clear and transparent, should be free from white spots, or spots of any kind that interfere with light. The size of the

Fig. 2.—Regular or normal axis of front limbs viewed from in front.

Bred by Giltmer Bros., Eminence, Ky.

Fig 3.—Ground or base narrow front limbs or the feet too close together.

pupil should change quickly when the horse is brought from darkness to light, or from light to darkness; the pupil is large in the dark and small in the light. This can be tested by the use of a lamp or lantern, or by moving the horse from a dark stall out into the sunlight. The eyelids should be thin, fine, freely movable, and without blemish. The lining or inside of the lid should be scarlet or light rose red in color. The tears should be clear and sufficient in quantity to keep the lids and eye moist. Finally, the eye should be large and expressive. Defective eyes are small, unequal in size, concealed or hidden, very protruding, cloudy or opaque. The wall eye is one in which the color is almost absent. It is sometimes called a "white" or "glass eye." Such an eye is unsightly, but not necessarily defective in vision. A short sighted horse or a long sighted horse may be addicted to shying; but such conditions are hard to detect by the average man.

12. Cheeks.—It should be a plain surface, free from scars, swellings, and wounds. The skin should be thin, covered with fine hair, and the blood vessels quite distinctly visible. Its defects may consist in wounds from the teeth, swellings, and distension from

a collection of food between irregular teeth and the inside of the cheek.

13. Nostrils.—These are the external openings of the nasal passages. They should be large, wide apart and well separated from the upper lip. Largeness of nostrils means large lung capacity. The membrane lining the nasal passages should be clean, scarlet red, and smooth. The discharge from the nose should be clear, inodorous, and small in quantity. After exercise this lining membrane may be deep red in color. The movements of the nostrils should be regular to correspond with the respiration. If the nostrils are small the discharge abundant, puslike, green, yellow, or bad smelling, the nostrils or nose are defective or diseased. Usually, a bad smelling discharge is a sign of a diseased molar tooth, especially if the discharge is only on one side. Inspiration and expiration should be noiseless.

14. Mouth.—This complex region may be considered the beginning of the digestive canal.

(a) **The lips** should be thin, relatively stiff and held closed when the animal is not eating. The cut or depth of the mouth should not be too great or too small. The lips may be paralyzed; if the lower lip is paralyzed on both sides it hangs pendulous, and the animal cannot drink without plunging its mouth into water below the corners. If paralyzed on one side the lip is drawn to the opposite side. The lips may be cut by the bit. The quivering lip is one that cannot be held still, owing to nervous irritability.

(b) **Three kinds of teeth** are found in the mouth of the horse. The incisors or front teeth are twelve in number—six above and six below. The canines or tusks are found in the male; sometimes incompletely developed canines are found in the mare. They are four in number. The molars in a full mouth are twenty-four in number—six in each half jaw. In examining a horse always determine the regularity, length, direction, integrity, and soundness of the teeth, as well as the age. (The age of the horse, as indicated by the teeth, will be discussed in another place.)

(c) **Bars.**—They occupy the space between the lower molars and the canines in the horse and the incisors in the mare. The bit rests on the bars. They should be free from injury; not over sensitive to the bit, but respond regularly and accurately to the impressions of the bit.

(d) **Lingual Canal.**—In this space lies the tongue. Good width, with proportion to the volume of the tongue, is to be desired.

(e) **Tongue.**—The tongue aids in grasping, chewing, mixing, and swallowing the food. It should be relatively large, possess free movement, and be free from wounds. The most serious defect is the lolling tongue. In this the horse carries the tongue hanging out one side of the mouth, especially when the bit is in the mouth. This is the result of a habit, and in some cases it may be prevented by bits especially constructed for that purpose.

(f) **Palate.**—This is the superior wall of the mouth. It has a series of ridges and grooves running from side to side. The ridges are sometimes erroneously called bars. The covering membrane should be rose colored. When this hard palate is swollen the horse is said to have "lampas." The swelling may be caused by cutting teeth, rough, irritating food, diseased teeth and indigestion. Sometimes it may be caused by a form of sore mouth. As a rule, the hard palate should not be cut and never burned for this trouble. Remove the cause or wait until the colt gets over cutting teeth, and recovery will take place without treatment. The soft palate hangs down from the back part of the hard palate and closes the opening between the mouth and the pharynx or throat. This soft palate is so large in the horse, that it prevents air or food from coming back into the mouth after reaching the throat. Hence, when a horse vomits the food or water comes out through the nostrils instead of the mouth.

15. **Poll.**—This is sometimes called the nape of the neck. It is the region injured by throwing the head up against objects, or by a stroke with a club over the head. In some cases abscesses form as a result of such injuries; then a large swelling will occur and sooner or later the abscess erupts or breaks open and discharges pus on the surface. The animal is then said to have "poll evil," a very serious and troublesome disease. It can only be cured by proper operation and correct treatment. This may require months.

16. **Parotid Region.**—This lies below the ear, above the throat, and connects the side of the neck with the cheek. It should be neither too full nor too much depressed.

17. **Throat.**—This unites the inferior border of the neck with the head. It should be wide, because great

width signifies a large larynx, and that means a large air passage; hence, large lung capacity.

The Head as a whole.—All the regions of the head should harmonize with one another. It should be neither too large nor too small for the size of the horse. The length of the classic head is about two-fifths of the height of the horse. The direction of the

Fig. 4.—Base wide or ground wide or feet too far apart.

head, or the position in which the head is carried most commonly, should be such as to make an angle of about forty-five degrees, with the horizontal or level ground surface. This position enables the horse to see better to the side and in front of him, and also enables it to support the bit with ease and execute movements readily and easily. If the head is carried more vertical, the horse is usually tender in the mouth. If it is carried more nearly horizontal the horse is usually hard in the mouth.

BODY.

Upper Surface.

1. **Neck.**—It presents for study an upper border, a lower border, a right and a left surface. The upper border supports the mane, and should be thin in geld-

ings and in mares. In stallions it is usually quite thick. It should be nearly straight or slightly curved from above to below. The inferior border is round from side to side and relatively wide. Its width measures in a degree the width of the wind pipe. A large wind pipe means a large lung capacity. The side sur-

Fig. 6.—Regular or normal axis of front limb.

faces are convex from above to below, with the thick or heaviest part being nearer the lower than the upper border. Along the lower part of the side surface runs the jugular furrow, in which lies the jugular vein. The direction of the neck should be such as to make an angle of forty-five degrees with the level or horizontal. If the head makes a similar angle with the horizontal, then the head and neck will make an angle with each other of ninety degrees, or a right angle. In form, the neck should be nearly straight, or but slightly arched, except in the fancy riding horse the swan neck may be desired. This means a high head and a compressed throat, but not speed. The mane and forelock grow out from the upper border of the neck. If the mane is long, coarse and stiff, it signifies common breeding. In well bred horses the mane is fine, silky and not overabundant; in fact, many well bred horses are deficient in quantity of mane. Sometimes this is due to a disease of the skin and not to breeding.

2. **Withers.**—This is located between the top of the neck and back, and between the tops of the shoulders. The withers should be high and extend well toward the back. As a rule, the withers represent the highest part of the body, except the head and neck.

The withers should be well defined, neither too thick nor too thin, never too low, and free from scars and diseases. The most common disease of the withers is known as fistulous withers. This consists in a deep seated abscess, which sooner or later opens to the surface. Very like poll evil, it requires correct surgical and medicinal treatment, with months of time to produce a cure. It injures the value of the horse from twenty-five to seventy-five per cent.

3. **Back.**—It is limited in front by the withers, behind by the loins, and on each side by the ribs. It receives the saddle and transmits the propulsive power of the hind limbs to the front part of the body. It should be straight, long—never too long—and in width correspond to regions in front and behind. The concave or sway back is weak and defective; the convex or roached back makes a rough rider, an unsightly horse, and often throws the front and hind limbs too close together.

4. **Loins.**—These are located in front of the croup, behind the back, and between the flanks. The loins should be wide and short; as a rule, they are never too

Fig. 7.—Foot and lower part of limb too far in front of the normal. Defective because it weakens the limb as a column of support; throws an excess of weight on the heels and flexor tendons and suspensory ligament and leads to a long toe and low heel.

Fig. 8.—Knee too far back of the normal; this weakens the limb as a column of support and puts excessive strain on the posterior ligaments and tendons.

Fig. 9.—The limb regular or normal except the foot is too far forward; this leads to long toe and low heel and increases the strain on back ligaments and tendon at the fetlock.

wide and rarely too short. A long back and short loins are always in order. Great width is desired, because it strengthens and supports the region. The loins usually take the same direction as the back, and should be straight.

5. **Croup.**—This is sometimes called the rump, and is a very powerful, muscular region. The croup is measured in length from the hip point or "haunch" to the buttock point. For speed, the croup is never too long. Width of croup is measured from right hip point or haunch to left hip point. Also from right buttock to left buttock point. For speed, the croup can be too wide, because it then produces too much wabbling or lateral motion. It can also be too narrow, and then throw the legs too close together, producing interfering. For the draft horse, other things being equal, the croup is rarely too wide. The thickness of the croup is indicated largely by the volume of the muscles. The direction for speed should be nearly horizontal; that is, the direction of the length line of the croup should approach a horizontal or make an angle with the level of twenty to thirty degrees. In the saddle horse this angle may be twenty-five to thirty-five degrees. In the draft horse, this angle may be from thirty to forty-five degrees. The square croup is one that is about as wide behind as in front. The pointed, mule-shaped croup is one that is much narrower behind than in front. In rating the good qualities of the croup, consider first the length, then the width, then the direction and the thickness. The term haunch is commonly applied to the hip point, or what some may call the hip. It is a part of the croup. It is the part broken when the animal is "hipped."

Lower Surface of Body.

6. **Xyphoid.**—This region corresponds to the back end of the breast bone. It is of no special importance.

7. **Abdomen.**—It corresponds to the inferior wall of the abdominal cavity. It is commonly called the belly. The wall of the abdomen is elastic, and yields or stretches when pressure is applied from without or within. The size of the abdomen varies with the breed, with the sex, and with the way the animal is fed. The draft horses generally have larger abdomens than the lighter breeds. The mare, especially when in foal, has a large abdomen. Horses and colts at pasture, where they eat large quantities of bulky food, have a large abdomen. All greedy horses, that are

fed large quantities of forage or hay, have a large abdomen. The size of the abdomen may be changed by reducing the bulk of the food. The grey hound, or tucked-up abdomen is indication of a very light eater or feeder. This condition of abdomen may be seen in the running horse as it is prepared for the race, but if a constant condition it is a sign of poor digestion. The most serious trouble about the abdomen consists in the various forms of rupture. In the colt the most common rupture is at the naval. This is usually present at birth. Ruptures in other parts of the abdomen are caused by injuries from horns or pointed objects, and sometimes by kicks. Ruptures from injuries are always very serious, and should be treated at once by pressing back the abdominal organs and applying a broad bandage around the abdomen pressing firmly over the ruptured place. A smooth thick layer of cotton may be placed over the ruptured place under the bandage, in order to increase the pressure.

Side Surfaces.

8. **Ribs.**—The rib region has for its base the last twelve ribs. The size of the rib region has some indication of the size of the thorax or lung cavity, and the size of the lung cavity determines the size of lung capacity. The length of the thorax is indicated by the spring of the ribs, and the separation of the ribs from one another. In other words, if the ribs are well

Fig. 10.—The lower part of the limb is back of the normal and the pastern is too upright or too near the perpendicular; this leads to a short toe and high heel (club foot) and by increasing concussion predisposes horse to ring bone, navicular disease and splints.

Fig. 11.—The lower part of limb back of the normal and the knee is sprung; it weakens the limb as a column of support and predisposes the horse to falling on its knees.

sprung and well separated, the thorax is long, and a long thorax is always desirable. Depth of thorax is measured from above to below and depends upon the length and curvature of the ribs. Great depth is desirable. The width or thickness of the thorax is

hollow above from the movable portion below. The movable portion is the part that moves outward during inspiration and inward during expiration. When the horse is "bellowsed" or has the heaves, there is a double inward movement during expiration.

10. Groins.—The groin corresponds to the fold of skin along the line of union, between the inside of the thigh and the trunk or body. It is of no special importance, except it should be free from skin tumors, wounds, injuries and swellings.

Front End.

11. Chest or Breast.—This region lies between the arms, below the lower border of the neck, and in front of the inter-axilla. The breast is sharp when the front end of the breast bone is prominent. The breast is hollow or sunken when there is a depression just inside of the upper end of each arm. This indicates poorly developed muscles or bad position of front limbs. The breast may be quite wide in draft horses, but it can be too wide for speed horses, because a very wide breast means wobbling or lateral motion. The breast may also be too narrow and throw the front limbs too close together, thus favoring interfering.

12. Interaxilla.—It is limited in front by the breast, behind by the xyphoid region, and on each side by the axilla or arm pit. It may be concave, convex or straight, according to the volume of the muscles.

13. Axillae or Arm Pits.—Each arm pit corresponds to the fold of skin that unites the inside of the front limb to the trunk. It is a favorite location for skin tumors.

Back End.

14. Tail.—This long, flexible appendage is an ornament as well as a useful organ to keep away flies. It should be attached high up on the croup and be carried relatively high when the horse is in motion. If the tail is attached low it can never be carried high. There seems to be a close relation between the direction of the croup and the attachment and carriage of the tail. A horizontal croup usually carries a high and well attached tail. An oblique croup usually carries a low and poorly attached tail. The practice of docking or

Fig. 12. Regular or normal axis of hind limbs viewed from behind.

measured from side to side, and depends upon curvature and length. Therefore, a large thorax or lung capacity depends upon great length, depth, and width, which as a rule, we never find too great. Large lung capacity is desirable in any kind of a horse; good wind as commonly understood is essential to a good horse. Defective ribs are short and flat, and close together. In big head the ribs may be bent out of shape, or become indented.

9. Flanks.—The flank is located below the loins, above the abdomen, behind the ribs, and in front of the stifle. It presents for study the hollow, the cord, and the movable portion. The cord extends from the haunch or hip point obliquely downward and forward to the lower border of the last ribs. It separates the

cutting off the tail, leaving it about six inches long is prohibited by law in many of the States. Sometimes a tail is carried to one side. This can be remedied by an operation, but must be done by a qualified veterinarian. A rat-tailed horse is one in which the hair has nearly all dropped out or fell out, giving the appearance of a rat's tail. This is usually caused by a parasitic skin disease. When of long standing it cannot be remedied.

15. **Anus.**—This is the posterior opening of the alimentary canal. This opening is guarded by a circular or sphincter muscle. When this muscle is broken or torn the opening gapes all the time. The tearing is a result of some form of injury. The constant gaping permits continual or frequent passage of air when the animal is driven, and this is most annoying to the driver. It cannot be easily remedied.

16. **Perineum.**—This extends in the female from the anus to the vulva; in the male from the anus to the back part of the testicle bag. In the female the perineum may be torn from the vulva to the anus, producing a condition in which manure and air can continually pass from the rectum without the control of the animal. Operations to relieve this trouble are successful in about one percent of the cases.

Genital Organs. (Male.)

17. **Testicles and Envelopes.**—It is important to examine the horse for the presence or absence of the testicles. If the horse be a stallion the testicles should be down and more or less prominent. Sometimes only one is down, where the other may be as high up as the abdominal cavity. This makes the operation of castration more difficult and dangerous. Also examine this region for sores, enlarged or suppurating cords and swellings.

18. **Sheath and Penis.**—Even in a gelding it is well to examine these parts, for occasionally one or both may have a tumor, which may seriously interfere with the health of the animal. Some of the tumors are malignant and possess the nature and danger of a cancer. In the stallion it is important to see that these parts are healthy and in no wise injured. Sometimes the penis may be greatly swollen or paralyzed, thus throwing a stallion out of service.

Genital Organs. (Female.)

19. **Vulva.**—This organ should be examined closely for discharges, ulcers and tumors, any of which might seriously interfere with her as a breeder.

20. **The Mammary Glands.**—These may be injured in such a way that the animal cannot suckle its young, and in consequence be useless as a breeder.

LIMBS.

Front Limb.

The functions or uses of the front limb are, first: a column of support; second: to disperse concussion; third: to aid in propulsion, especially when pulling at a slow gate. The two front limbs support about five-eighths of the weight of the body.

1. **Shoulder.**—The bony base of the shoulder is the scapula or shoulder blade. This bone is covered both inside and outside by muscles. The shoulder should be long and well inclined backward. Some claim that it should make an angle of forty-five degrees with the horizontal, but this much inclination will rarely be found. As a rule, the angle will be somewhere between fifty and sixty degrees in the speed horse, and between sixty and seventy degrees in the draft horse. The shoulder should be well covered with muscles, be free from injuries, scars or blemishes. In short, the shoulder should be long, well inclined backward, possess well developed muscles, and be free from disease.

2. **Arm.**—It has for its bony base the humerus. The direction of the arm should be such as to make an angle of fifty to sixty degrees with the horizontal or level. It should be of medium length; if too long, the step will be shortened; if too short, the step may also be short. The medium length permits complete extension without stumbling. The volume of muscle should correspond with the parts above and below.

3. **Elbow.**—It is located between the arm and the forearm, and the top of the ulna forms its bony base. The bony process should extend well upward and backward, and be of good length. The elbows should not extend inward or outward, but directly upward and backward. This is the favorite seat of what is known as "shoe-boil." This is caused by the horse lying down on his feet like a cow. The foot or the shoe injures the elbow.

4. **Forearm.**—The base of the forearm is the radius. The forearm should be absolutely long, especially in speed horses. A long forearm means long muscle, and long muscles mean relatively long or great contraction. The muscles that move all the parts of the limb below the knee are found in this region. There is one exception where a short forearm may be desired. A short forearm and a long cannon seem to be desirable when high knee action is wanted, but in all

Fig. 14.—This side view of hind limb is regarded by some as normal, but by others as being defective because it is too crooked.

other cases a long forearm and a short cannon are best. The forearm should always be vertical or perpendicular. The width is measured from in front to behind at the upper end, lower end, and middle; this gives you an idea of the volume of the muscle. Thickness is measured from inside to outside at the same places as for width; this gives an idea of the size of the bone.

5. **Knee.**—This region corresponds to the wrist of man and not to his knee. Its bony base consists of seven small bones. The knee should be fine, wide, thick, and vertical, always in harmony with the parts above and below. The height of the knee will depend upon the variation in the relative length of the forearm and the cannon. A long cannon and short forearm usually means a high knee and also high knee action but not speed. A short cannon and a long forearm means a low knee, with low knee action and speed. The defective knee is one that is too small, out of position, or diseased. If the knee extends back of the normal, it is called the lamb knee; if it extends in front

of the normal, the horse is said to be knee-sprung; if it extends inside of the normal toward its opposite, the animal is knock-kneed; if it extends outward the animal is bow-legged.

Hind Limb.

The functions or uses of the hind limb consist, first, in its power for propulsion, which is much greater than in the front limb; second, as a column of support, the two hind limbs supporting about three-eighths of the weight of the body.

6. **Thigh.**—Its bony base is the femur. This region is sometimes divided into thigh and buttock. The thigh should make an angle of about eighty degrees with the horizontal or level, and its lower end should extend slightly outward. The length of the thigh is measured from the hip joint to the stifle. It should always be long, especially for speed. Its width and thickness will determine the volume of muscles. It is well that the muscles extend well down on the thigh and buttock toward the leg or gaskin.

7. **Stifle.**—The stifle corresponds in height to the elbow. It is the place where the patella or the knee cap plays over the lower and front part of the femur. It should be rather distinctly outlined, neither too close nor too far away from the abdomen. This is the location of what is commonly known as the "stifled" place. This is usually an upward dislocation of the knee cap. In this case the little bone catches above the upper lip of the articular surface of the femur; then the hind limb is locked or stiff and immovable until the bone slips in place. Sometimes the small bone slips out over the outside lip; then it can be felt with the hand. This last trouble is more difficult to cure than the former.

8. **Leg or Gaskin.**—The tibia is the bony base of this region. The bone is covered by muscles at all places except the inside surface. It corresponds in position to the forearm of the front limb. Like the forearm, it should be long for speed. A long leg and a short cannon form the best combination for speed. A short leg and a long cannon may produce high hock action. The leg should form an angle of sixty-five to seventy degrees with the horizontal. It should be wide and thick when measured at its upper end when

end and middle; these measurements will determine the volume of the muscles and the size of the bone.

9. **Hock.**—In the hind limb this region corresponds in location to the knee of the front limb. Its bony base consists of six small bones. The hock should be vertical in direction, neatly outlined, wide, thick, and without any degree of fleshiness. The hock is said to be the key of the hind limb. It is here that the

Fig. 15.—(1) This is the normal or regular side view axis. A, hip joint; B, buttock point; s, stifle joint; h hock joint; Pa, perpendicular or plumb line dropped from stifle to the ground; Hc plumb line dropped from hip joint; Bt plumb line dropped from the buttock point. These three plumb or perpendicular lines are parallel and Pa and Bt are equidistant from Hc in the normal or regular axis.

(2) The greater part of limb is too far in front of the normal; it weakens the hock; predisposes to over-reaching (forging); and often leads to a long toe and low heel.

(3) The greater part of the limb is too far back of the normal; it increases concussion and predisposes the horse to ring bone.

force of the propulsive power is often concentrated. In consequence this region is more frequently diseased than any other part of the hind limb. It is here that we find bone spavin, curb, enlargement of the synovial sacs, commonly called "bog spavin" and "thoroughpin," and also diseases of the skin are not uncommon about the fold of the hock.

Regions Common to Front and Hind Limbs.

10. **Chestnuts.**—In the front limb the chestnut is situated about the middle part of the inferior third of the forearm on its inner surface. This is said to be the remnant of the internal digit, corresponding to the

thumb of man. It is of no special importance. In the hind limb the chestnut is found on the internal surface of the hock. It is a rudiment of the great toe of the hind limb.

11. **Cannon and Tendons.**—The bony base consists of the large cannon and two split bones. There are no muscles in this region. These parts act only as levers and columns of support. The cannon should be vertical. For speed it should be short; for high knee or hock action it should be long. It should also be relatively wide and thick. The tendons should stand out distinctly and well separated from the cannon bone. The tendons should run parallel with the cannon. The cannon of the hind limb is a little longer and narrower than that of the front limb. The cannon region is a favorite seat for splints and diseases of the tendon.

12. **Fetlock and Ergot.**—The bony base is formed by the lower end of the large cannon and upper end of the first phalanx and two sesamoid bones at the back part of the articulation. The fetlock should be wide, thick, fine, and free from blemishes and diseases. It is here that a change in the direction of the limb takes place. The cannon above is vertical and the pastern below forms an angle with the horizontal of fifty to sixty degrees. The fetlock supports on its back part a bunch of coarse hair, in the middle of which is a small horny growth called the ergot. "Wind galls" or distensions of the synovial sacs are quite common at the fetlock.

13. **Pastern.**—It lies below the fetlock and above the coronet. The direction of the pastern will vary, the angle forms being somewhere between fifty and sixty degrees with the horizontal. If the fetlock is too much inclined an excess of weight is thrown upon the back tendons and ligaments, especially at the fetlock. If the pastern is too upright or too nearly vertical, too much concussion is thrown upon the bone, and this predisposes the animal to bone diseases. The pastern should correspond in width and thickness to the parts above and below. The length of the pastern will vary somewhat with its direction. A short pastern is usually very upright; a long pastern is generally very much inclined. It is said that the horse with an inclined pastern is an easy driver or saddler. The pastern is frequently the location of disease. Ring bone, skin disease and wounds are found here.

14. Coronet.—It lies below the pastern and above the foot. Its bony base is the second phalanx. It should take the same direction as the pastern and be relatively wide, thick and fine. At the coronet may occur ring bone, quittor, side bones, grease heel, and wounds.

Fig. 5.—Shows five front views of front limbs. Beginning on the left. 1. Regular, normal standing position or axis. 2. Toe-narrow or pigeon-toed. 3. Base wide or ground wide. 4. Toe-wide or toes pointing outward. 5. Limbs down to fetlocks too close together and toe wide.

15. Foot.—The foot is formed by the third phalanx or coffin bones and the navicular bones, ligaments, tendons, soft tissues, blood vessels, nerves, and the horny hoof. The front foot is more nearly round, wider, and less concave at the sole than the hind foot. The frog of the front foot is larger and nearer the ground than in the hind foot. The wall of the hoof at the toe is more inclined in the front foot than in the hind; in the front foot the toe line makes an angle of fifty to fifty-five degrees with the horizontal, while the toe line of the hind foot makes an angle of fifty-five to sixty degrees with the level. The toe line of the front foot is twice as long or high as the heel. In the hind foot the heel is about one-third as high as the toe. Viewing the foot from behind, the heels should be well separated, equal in size and height. Viewing the bottom of the foot, the sole should be concave and thick, the frog strong and healthy, the bars neither too straight nor too much inclined, and the bearing border of the wall and the sole should be perceptibly worn from usage. The horn of the standard foot is black or dark gray; the wall is smooth and shiny, showing its fibre structure.

Defects of the Foot.—1st. The foot may be too large or too small for the size of the horse.

2nd. The foot may be too flat, not sufficiently concave in the sole.

3rd. The toe may be too long or the toe may be too short and the heels too high. The high heel and short toe form what is called the club foot.

4th. The foot or hoof may be crooked, the inside part of the wall may be higher or lower than the outside.

5th. The quality of the horn may be deficient; it may be too soft, too dry and brittle and too easily split or broken.

Diseases of the Foot are as follows: Punctures or snags, thrush, canker, wall cracks, corns, founder or laminitis, horny tumors of the wall and sole, and various other wounds and injuries.

All the directions mentioned in the preceding paragraphs apply to the position of regions or parts when the horse is standing square on all his feet.

THE NORMAL AXES OR BEST POSITIONS OF THE LIMBS.

Front Limb.

1. Viewed from one side, a plumb line dropped from the middle of the arm should strike the center of the hoof, and be equally distant from a plumb line dropped from the point of the shoulder and one dropped from the point of the elbow. Any deviations from this normal position are more or less defective.

2. Viewed from in front, a plumb line dropped from the point of the shoulder divides all the lower part of the limb into outer and inner halves, and separates the right foot from the left foot a distance equal to the width of one of the feet. All deviations from the normal axes are more or less defective.

Hind Limb.

1. Viewed from one side, a plumb line dropped from the hip joint obliquely crosses the middle of the

Fig. 22.—(a) Shows a foot where the axis is "broken" at the coronet, and the toe is relatively too long or high for the height of the heel. The dotted line along the lower border shows how much more the toe must be rasped away than the heel in order to bring the axis back to its normal position and establish the proper relation between the toe length and the heel length or height.

(b) Shows the normal or straight axis and the correct relative height or length of toe and heel.

(c) Shows the axis broken at the coronet in the opposite direction to that at a. The toe is too short and the heel is too high. The dotted line along the lower border shows how much more the heel must be rasped away than the toe in order that the defects of axis and toe and heel lengths may be partly corrected. It may take two or more "shoeings" to correct completely these defects.

leg or gaskin and strikes the center of the hoof; this line is equally distant from a plumb line dropped from the stifle and one dropped from the buttock point. The plumb line dropped from the buttock point usually touches the back border of the hock, the tendons, and the fetlock. All deviations from the normal axes are defective.

2. Viewed from behind, a plumb line dropped from the point of the buttock divides the hind limb into outer and inner halves, and separates the right foot from the left foot a distance equal to the width of the fetlock. Deviations from the normal axes are defective.

Fig. 18.—(a) Toe wide feet, front view. The outside half of wall of hoof is longer and higher than the inside half. The axis deviate outward from the fetlock to the ground. This predisposes horse to interfere with the inside heel. c strikes usually at e. This defect may be relieved by rasping away more of the wall than the inside half at each time of shoeing until the inside and outside halves of the wall are of equal height. Then the toes should point directly forward.

(b) Toe-wide feet, back view.

SHOEING THE HEALTHY FOOT OF THE HORSE

Bearing in mind the relation between the toe line and the heel, the inside and the outside height of the hoof, prepare the foot for the shoe, keeping these relations normal, or trying to make them normal. As a rule, it is best to use the rasp and not the knife in leveling and smoothing off the lower border of the wall of the hoof. If the sole and the frog are healthy, they should never be pared or cut away with the drawing knife. The lower border of the wall is to be kept level and rasped down until the rasp begins to cut away a little of the sole.

The size of the shoe should be determined by the size of the animal and the kind of shoe. A steel shoe is always better than an iron shoe, because a small steel shoe will wear longer and do better service than a large iron shoe. The smaller the shoe, the better for the animal, providing it will stand the wear and protect the hoof.

In fitting the shoe to the hoof, see that the outline of the shoe corresponds closely to the outline of the hoof or wall. The heel may project back of the heel of the foot one-fourth to one-half inch. The nail holes in the shoe should be well toward the toe, because

nails in the heel or back part of the wall prevent healthy expansion of the foot. Heel calks and toe calks are unnecessary, and injurious to the healthy

Fig. 19.—(a) Shows the direction of the flight of the regular, normal or straight feet in walking.

(b) Shows how the feet move when is toe-wide.

(c) Shows the line of movement in a toe narrow horse.

feet of horses in the Southern States. The plain, level, or furrowed shoe is far better than a shoe standing up on stilts (calks). After the shoe has been made to fit the prepared foot, as accurately as possible, heat the shoe red hot and touch it to the prepared foot at the exact place it should go for about five seconds. This makes the shoe fit exactly and closes the porous openings in the freshly rasped wall. Remember that it is not well nor wise to hold the hot iron on the foot longer than ten seconds. Now the cool shoe is ready to be nailed on with as small nails as

consistent with the size of the shoe and the foot. Three nails on each side toe should be sufficient. The nails should come out one-half to three-quarters of an inch above the lower border of the wall; then clipped off and clinched. The outer surface of the wall should not be rasped away, because it is naturally covered with a protective varnish that prevents excessive drying out of the foot.

The toe of the shoe being firmly fixed to the toe of the wall prevents wearing away of the toe of the wall, but the heels being free are worn away by rubbing

Fig. 13.—Shows four positions of the hind limb from posterior view. Beginning on the left. 1. Toe-wide or toes pointing outward. 2. Toe-narrow or pigeon-toed. 3. Base narrow or ground narrow or limbs and feet too close together. 4. Base or ground wide. Limbs and feet too far apart, especially for a speed horse.

Fig. 16.—(a) Regular or normal foot, front view. (b) The same with back view.

Fig. 17.—(a) Toe narrow or pigeon-toed feet, front view. Inside half of wall of hoof higher and longer than the outside. Predisposes to interfering with the inside part of toe which strikes usually the inside part of the opposite fetlock, as c strikes e. The axis inclines or deviates inward from the fetlock to the ground. This defect can sometimes be remedied by rasping down the inside half of the wall more than the outside half, at each time of shoeing, until the inside and outside halves of the wall are of equal length and height. (b) The back view of toe-narrow feet.

Fig. 20.—Lower or ground surface of front foot. (a) Middle left of the frog. (b, c, d) Inferior or bearing border of the wall of the hoof. (e) Sole; (f-f) body of the frog; (k-k) branches at base of frog; (h) joint or apex of frog; (i-l) lateral clefts of frog; letters i-l are on the base.

Fig. 21.—Lower or ground surface of hind foot. Notice that the toe (b) is more pointed and the width (c to d) are narrower than the same parts in the front foot. The frog is smaller and the sole is more vaulted or concave than in the front foot.

on the upper surface of the shoe. As a result, in the course of three or four weeks the toe becomes long and the heels too short. In order to remedy this, the shoe should be removed, the toe rasped off to its normal length, and the old shoe reset or a new one put on. Thus it will be seen that it is necessary to re-

set the shoes on the horse at least once a month, in order to keep the feet in a normal, healthy condition.

Remember that the frog, the sole, and the wall should not be rasped or cut away, except the wall at its lower border, upon which to fit the shoe; because the hoof will dry out, become smaller, harder and inflexible if these parts are cut away.

THE AGE OF THE HORSE DETERMINED BY THE TEETH

The teeth are made up of hard substances. The outer part that is readily seen by the eye is enamel. This is very hard; in fact, the hardest substance in

Fig. 23.—Three views of colt's mouth about 1 week old.

A

B

C

the body. It is white and ivory-like in appearance. In the young tooth just cut this may be covered by a soft yellow layer called cement, which soon rubs off or wears away. In the old horse this may be covered with a yellow tartar-like substance, which makes the teeth appear yellow. The color of the teeth is no index to age. This enamel dips down into the table surface of the incisors and forms a cup-like cavity in the new tooth on this surface. In the molar tooth it dips down into the tooth on the table surface several times. The bulk of the tooth is made up of a softer substance called dentine. It surrounds the pulp cavity and lies just inside of the enamel. The enamel dips down into it on the table surface. When the teeth wear away on this surface, the dentine wears faster than the enamel, which keeps the table surface rough and with sharp projections of enamel. Thus

nature keeps or maintains a sharp and rough surface for cutting and grinding purposes.

The horse, like man and many other animals, develops two sets of teeth. The first set may be called temporary teeth; the second set are called permanent teeth.

The temporary teeth of the horse are all of the incisors and the first three molars in each half-jaw, making twenty-four in all. The permanent teeth consist of six incisors above and six below, two canines above and two below, and six molars in each half jaw, making forty permanent teeth in the mouth of the horse. In the mare the canines are usually absent.

Fig. 25.—Three views of colt's mouth at three months old.

The names of the incisor teeth must be known in order to understand the signs and changes that appear in them. The two central incisors, above and below, are called nippers. The two incisors touching and next to the nippers, one on each side, above and below (four in all), are called dividers. The remaining four incisors located each one on the outside of a divider, above and below, are called corners. The canines are designated by their location. The molars are numbered in each half jaw, beginning below at No. 1 and running upward and backward to No. 6.

From birth to the time the horse is five years old the age is indicated chiefly by the eruption or cutting of temporary and permanent teeth. The colt may be born with temporary nippers, but if not present at birth they appear in five to nine days. The dividers will be cut in about seven weeks after birth; the corners in six or seven months after birth. The first three molars in each half jaw are the only molars that are temporary. They may be present at birth, but if not present then, they will appear in seven to ten days. The fourth molar in each half jaw will appear

Fig. 26.—Three views of colt's mouth at one year old.

Fig. 24.—Three views of colt's mouth at one month old.

in ten to twelve months after birth; this is the first permanent tooth in the horse, and serves to fix the age of the yearling. No more changes in the way of eruption of teeth will occur until the colt is two and a half years old. From the time the colt is one year old until it is two and one-half years old, the age must be determined by the condition and wear of the temporary incisors.

At two and one-half years the temporary nippers are shed or drop out and permanent nippers come out in their place; the upper and lower permanent nippers will meet each other by the time the horse is

three years old. At this same time the first and second temporary molars in each half jaw are shed and their places taken by permanent molars. Also the fifth permanent molar in each half jaw is cut at this time.

At three and one-half years old the temporary dividers are shed and replaced by permanent ones; these permanent dividers, above and below, will meet each other when the horse is four years old.

At four and one-half years old the temporary corners are shed and replaced by permanent corners; the permanent corners, above and below, will meet by

Fig. 27.—Three views of colt's mouth at 2 years old.

Fig. 28.—Three views of 2 1/2 year old mouth.

Fig. 29.—Three views of the 3 1-2 year old mouth.

the time the horse is five years old. During this same period the sixth permanent molar in each half jaw is cut; also the canines in the male appear at this time. The five year old horse has a full mouth of permanent teeth.

At six years old the cup on the table surface of the lower nippers is worn away, and this surface is nearly level.

Fig. 30.—Three views of the 4 1-2 years old mouth.

Fig. 31.—Three views of a horse's mouth 5 years old.

Fig. 32.—Three views of 6 years old mouth.

Fig. 33.—Three views of seven years old mouth.

Fig. 34.—Three views of eight years old mouth.

Fig. 35.—View of table or wearing surfaces of incisor or front teeth of horse 9 years old.

Fig. 35.—Three views of a horse's mouth at 10 years old.

Fig. 36.—Three views of a horse's mouth at 11 years old.

Fig. 37.—Three views of a horse's mouth at 12 years old.

Fig. 38.—Three views of a 13 years old horse's mouth of incisor or front teeth.

Fig. 39.—Three views of the incisor or front teeth of a horse 15 years old.

At seven years old the dividers have lost the cup and are nearly level.

At eight years old the cup has disappeared in the corners.

At nine years old the outline of the table surface of the nippers is slightly oval or nearly round, and the dental star or white line appears in the nippers. The dental star or white line is a white chalky spot or line near the outer border of the table surface and is the beginning of the obliterated or remnant pulp cavity. In front of this white line is the round, hard remnant central enamel. The location and form of the dental star and the central enamel may be seen by referring to some of the illustrations.

At ten years old the lower nippers are still more nearly round, the central enamel is distinctly triangular, and the dental star more prominent.

At eleven years old the outline of the wearing sur-

face of the dividers is round and the white line or dental star has made its appearance in the dividers.

At twelve years old all the inferior tables are round. The dental star in the nippers and dividers becomes a yellow spot. In some cases the central enamel may disappear in the nippers; also in the superior corners.

At thirteen years old the inferior tables are still round, the central enamel in the lower nippers is gone, and sometimes it has disappeared in the dividers; the central enamel is always gone in the superior corners. The dental star is round in the lower nippers and nearly round in the lower dividers. It is usually round in the upper corner. The central enamel in the upper nippers is round.

At fourteen years old the table or wearing surface of the lower nippers is more or less triangular.

At fifteen years old the lower nippers are triangular. The superior tables are becoming triangular,

Fig. 40.—Three views of 17 years old horse's mouth of front teeth.

Fig. 41.—Three views of a 19 years old horses's mouth.

and the central enamel is present in the upper nippers.

At seventeen years old all the inferior tables are triangular. The superior tables are becoming triangular, and the central enamel is very small in the upper nippers.

At nineteen years old the inferior tables begin to appear somewhat quadrangular or four-sided in outline. The lower corners may yet remain triangular. The central enamel in the upper nippers is gone or very small.

At twenty-one years old the tables of the superior nippers and dividers are triangular and usually the central enamel has disappeared in all the upper incisors.

As the horse grows older from year to year, the incisor teeth become shorter and narrower from side to side and more widely separated from one another. Al-

so, as the horse grows older the angle, which the teeth make with the jaw, changes. The older the horse the more nearly the teeth appear to extend out straight from the end of the lower jaw. In judging the age of a horse be careful to distinguish between temporary and permanent teeth. Temporary teeth are always smaller and shorter than permanent teeth.

Moreover, always examine the thickness of the lower jaw and remember that the lower jaw is thick in young animals, and thin or sharp in old animals. Also observe the degree of depression in the supra-orbit. Never neglect to observe the direction of the incisor teeth and the condition of the molars and canines.

Fig. 43.—Is a section outline, the tooth being cut or sawed through its middle from before to behind. It shows the pulp cavity in its central part; around it is the dentine and outside of the dentine is the enamel. C is the cup made by the dipping downward of the enamel on the table surface into the dentine. The deeper part of this enamel is called the "central enamel." When this lower nipper tooth wears down to a-a the cup is gone and the horse is 6 years old. When the lower nipper wears to b-b is about 10 or 11 years old. When the lower nipper to d-d the horse is 13; at n-n the horse is 20 to 25 and at x-x about 30.

Fig. 42.—Three views of a 21 years old horse's mouth.

Fig. 44. The above series of outlines show the outline of the table or wearing surface of the left lower nipper at the ages indicated by the figures above each one. Notice how the diameter a-b decreases and the diameter m-n increases as the animal grows older. At 13 the two diameters are nearly equal and at 15 m-n becomes greater than a-b. The outline at 5 approximates an ellipse or oval; at 11 or 13 it becomes nearly round; at 15 to 21 it becomes triangular and at 30 it approaches a quadrilateral.

LAMENESS AND THE DISEASES ASSOCIATED WITH IT.

Lameness means weakness, and is a sign or symptom of disease rather than a disease itself. In examining a horse for lameness it is essential to locate the lame limb and then the seat of the lameness in that limb. In locating the lame limb it is best to have the horse free from harness or rider and trot in a way that it can have free movement of the head. If the lameness is in the front limb, the head will nod or rise when the lame limb strikes the ground; the well limb will drop or strike the ground with more force than usual. If the lameness is in the hind limb, the croup on the lame side will rise excessively when the lame limb strikes the ground; the well limb will also drop excessively or strike the ground with greater force. If both front limbs are lame, the horse will walk as if on stilts; the steps will be short; there is a lack of elasticity; the feet are kept close to the ground; the hind feet are raised higher than usual; the head is carried higher than common; the loin region may be arched; the shoulders appear stiff and the animal may refuse to trot. If both hind limbs are lame, the steps are short and awkward; the front limbs may be kept farther under the body than usual, and raised higher than normal when in action; the head is usually held lower than common; backing is difficult and the animal may refuse to trot. If the animal is lame in all four limbs it may refuse to walk or want to lie down, and if forced to walk, the gait will be wabbling and the animal will appear as if sore in the loins. If the horse is lame in both right legs there will be a see-sawing action between the head and the haunch, due to the raising of the head when the lame limbs come to the ground and dropping of the croup when the well limbs strike the ground. These motions are present in the trotter. If the animal is a pacer the head and the lame croup go up together, and the head and the well croup go down together. If the animal is lame in diagonal limbs, as a right front and a left hind, the entire body rises as the lame limbs strike the ground and drop when the well limbs strike the ground, when the horse is trotting.

After locating the lame limb or limbs, then locate

the seat of the lameness in that limb. This can only be done by the study of special diseases and their attending symptoms.

PUNCTURES OF THE FOOT.

Sharp objects like nails, snags, etc., may pass through the sole or frog, injure the soft, vascular and sensitive tissues above and infect them with pus or other disease-producing germs. The nail or other sharp object usually passes through the sole or the frog near the point of the frog or along the sides of the frog. In most cases the nail is pulled out when the foot is lifted by the animal, but in some cases it may remain until removed by man. If the snag or nail is out, the hole may partially close or be filled with dirt and sand and the animal may not show any lameness for one or two days.

Symptoms.—Usually the lameness is more or less intense, showing signs of great pain. The pain may be so great that the animal refuses to place the foot on the ground. Close examination of the sole or the frog with the drawing knife or pen-knife may locate a black spot, and this may be the point where the nail or snag entered the foot. By using a clean darning needle or an awl, one may determine whether this hole passes down to the quick or not. By the use of hoof searchers or the blacksmith's nippers, one may produce pressure over various parts of the sole and the frog to determine the sensitive place; when a place is found where the horse flinches on pressure there is likely to be found the place of entrance of the nail or snag. Sometimes this place cannot be found by the ordinary observer; then pus forms above the sole and frog, producing great pain and finally breaking out and discharging at the back part of the foot between the frog and the sensitive tissue above it. In some cases the punctures will injure the bones and the tendons, and this may result in a serious and prolonged form of lameness. In other cases the articulation may become diseased and often result in a stiff joint.

Treatment.—As soon as the location is found, cut through the sole or the frog around the puncture down to the quick, making an opening one-half to one inch in diameter. Now use clean cotton and boiled and cooled water to clean out the place; then smear tar round over the sides and bottom of the hole and plug the opening with cotton. The tar will hold the cotton in place, act as a disinfectant, and prevent germs from getting into the wound. The next day remove this cotton, clean out the pus with wads of clean cotton, and put in more tar and cotton. Repeat this daily until recovery takes place. As a rule, this simple treatment will cure all ordinary cases, but if the bones, the articulation or the tendons are injured and infected, recoveries may be slow; yet it is well to follow this line of treatment.

THRUSH.

This disease involves the frog and may extend to the sensitive tissue above the frog and the sole. It may be caused by injuries to the frog, but it is most frequently produced by permitting the horse to stand in manure and urine. The germs in manure and urine disintegrate or rot the frog, and in some cases the entire frog is destroyed. This disease may be associated with nail puncture, grease-heel or canker.

Symptoms.—The frog exhibits signs of decaying; gives off a bad smell or odor, and pieces of it may be readily torn away. If any of the sensitive tissue is exposed, lameness will be present when a hard object strikes that tissue, but as a rule lameness is not present in the early stages of this disease.

Treatment.—Remove the cause; if the horse is standing in filth, get it into a clean stall; clean and disinfect the feet, and many cases will get well without further treatment. Coal tar or pine tar may be applied daily to the diseased frog. If the sensitive tissue is not exposed, powdered zinc sulphate or calomel may be dusted over the diseased frog after it has been cleaned. If associated with another disease the other disease must also be treated.

CANKER.

It involves the sensitive or velvety tissue above the sole and the frog. The exact cause is unknown, but

it is very likely due to some irritating germ. It is often associated with, or a sequel to, nail puncture, or an old standing case of thrush.

Symptoms.—A soft fungus-like growth may appear through an opening in the sole or frog; sometimes this growth appears at the back of the frog between the frog and the sensitive tissue above it. This growth is well supplied with blood and appears like "proud flesh" or exuberant granulations. Often it grows to enormous size and sometimes there may be more than one of these growths.

Treatment.—First clean up the parts with water that has been boiled and cooled, to which has been added some creolin or carbolic acid (one tablespoonful of creolin or carbolic acid to one quart of water); now take a sharp knife or a pair of curved scissors, and clip off this growth down level with the upper surface of the sole or the frog. With some cotton apply strong carbolic acid or creolin, and if possible apply bandages around the foot so as to produce pressure upon the spot or place from which you clipped this growth. Pressure may be obtained over this place by applying a shoe to the foot with a broad piece of leather above the shoe. Then cotton may be stuffed in from behind to produce pressure on the place. The last method makes it somewhat difficult to dress the place when that is required. But if the place is thoroughly disinfected when first dressed it may not require another dressing for a week or ten days. Many times at the end of that time we find that another growth has made its appearance. If so, cut it away again and be more careful in applying plenty of strong creolin or strong carbolic acid, and be sure to get plenty of pressure over it with the cotton. In some instances this disease may appear in all four feet and the growth may come out all over the sole and the frog. Such cases are usually hopeless when it comes to treatment, especially in the hands of the ordinary man.

CORNS.

They may involve the velvety or sensitive tissue above the sole at the heel, between the bar and the outer wall. They may also involve the sensitive tissue on the inside of the bars. Corns occur usually in the front limb, and more frequently at the inside heel than the outside heel.

Causes.—Flat feet are predisposed to injury of the velvety tissue of the sole at the heel. High heels are predisposed to injury of the sensitive tissue inside of the bar. Paring away the sole at the heel and leaving the shoe on too long pulls the shoe forward and off of the wall on the sole at the heel, which finally injures the sensitive tissue above the wall at this point. Cutting away or thinning the bars often leaves too uneven pressure at the heels, resulting in corns. Excessive drying out and contraction of the hoof often lead to corns. In some cases horses seem to be predisposed to corns in such a degree that it is difficult to determine the cause.

Symptoms.—As a rule, there is more or less lameness; it is intensified on hard ground or pavement, and when the foot becomes dry. Producing pressure with hoof searchers or the blacksmith's pinchers will usually produce pain and flinching. If the shoe is removed, cutting or rasping away the sole at the heel may show red spots in the sole at this place. Cutting away the sole down to the quick may show nothing but blood stain or moist horn; yet in some cases pus may be found, and when this pus is not liberated it may work its way up inside of the wall to the top of the heel and escape between the skin and the upper border of the wall of the hoof.

Treatment.—It is wise to prevent this trouble by proper shoeing and removing the shoe and re-setting it at least once a month; also use hoof ointment in hot and dry weather to prevent excessive drying out of the hoof. Moreover, avoid rasping away the wall or cutting away the sole at all. The curative treatment in the early stages consists in removing the shoes, poulticing the feet at night, or standing the horse in water which just covers his hoofs until the hoof becomes soft and flexible. On removing the poultice or taking the horse from water, clean the hoof and when nearly dry apply all over the hoof some of the following ointment:

Tar 1 pound.

Lard 3 pounds.

Melt the tar and lard together and mix thoroughly, and let cool before applying.

In some cases it may be necessary to poultice or soak the feet every night for a week or ten days; also

apply the ointment every morning. In shoeing a horse with corns, or one subject to corns, the heels should be rasped down so that they do not press on the shoe; the shoes should be removed and re-set as soon as the heel grows out and begins to press on the shoe. In such cases it is well to apply every day the hoof ointment all over the hoof.

If pus is found it must be liberated by cutting a free opening, then disinfect with carbolic acid or creolin solution and apply tar and cotton as for nail puncture. Repeat this treatment every day until no more pus appears and new sole is formed, then apply hoof ointment and shoes as previously directed.

LAMINITIS, OR FOUNDER.

It is an inflammation of the sensitive laminae; this membrane is very vascular and sensitive; it lies just inside of the wall of the hoof and covers the front surface of the third phalanx or coffin bone. It corresponds to the inner sensitive part of the skin; in fact, it is a modified form of skin.

Causes.—Young animals, unaccustomed to hard work, are predisposed to this disease. Overwork or exhaustive exercise may cause this trouble. Often it results from prolonged slow work, in which the feet become exhausted; rapid work or excessive exercise for a short period may produce the trouble in a horse unaccustomed to work. When the feet are exhausted and the animal is hot from overwork, drinking an excess of cold water or eating an excess of food will cause this disease. In some cases, eating too much corn, rye, barley, wheat, or any concentrated food may produce founder instead of colic; but sometimes this will produce both colic and founder. Occasionally excessive purgation will in some way result in founder. In rare instances founder may be a sequel of, or be associated with, lung fever, pleurisy, or inflammation of the bowels.

Symptoms.—In severe and acute cases the temperature may be as high as 102 to 105 degrees Fah.; and the appetite may be entirely lost; the animal may show signs of intense pain, and rapid breathing; refuse to move unless forced, and prefer to lie down most of the time. Close examination of the feet will find them warmer than usual; and they also may be relatively dry. Pressure with the hoof searchers or pinchers, especially at the toe, will produce pain and

flinching. When the animal is forced to move and the disease is in only the front feet, the hind feet will be advanced under the body and both front feet will be raised and carried forward at the same time, and the horse will try to rest the weight on the heel by throwing the front feet forward. If the hind feet alone are involved, which is very rare, the front feet will be placed back under the body, in order to take as much weight as possible off of the hind feet. At the same time, the hind feet may be pushed forward so as to rest most of the weight they bear on the heel. If all four feet are foundered then the animal may refuse to move and desire to lie down most of the time. In some cases a foundered horse may persistently stand in one place until it drops from exhaustion. A horse with this disease will move with less pain over soft ground than over hard ground.

In a chronic case, or one where repeated attacks of acute founder have occurred, a change in the form of the hoof will take place. At first, there will be a series of more or less rough rings appear round the top of the wall. The sole will become depressed or bulged downward; this is due to the separation of the sensitive from the insensitive laminae at the toe, and in consequence the third phalanx or coffin bone drops down at its front part upon the sole; the space between the sensitive and insensitive laminae may be filled up with blood or organized material resulting from the inflammation. In the course of six to nine months the toe line or front part of the wall becomes concave or depressed from above to below, rough and softer than common; the sole in some cases may be worn through by contact with the ground and pressure from the bone. A chronic condition like this is very difficult to remedy, and in many cases never can be cured.

Treatment.—Ordinary acute cases should be placed where the feet may remain in moderately cold water for hours immediately after the disease is discovered. In case the animal cannot be placed in water, wrap rags or cloths around the feet and keep them wet with cold water. Some prefer to apply poultices of bran, corn meal, or any clean material that will hold moisture on the feet; but poultices should be changed frequently to prevent souring and filth. If the animal is suffering intensely, apply hot water to the feet, using it just as hot as you can hold your hand in. Apply this with rags around the feet and keep it up

for several hours. After the animal is over the intense pain, cold water may be used instead of the hot. If at any time the horse is taken out of the water, or its use is discontinued, let the feet partially dry, apply hoof ointment all over the hoofs, using the same ointment as recommended under the subject of "Corns." In the course of two to five days, many cases will appear to have completely recovered; the pain will have disappeared and the animal walk as if sound and well. Yet it is unsafe to put that horse to work; it should rest with light feed or in pasture for 10 to 15 days, and during all this time apply the hoof ointment all over each hoof every day. When the horse is put to work it should be done with care and frequent rests. Remember that one attack predisposes a horse to another, and repeated attacks lead to incurable chronic cases.

In cases where the animal has overeaten and shows signs of indigestion or colic, it may be necessary to treat the colic or indigestion at the same time the feet are being treated. Some persons are anxious to treat these cases by drawing blood from around the coronets, but this should not be practiced, because it is liable to lead to serious injury to the foot. In a horse in good condition one to three quarts of blood might be extracted from the jugular vein. In some cases partial relief might be secured by making an opening through the toe of the sole, near the line of union between the sole and the wall; this opening should be made down to the quick; it will let out any blood that may have accumulated there, but will not do any good unless there has been some escape of blood into that part. If this is done, plug the opening with tar and cotton, and treat it thereafter as for nail puncture.

Chronic cases cannot be treated in the same way that acute cases are handled. The chronic case should be placed in a large box stall or paddock where the floor or ground is kept well littered and soft. Apply the hoof ointment daily and once every three or four weeks rasp down the heels about one-fourth of an inch; also rasp away the point of the toe from above to below, cutting only the toe part of the wall. Never pare away the sole for fear of making an opening and allowing the bone to protrude. The feet or legs should be rubbed well two or three times per day; the animal should be fed so as not to be kept too fat, making the weight on the feet as light as possible. If recovery takes place it will require 12 to 18

months of this careful handling and treatment. A new hoof must be grown, and in its normal condition, so that the sensitive and insensitive laminae (leaves) may be normally united, the wall in its proper direction, and the sole and the bone in their proper conditions.

QUITTOR.

This term is applied to designate mortification, decay, or death of a limited part of tissue anywhere below the knee in the front limb, or below the hock in the hind limb. It may involve the skin and some of the tissue immediately under it, then it is called skin quittor. It may involve a coronet, and then it is called coronary or sub-horny quittor; this is a variety of skin quittor. It may involve the tendons, about the foot, then it is called tendinous quittor. It may also involve one or both lateral cartilage, then it is called cartilaginous quittor.

Causes.—Injuries which bruise the skin or injure the deeper parts give opportunities for germs, such as the necrosis bacillus, to enter and destroy cells and tissue. Wounds made by shoe calks, by interfering, bruising of any kind, and punctures may lead to this trouble.

Symptoms.—If the skin is involved, there will be more or less swelling, and in the course of a few days the dead parts will lose heat, the hair on it may stand on end, this dead skin may crack, and finally a line of separation will appear between it and the living tissue around it. In the course of several days, sometimes weeks, this dead part will slough out, leaving a deep pit-like ulcer, which should heal with proper care, leaving a scar with no hair on it. If the injury is at the coronet, passes down under the upper border of the wall, there will be considerable pain and lameness; this is due to the fact that the horny wall prevents swelling, and this increases pressure on the nerve ends and pain. If a tendon is involved, a rather deep opening is found and at the bottom of it may be seen and felt a more or less ragged soap-like tendon. Parts of this tendon may come away in shreds. In some cases only part of it may be destroyed. It is important to note that the tendons run along the front and back surfaces of the cannon, block, pastern, and coronet.

The lateral cartilages are two in number, an inside

and an outside one. They are attached to the lateral angles of the coffin bone. The front end of each one begins just inside of the upper border of the wall, about one inch from the middle part of the upper border of the wall. Each one extends backward along this border, and its back end curves around the back end of the fatty cushion above the frog. The lateral cartilage in health is flexible. It can be felt above the border of the wall at the heel. When this cartilage is injured by a bruise or wound, and it begins to decay, as a result of the action of germs, it may continue to decay until the entire cartilage is removed. This may go on through a period of several months. The parts around the injury will be swollen and enlarged, causing considerable pain and lameness. A small opening through the skin may remain immediately over the decaying parts of the cartilage. This opening in the skin is usually surrounded by button-like granulations. When the part of the cartilage immediately under this opening is destroyed, another opening may occur in front or behind the first opening. Then the first opening will close. Thus a successive series of openings will appear and disappear in the skin over the cartilage along and above the upper border of the wall of the hoof.

Treatment.—In skin quittor and coronary quittor cleanse the part with boiled water containing creolin and carbolic acid, then apply some strong creolin or carbolic acid immediately over the dead tissue; next cover it and the surrounding skin with carbolized vaseline, then with a layer of cotton, and over this apply a bandage. In some cases this must be dressed every day; in others, it may be dressed every three or four days, or once a week. When the injury extends under the upper border of the wall of the hoof, it may be necessary to rasp the wall away immediately over the injury, until it gets quite thin; this will permit it to distend and relieve the pressure and pain. In treating tendinous quittor clean out the wound with clean, boiled cotton and water with creolin or carbolic acid in it, and remove all shreds or loose pieces of tendon; now apply, on a piece of bandage or some cotton, a small quantity of ointment made by mixing two drams of red iodide or mercury with two ounces of vaseline; then apply vaseline around the opening, clean, boiled cotton and a bandage. Repeat the use of the ointment every other day until the wound stops discharging pus, then use less in quantity of the ointment and dress less frequently, being careful

to keep the wound well protected with clean cotton and bandages. It may require several weeks to effect a cure.

In treating cartilagenous quittor good results are more difficult to secure, and many times it is impossible to do effective work without a complicated surgical operation, but this can only be done by an expert. However, the farmer can try the following method: Secure some good, stiff cord about 1-16 of an inch in diameter; soak this cord in a saturated alcoholic solution of bichloride of mercury (corrosive sublimate); this solution can be made by adding the drug to alcohol as long as it will be dissolved; let the string soak in this for one or two days; remove it and hang up until it dries. Clean the foot round the opening through the skin, take a small piece of this dry cord and push it down into the opening as far as you can clip off the end even with the skin. In the course of three or four days remove this and insert another piece of this cord. Repeat this until the opening closes. This may not remove the enlargement or the lameness, but may stop the decay of the cartilage. Applying hoof ointment to the hoof every day will make it more flexible and permit greater expansion, thereby reducing the pressure and consequent pain and lameness.

CRACKS IN THE WALL OF THE HOOF.

Wall cracks are designated toe cracks and quarter cracks, according to their location. A toe crack is located at the toe of the wall and extends from the upper to the lower border, or from the lower to the upper border. A quarter crack usually lies behind the widest part of the foot in the side of the wall extending from above to below.

Causes.—The condition of the horn often determines the presence or absence of a crack. If the wall or entire hoof becomes excessively dry as a result of the blacksmith rasping away the protective covering of the wall or paring away the sole and frog, normal contraction and expansion may not occur without splitting the dry and brittle hoof at some weak point. The hoof may become weakened and partially disintegrated by standing the animal for a long time in manure and urine, or any wet, muddy place. Such a hoof is liable to crack with ordinary expansion and contraction. It is possible that horses with high knee action or high hock action may produce sudden and violent expansion upon hard pave-

ment or road and suddenly produce a crack in a rather strong hoof; but this is not common.

Symptoms.—The most prominent symptom is the visible crack, which opens and closes when the foot is used. A toe crack closes when the foot is on the ground and opens when the foot is off the ground. A quarter crack opens when the foot is on the ground and partially closes when the foot is taken

Fig. 45.—This illustrates two methods of closing crack in the wall of the hoof. One with horse shoe nails and the other with clamps that are applied with a special force-like instrument.

from the ground. This opening and closing pinches irritates and injures the soft tissues (sensitive leaves) which press up into the crack. Germs readily enter the tissue and produce inflammation and pus. When the pinching occurs it produces great pain.

Treatment.—If the crack can be closed in the early stages before inflammation and pus appear, the pain will cease. The crack may be closed at the toe by using small horse shoe nails and driving them through from one side of the crack to the other. Usually three or four nails are sufficient. It is well to cut a little opening or hole 1-8 to 1-4 of an inch deep about 1-2 an inch from the crack; these holes can be made on each side so that the nail can enter the wall at one and come out at another directly opposite it. It is well to keep such a foot shod constantly. These nails should hold the crack closed until a new hoof grows; this will require 12 to 18 months. In many cases the wall at the quarter is too thin to permit the use of nails in closing the crack. In that case apply a shoe that is about half way cut in two at the toe; have the nail holes run back to the heel; also an inside clip that will catch on the bar at the inside of the heel next to the frog. Nail on this shoe after preparing the foot for normal shoeing; if the foot is very dry and hard it may be necessary to pare away some hard part of the

bar and cut down the heel a little more than common. When the shoe is nailed on use the blacksmith's tongs between the heels of the shoe and press them outward slowly and gradually until crack is closed. In some cases it may be necessary to partly close the crack the first time and in three or four days complete it. The objection to the use of such a shoe is that it must remain on, being re-set every three or four weeks, for 6 to 12 months. This seriously interferes with the expansion and health of the foot.

When pus and inflammation are so great that the crack cannot be closed, it is well to cut away the horn on each side of the crack, until it is so thin that it will not pinch the soft tissue. Now cleanse the part, apply tar and cotton or hoof ointment and cotton and a bandage so as to produce pressure. Repeat this application every day until no more pus is present, then repeat it only about once a week. During this treatment the animal must have rest, and in the course of a month or six weeks it may be in such a condition that a normal shoe may be applied and the animal put to work.

HORNY TUMOR of the WALL.

This involves the wall of the hoof, the sensitive and insensitive leaves, and the third phalanx, os pedis or coffin bone.

Causes.—It may be a sequel of toe crack or quarter crack; the nail of the shoe may be driven too close to the quick and long continued pressure cause this trouble, toe clips and quarter clips may also induce it by long continued pressure; clefts or openings in the white line at the union between the sole and the wall may permit dirt, sand and small pebbles to work upward and produce pressure that would in time cause this trouble.

Symptoms.—At first there appears an obscure soreness, which is hard to locate; later, by applying pressure with the hoof searchers or the blacksmith'sippers, a sensitive place may be found. Closely examining the white line will show that this line at the sensitive place is obscure or bent inward toward the frog. Sometimes an opening may be found which is filled with dirt. After locating the place involved, take a small, narrow, and long knife, a small pointed drawing knife is best, clean out the part from the white line up on the inside of the wall, going up as far as any dirt or soft, white, leafy insensitive tissue

may be found. This will require much care and patience, and sometimes it will be necessary to cast the animal before it can be done. When completely cleaned plug the hole with tar and cotton; repeat the dressing daily and apply hoof ointment every day. If not completely removed, the tumor will return in the course of a few months; then it may be removed again. Sometimes it may be necessary to remove a strip of the wall from its lower border to the upper border, about 1-2 inch wide, immediately over the tumor. Then the entire tumor can be removed; after its removal, apply cotton and hoof ointment or tar and bandage so as to apply pressure. Repeat the dressing every day for three or four days and thereafter about once a week. In the course of two months the shoe may be applied and the animal put to light work. It will require 12 to 18 months before a new hoof will be developed.

SIDE BONES.

The lateral cartilages, which are diseased in the cartilagenous quittor, are sometimes involved in another disease called Side Bones. In this lime salts are deposited in the cartilage in sufficient quantity to make the cartilage become larger, harder and inflexible. This trouble is more frequently found in the front than in the hind foot. It is also more frequently found in mules than in horses in the South.

Fig. 46.—Shows side bones, a ring bone at pastern joint and two furrows in the toe of the third phalanx produced by pressure of a horny tumor of the wall.

Causes.—In health the back and upper part of the cartilages are pressed outward when the foot expands at the time it is on the ground and bearing weight. If the nails in the shoes are back in the quarter and heel, as is so commonly the case in shoeing mules, this form or kind of shoeing prevents expansion and increases pressure on the lower part of the cartilage.

Fig. 47.—A photograph of a left front foot of a mule showing two side bones extending above the outer parts of the superior border of the wall of the hoof.

Long continued work under such conditions produces a low and slow form of inflammation, which finally results in the formation of a side bone. Excessive drying out of the hoof also contracts the wall, makes it harder, less flexible, and thus increases pressure, which may result in side bone. It is possible that overwork and over expansion of the lateral cartilages might lead to inflammation which would result in lime deposits in the cartilage. Sometimes side bones may be associated with navicular disease, quarter cracks, cartilagenous quittor, ring bones and occasionally it is said to be a sequel to founder. Again it is possible that a direct injury which might not cause an open wound might result in side bone; this, however, is very infrequent.

Symptoms.—The lameness will be more intense on hard than on soft ground. In the early stages there may be distinct sensitiveness or flinching when the cartilage is pressed by the thumb or finger. In the later stages the cartilage will be hard, inflexible and large. Sometimes the enlargement is so great that it makes the mule foot appear as if it had bunions, and wider above than below, this is especially so if both cartilages are involved.

Treatment.—In the early stages apply cold water or soak out the feet in water to reduce the fever. When the animal is removed from the water and the feet nearly dry, apply hoof ointment all over the hoof. See that the shoes thereafter are not nailed at the heel or quarters and that the foot does not dry out or become too hard in dry weather; excessive dryness of hoof may be prevented by frequent application of hoof ointment. In old standing cases, where the cartilage is large, hard and inflexible, try to induce greater expansion at the heel by frequent soaking the feet and frequent applications of hoof ointment. This may not cure the trouble or remove the enlargement, but may relieve the pressure and the pain, and thus enable the horse or mule to do considerable work on the farm. It is a good plan to keep such an animal off the hard road, and work it only on the farm in the soft fields where the animal will not suffer so much pain. It is possible to relieve the pain entirely by taking away the nerve supply to that part of the foot; this can only be done by an expert.

NAVICULAR DISEASE.

The navicular bone, the flexor tendon, which plays over the back surface of this bone, and the sheath that covers this tendon are the parts involved in navicular disease. These parts are somewhat deeply situated and cannot be felt or seen; hence the changes that occur are not visible on the surface.

Causes.—It is probable that a tendency to navicular disease is inherited from some near ancestor. Deep punctures that may reach the sheath, the tendon, or the bone may cause this trouble. It is possi-

Fig. 48.—N is the navicular bone showing conditions as in navicular disease. 3 is the os pedis with bony and rough growths from osteitis and s is the second phalanx with a ring bone.

ple that excessive strains on the tendon may result in navicular disease. Some persons claim that bruises or bruising strokes over the region of the frog might cause it; this is very doubtful. If the foot becomes dry, contracted or hard, there is little expansion and little dispersion of concussion; the navicular bone is directly under the gravity line of the limb, and as a result it receives this increased shock or concussion; now if this condition of excessive concussion on the navicular bone be continued indefinitely on a hard road, it is very likely that the bone will suffer; or it will result in some form of inflammation of the bone. This seems to be the most common cause of navicular disease. It is said that horses which have rheumatism or big head are very liable to have navicular disease. Horses with short, upright pasterns and flat feet usually have excessive concussion on the bone; and this may be one of the predisposing causes of navicular disease.

Symptoms.—At first there will be obscure lameness, and it will be difficult to find any swelling, injury or change in the limb to account for this lameness. The lameness may disappear and recur again in two or three weeks. After a few days it may disappear and return in a few weeks. This periodic coming and going of lameness may be kept up for one or two years before the horse becomes continuously lame. If the foot or hoof is not already contracted smaller than its opposite, it may become so in the course of six months or a year; this is partly due to non-use of that foot. In some cases the muscles of the shoulder will shrink, a result of non-use, on account of the lameness in the foot. Very rarely is this trouble found in the hind foot, but it is more frequent in the front foot; and sometimes it may be in both front feet. If in both front feet, the horse will shift the weight from one foot to the other, and try to keep the feet when standing, in advance of a normal position. Backing is rather difficult; the steps are short, and the animal walks as if on stilts. Except in rare cases the animal is more lame when it is first taken out of the stall than it is after being driven some time. The lameness is more intense on hard ground or pavement than on soft ground. Occasionally a single step will produce violent pain; and the animal for sometime may be unable to bear weight on that foot without great pain. If one foot is involved the position of that limb or foot may indicate something of the character of the disease. Some say the foot will

be extended in front of its opposite, others that it will be held back on the toe; but it is more probable that the animal will shift the position of the foot from one place to another, in order to secure rest and relief from pain. It is often asserted that pressure in the hollow of the heel with the thumb will produce pain and flinching; this is not to be relied upon, because many horses are excessively sensitive to this pressure. If the animal is shod, it will be noticed that the toe of the shoe is worn away much faster than the heel. If it is not shod, the toe of the wall is worn away faster than the heel. Sometimes the foot may be picked up and twisted or wrenched with the hand from side to side, and this will cause flinching or pain. In making a diagnosis all other parts of the limb must be carefully examined in order to see that there is no other cause for the lameness. Remember that a horse lame with navicular disease is quite often said to be lame in the shoulder.

Fig. 49.—Same as Fig. 48 except the first and second phalanges are in their natural position.

Treatment.—In the early stages give the animal rest with slight and regular daily exercise; soak out the feet and apply hoof ointment to prevent contraction and induce expansion. Sometimes it may be necessary and useful to rasp away the wall over the quarters and heel, until it is so thin you can make an impression by pressure with the thumb; also rasp down the heels and lower border of the wall, and cut away the bars until they are quite thin. Now apply hoof

ointment and let the animal take exercise every day in a pasture. A soft and wet pasture if possible. The hoof ointment should be applied to that foot every day. In the course of two or three months that foot should have become as large and as well expanded at the heels as its opposite. In old standing cases the only means of relief is to "nerve" the foot. This operation removes a section of the nerves that supplies the foot with sensation; this can only be done by an expert. However, it must be remembered, that with proper care and judicious handling, a horse with navicular disease may do considerable slow work on the farm if kept off the hard roads.

RING BONE.

This disease usually involves the first and second phalanges, and sometimes the third phalanx or os pedis is also involved. The regions enlarged may be the pastern and the coronet. An inflammation in the bone or involving both bones and the pastern articulation, usually results in a bony enlargement. Ring bone may occur in any limb, but it is more common in the front limbs than in the hind.

Causes.—A tendency to ring bone may be inherited. A bad conformation may also be inherited. A short upright pastern predisposes a horse to ring bone, because it increases concussion. Some assert that a long oblique pastern increases the weight to such an extent on the tendons and ligaments that they are liable to be torn loose or become diseased at their points of attachment; this would in turn produce inflammation in the periosteum, the vascular membrane that

covers the bone, and finally result in a bony enlargement or ring bone. Rheumatism and big head are said to be predisposing causes of ring bone. The real exciting cause of ring bone is excessive concussion, resulting from short, upright pasterns, high stepping, hard roads and pavements, an excessively dry, hard and inexpandible hoofs.

Symptoms.—In the beginning a small enlargement may appear somewhere along the front or lateral sides of the pastern or corners. The enlargement may be so small that it is hard to detect. Lameness may be more or less severe, according to the extent and location of the inflammation. If the pastern articulation is involved, the lameness may increase with exercise. If there is no enlargement on the back surface of the pastern or coronet of the front limb, the animal will try to bear most of the weight on the heel; often the heel will be placed on the ground first and then on the toe. In the hind limb the animal will usually put most of the weight on the toe. In cases of some standing the enlargement will be more prominent, it will be hard and bony, and the animal may be more lame or more stiff; the pastern joint may become obliterated or in other words the first and second phalanges firmly united by a bony deposit.

Treatment.—Rest is very essential in this disease. If there is much fever and pain it may be well to apply cold water for several hours each day until the fever is reduced; then apply some of the following ointment:

Mercuric Iodide 4 drams.
Vaseline 2 ounces.

Mix thoroughly and apply all around the pastern over the ring bone after clipping off the hair with the scissors or clippers. This should be rubbed in well; it is best to apply it at night and tie the halter strap so short that the animal cannot reach the foot with its lips; keep the animal thus tied for 24 hours. The ointment will blister and make the part swell and become more or less sore on the skin. In the course of two or three days the pastern may be washed with water and soap, and a little vaseline applied. In two or three weeks, if the animal is still lame, make a second application of this ointment.

Fig. 50.—A ring bone at the pastern joint. The joint is stiff and the bony growth is large. 1 is the first phalanx and 2 is the second phalanx. The fetlock is at the upper end of (1) and the coffin bone or os pedis is below (2).

ment in the same manner. Remember that rest for a considerable time—from one to four months—is very essential to the treatment of ring bone in its early stage.

In old cases, where the bony growth is large, the blistering treatment may not do much good. Then the only means of relief is to remove the nerve supply to that part of the limb. In all cases it is well to note the condition of the hoof; if it is dry and hard, soak up and apply hoof ointment regularly.

SPLINTS.

Bony enlargements along the lateral borders of the cannon bone, at the line of union, between the splint bone and the cannon, are called splints. In young animals a splint bone is united to the cannon bone by a ligament. In some cases this ligament becomes injured and inflammation appears, which results in bony enlargement and union of the two bones. Sometimes the union is made without an external enlargement.

Causes.—Splints occur in young horses far more frequently than in old ones; this is especially true if the young horse is put to severe work on a hard road or pavement. The concussion becomes so great that the interosseous ligament uniting the two bones becomes partly separated from the bone, or the periosteum becomes injured and consequently inflamed; this results in the formation of a bony growth to more firmly unite the bone. It is during this period of inflammation and bony growth that the animal is lame. As a rule, a splint that is present in an old horse rarely produces lameness; because that splint was formed when the animal was young.

Symptoms.—In the very beginning lameness is the only symptom of the disease; in a short time an enlargement may appear along the border of the splint bone or the cannon. This may be quite small at first and afterwards become more prominent. In some cases more than one small enlargement may appear along the border of the cannon; then the animal is said to have a beaded splint. The lameness during the growth of a splint increases with exercise and is more intense on hard roads than on soft ground. Occasionally an enlargement may appear along the inner

border of the splint bone near the tendons and suspensory ligament. This cannot be seen but may be felt by lifting up the foot and pushing the tendons to one side. This form of splint is often called a peg-splint. Splints occur most frequently on the inside border of the front cannon; occasionally they occur on the outside border of the front cannon and quite rarely appear in the hind limb. Sometimes a splint on the inside of the front limb will cause the horse to throw his foot outward when in motion. The most serious form of splints are those that are high up near the knee in the front limb, or near the hock in the hind limb; also the peg-splint is liable to cause severe and sometimes incurable lameness.

Treatment.—Rest is important in the treatment of splints, but not absolutely necessary. The blistering ointment recommended for beginning ring bone may be applied to a splint. It will not remove the enlargement, but may remove the lameness after one or two applications. The cause of pain in a splint is often due to pressure of the bony enlargement against the per-

Fig. 51.—Shows the bones of sound hock. o is the os calcis which forms the point of the hock and to which is attached the large ham-strong tendon; a is the astragalus which articulates with the lower end of the tibia; sc is the scaphoid, sometimes called the middle cuneiform; lc is the large cuneiform; c the cuboid; s the external splint bone; can is the cannon bone. Between the scaphoid (sc) and the larger cuneiform (lc) is the place where a bone spavin usually begins.

iosteum. In order to relieve this pressure, a needle-pointed firing iron may be pressed down through the skin and periosteum when the iron is red hot. This serves in place of blister and also relieves the pressure on the periosteum. Some surgeons use a knife and insert it in a small opening under the skin and cut the periosteum; but this can only be done by the qualified expert. It is never advisable for an ordinary man to attempt to chisel away or cut off splints. As a rule, an expert veterinarian does not cut off a splint. Remember that old splints which do not produce lameness are not considered as causes of unsoundness. Old splints are generally regarded as only unsightly and a slight blemish.

BONE SPAVIN.

In most cases this disease is confined to the four small bones on the lower part of the tarsus or hock.

Fig. 52.—The left hock showing a well developed bone spavin.

In other cases it may involve also the two upper bones of the tarsus, the lower end of the tibia, and the upper end of the cannon, and one or both small splint bones.

Causes.—Narrow hocks and crooked hocks are predisposed to bone spavin. The narrow hock is too

small to withstand the pressure from concussion and the pressure from the pinching action in extreme flexion of the hock while in motion. It is possible that rheumatism and big head predispose a horse to spavin. It is also very probable that a tendency to bone spavin is inherited. Young animals, race horses, hunters are said to be predisposed to bone spavin; but in many cases this may be due to the violent and severe work required of the hock in these kinds of work. The exciting causes of spavin are excessive concussions, great pinching action and possibly the partial tearing of ligaments of the hock. Concussion when excessive and prolonged produces inflammation in the small bones, where it is most severe. The pinching action occurs when the hock is excessively flexed; then the small bones are pinched very like the nut in the nut cracker. The tearing of ligaments may occur when the foot is caught and the animal pulls to get loose; this seems to be very rarely the cause of bone spavin. In fact, it is about as rare as the production of bone spavin by direct strokes or injuries.

Symptoms.—In many cases a small enlargement first appears on the inner and front aspect of the lower part of the hock. At first this enlargement will be so small that it is difficult to detect. Rub down the hair on both hocks and compare one with the other, using the fingers and the eyes. In cases of some standing this enlargement will be sufficient in size to be seen and felt quite easily. In other cases there may be no outer enlargement, and yet there will be a bone spavin present; in this case the inflammation is confined to the articular surfaces between the small bones. The bone spavin with an outer enlargement is called a periosteal spavin. One without an outer enlargement is called an occult or hidden spavin. The lameness in spavin is peculiar. In periosteal spavin the lameness usually gets worse with exercise. The length of the step in the limb with spavin is shorter than usual. In moving the foot forward in flexing the cannon and hock of the tibia there is often a kind of hitching, double movement. This is not always present and it is hard to observe when it occurs. If the foot is held up in the position in which the blacksmith holds the hind foot while shoeing it, for five or six minutes then the animal is immediately forced to trot the lameness will be greatly intensified; often the animal will start off on three limbs, holding the lame limb from the ground. In some cases the animal will raise the

limb upward, and higher than usual, somewhat in the manner indicating stringhalt. Pushing the animal from one side of the stall to the other, may produce signs of lameness.

Treatment.—With proper treatment over 50 per cent. of the cases should recover from the lameness. The enlargement may not disappear and a little stiffness may remain. Rest is essential in treating this disease. Point and line firing have been used in many instances with success. If point firing is used, the small point should be pushed down into the enlarged

Fig. 53.—Two hocks showing two different bone spavins.

bone, through the periosteum, over the entire enlargement; the points should not be closer than 1-2 inch to one another. In line firing the lines are about 1-2 inch from one another. Some advise cutting the tendon which runs obliquely down over this region, and removing a section of the tendon. Others advise inserting a curved knife under the skin and cutting the periosteum over the bone in one or two places. As a rule, the firing and the operations above suggested can only be done by the expert.

The farmer can best use blistering applications. The following is one of the many that may be tried:

Red Iodide of Mercury 4 drams.
Pulverized Cantharides 3 drams.
Turpentine 1 fluid ounce
Vaseline 3 ounces

Mix thoroughly and apply some of it all around the hock covering the enlargement; it may be well to clip

Fig. 54.—Hind view of hock showing a well developed bone spavin (sf). This is sometimes called a "periosteal" bone spavin.

the hair before applying; always rub it in well. Tie the halter strap short, so that the animal cannot reach the hock with his lips. Keep him thus tied for 24 hours. The application should not be repeated under three or four weeks. During this time the animal should have rest in a box stall or small pasture.

DISEASES OF THE TENDONS AND LIGAMENTS.

Most commonly this involves the back tendons in the cannon region; also the suspensory ligament and the sub-carpal tendon, or check ligament, may be involved. If the back or flexed tendons at the cannon region are injured by sprain or a stroke from kicking, and sometimes from the single-tree or plough, they may become inflamed. It is believed that over-work and exhaustion of the muscles will lead to sprain and inflammation of the tendons.

Symptoms.—As a rule, the enlargement of the tendons may be seen and felt. The enlargement may not

be very great, and a swelling in the skin should not be mistaken for an enlargement of the tendons. The lameness usually gets worse with exercise and with work. In old, standing cases the inflamed and enlarged tendons may contract and become shorter; this will pull back the foot in varying degrees and likewise push forward and over the fetlock. Thus the horse may become "cock-ankled," and in some cases may be so bad that the animal walks on the toe or on the front wall of the hoof, instead of the sole and frog.

The suspensory ligament begins on the back surface at the upper end of the cannon bone, between the heads of the two splints bones; it runs downward on this surface to about the lower third of the cannon; here it divides into an inner and an outer branch. Each branch runs downward and forward over the fetlock of its corresponding sesamoid bone, and then bears downward and forward until it unites with the anterior extensor tendon. This ligament helps hold up the fetlock and is the one pressed by the thumb and inger when we wish to make the horse raise its and finger when we wish to make the horse raise its foot. If injured, it occurs usually along one of the branches just above the fetlock, and the enlargement may be seen and felt.

The sub-carpal tendon or check ligament is a downward extension of the back ligament of the carpus or knee; it runs downward from the back part of the knee between the back tendon and the upper part of the suspensory ligament. It unites with the deep flexor or back tendon about the middle of the cannon region. It may be injured by sprains and possibly by direct strokes. If injured, it is enlarged and the enlargement may be felt. In determining enlargements of these tendons or ligaments always compare the tendon or ligament with the same in the opposite limb.

Treatment.—There is no disease producing lameness in which rest is more essential than in inflammation of the tendons and ligaments.

Secure a woolen flannel bandage 4 to 5 yards long and 2 or 3 inches broad. It may be well to have two or three of these. Wet this bandage and put it on from the pastern up to the knee; it may be drawn moderately tight, but not too tight. As it dries out it contracts and produces pressure. The water also reduces inflammation. When it has become dry, remove it, wet it again, or use another, and apply as before. Remove, wet, and re-apply this or another bandage six to ten times a day. In cold weather four to five times

a day may be all that is necessary. This should be kept up a least two weeks. If at the end of that time the enlargement and lameness have not disappeared, apply over the enlarged part some of the blistering ointment recommended for beginning ring bone. Do not repeat this blister for two or three weeks. If the tendons have contracted, the ankle thrown forward, and the foot backward, the only means of relief is an operation that cuts one or both of the tendons and permits the limb to become straight. This can only be done by the expert.

Tendons in other parts of the limbs may become inflamed. For example, the tendons back and above the knee may become contracted and produce the "knee sprung" condition. Sometimes this may be remedied by an operation. Occasionally the "ham

Fig. 55—Shows the position and relations of some of the parts of the front limb. Along the line of union between the splint bone and the cannon is the location of splints. The location of the suspensory ligament is also clearly defined. The check ligament or subcarpal ligament is visible. The back tendons, here designated flexor perofraus and flexor perforatus, are known respectively as the deep flexor and the superficial flexor tendons.

string" tendon above the hock may be injured; but this is rare unless there be a distinct wound, such as a cut or bruise. If the "ham string" tendon is completely severed, little can be done by the ordinary man to produce recovery.

CURB.

Any enlargement along the back border of the hock from just below the point of the hock down to the cannon is said to be a curb. Usually a curb involves a ligament running along beneath the tendons at this border. Sometimes it involves the tendons and occasionally it may be associated with enlargement of the bone.

Causes.—Crooked hocks or crooked hind limbs and young horses are predisposed to curbs. No doubt excessive strain on a weak hock will injure the ligament or the tendon. A tendency to this disease, especially a crooked hock, may be inherited. In fact, some instances a stroke against a single-tree or other hard objects might produce this trouble; but this is extremely rare. Curbs are produced in young horses when they are over-worked or when they are being broken, and they rear up frequently, throwing excessive weight and strain up on the hocks.

Symptoms.—A distinct enlargement or bulging along the back border of the hock is a positive sign of curb. This may be best observed by standing at one side. In the early stages there may be some local fever and some sensitiveness on pressure with the thumb or fingers. Generally the lameness increases with exercise; yet in some cases the lameness appears to be better after the animal is warmed up.

Treatment.—In the early stages apply cold water bandages for a week or more. Then apply the mercuric iodide blister (see treatment for ring-bone for this blister). If the horse is still lame at the end of three weeks, repeat the blister. Some fire in lines and blister at the same time. Rest in a box stall is very essential. If the animal is a colt or young and playful, he should be restrained from running, jumping and rearing. In old horses a curb may be present which is of long standing and not attended with lameness. Common law would hold such an animal as unsound, yet the animal may never go lame from the curb.

DROPSICAL CONDITIONS OF THE SYNOVIAL SACS.

These conditions are commonly called "wind galls." However, the soft, puffy enlargements never contained air or gas, but nearly always contain an excess of synovia, the lubricating material of joints and tendons. The synovial membrane becomes injured or changes in such a way that synovia is secreted faster than it is absorbed; this results in an excess of thick and abnormal synovia, which distends or dilates the synovial sac, producing the enlargement.

Causes.—Injuries of the synovial membrane may be so slight that the changes come on very gradually. Sometimes the slight pinching or pressure on the secreting cells of the synovial membrane may result in their destruction. Over-work in many cases may account for this trouble by causing over stimulation and secretion by the synovial membrane. Occasionally this trouble may be associated with rheumatism or big head. It also may be a sequel to severe inflammation of an articulation or tendon.

Symptoms.—In the early stages there may be lameness, but as a rule lameness is absent. When the weight is off the limb, the enlargement is soft and puffy, but when the weight is on the limb it may feel hard and tense. This variation is due to the variation in the pressure of the liquid against the wall of the sac. In very old, standing cases, as in old horses, lime salts may be deposited in the tissues around the sac, and thus it may become hard and bone-like; in these cases lameness may be more or less severe. The most common one of these synovial distensions is found at the fetlock, it is just above the fetlock, along the inner and outer border of the back tendon; this is a distension of the sac of the deep flexor tendon. Another is found just in front of the branch of the suspensory ligament; this is a distension of the synovial sac of the fetlock articulation. Another is found on the front surface of the fetlock. This is a dilatation of the sac of the anterior extensor tendon. On the front, the outside, and the back surface of the knee may occur five different synovial distensions of sacs of tendons and the articulation. Occasionally one may occur at the point of the elbow, and also at the point of the shoulder. In the hind limb three may occur at the fetlock as in the front limb. At the hock one may oc-

cur at the point of the hock. Another may occur on the back part of the hock; this shows a soft, puffy enlargement that is larger on the inside than the outside; it lies on the back surface some distance from the point of the hock and the "ham string" tendon, and the inside enlargement often extends down along the back part of the inside surface of the hock. This is a distension of the deep flexor tendon synovial sac of the hock. It is sometimes called a tendinous thoroughpin. The distension of the articular synovial sac at the hock may occur in three places; one at the internal, upper and front aspect of the hock, commonly called "bog spavin;" another on the back surface and internal part, and a third on the back surface and external part. The last two are called an articular thoroughpin. The distensions called "bog spavin" and articular thoroughpin may be changed by pressure. Pressing on the bog spavin will enlarge the distensions on the back surface of the hock, and pressing on the inside or outside of the back surface will enlarge its opposite or the "bog spavin." Sometimes the bog spavin enlargement is present without any enlargements on the back surface. At the stifle a synovial enlargement may appear, but this is not common. Another may occur just over the upper end of the femur directly over and to the outside of the hip joint. This is a distension of the synovial sac of the tendon of a muscle.

Treatment—As a rule, it is unwise and dangerous to open the sac of an articulation, because it may lead to inflammation of the articulation, and result in a stiff joint. Moreover, it is not wise or safe to open all synovial sacs of tendons. The following synovial sacs of tendons may be opened with some degree of safety; the sac of the anterior extensor tendon at the fetlock may be opened at its lower part. The synovial sac distension at the point of the elbow may be freely opened. The distension at the point of the hock, commonly called "capped hock," may be opened on its back part low down and to one side. After opening any of these sacs keep them cleansed by using boiled and cooled water and creolin or carbolic acid, and as a rule it is well to let the animal have some exercise every day. The other tendinous sacs may be treated by applying blisters and sometimes by using an aspirating needle and drawing off the excess of thick and abnormal synovia. This is a hollow, sharp-pointed needle, like a large hypodermic, and is pushed

into the sac and the liquid allowed to escape; it can be done every day for a few days and then the following blister may be applied.

Pulverized Cantharides	1 ounce
Turpentine	1 fluid ounce
Vaseline	2 fluid ounces

Mix thoroughly and apply once every three or four weeks.

All operations on articular sac distensions, and most of those of the tendons, should be put in the hands of the expert. Pressure is often applied by the use of specially constructed trusses and bandages; these must be bought at instrument houses. When used they must be kept on all the time the horse is at rest and taken off when the horse is at work. This must be kept up in some cases for months, and even then the pressure treatment is not always productive of a permanent cure.

INFLAMMATION OF AN ARTICULATION.

This is sometimes called arthritis or an open joint. However, the joint is not always open in cases of inflammation of articulation.

Causes.—Open joints are caused by penetrating wounds. A severe injury of the joint may lead to inflammation and pus formation in an articulation, but it sooner or later opens to the surface. It is possible that infection of a joint may occur in connection with pyaemia (an excess of pus in the blood forming or resulting in abscesses in numerous places in the body). In some cases of distemper or strangles pyaemia may occur. In inflammation or infections of the navel cord of a young colt or calf may also result in a general disease similar to pyaemia.

Symptoms.—At first an ordinary wound with a slight lameness may be all that is observed. In 24 hours the tissues around the articulation will become swollen, warmer than usual, and the animal will suffer intense pain. If the joint is open a watery secretion, streaked with blood, may be all that is observed during the first 24 hours. Later, the secretion may collect about the opening in grayish colored, jelly-like masses; this is coagulated abnormal synovia. Later pus may be discharged, usually from one opening,

but sometimes two or more openings may appear around the articulation. If the joint is not open, it will become greatly swollen, warm, very painful, and usually, if infection has occurred, it will open at some point in the course of a week or ten days, and then discharge pus. The discharge of pus is usually kept up for weeks, and the trouble may finally result in an obliteration of the articulation and a stiff joint. This is especially true if the treatment is not begun early and continued correctly.

Treatment.—If discovered immediately after the injury, the wound should be thoroughly disinfected with boiled and cooled water and boiled cotton, using some creolin or carbolic acid in the water. Saturate some cotton with a mixture of equal parts of linseed oil and turpentine: apply this in and over the wound, then bandage to hold in place. If no infection has occurred this will protect and prevent infection. If infection has occurred and the joint is inflamed and enlarged, then it is more difficult to destroy the infection. If it is possible, boil three or four gallons of water and add to it after boiling one part of bichloride of mercury to every 2,000 parts of water (15 grains of bichloride to every quart of water). Place this in a glass vessel or a glazed earthen vessel (never in a metal vessel), or use a large glass funnel, to which may be attached a rubber tube. A large rubber family fountain syringe may be cleaned up with boiling water and used for this purpose. After filling the rubber bag of this syringe, or the other vessel, hang it or place it above the horse and near enough so that the rubber tube and nozzle will reach the diseased joint. Place the nozzle in the wound that opens into the articulation and let this bichloride solution slowly pass into this joint as long as the five or six gallons of the solution will last. Then cover the wound as previously directed and bandage. Repeat this treatment the following day, providing pus is formed in the intervening 24 hours. If no pus is formed, use the other dressing and wait until the next day. If no pus is then present, repeat the dressing with the turpentine and raw linseed oil mixture, and do not redress for two or more days. During the treatment keep the animal at rest; do not lead him out to water. If you have an enlarged joint, and are uncertain whether or not infection has occurred, apply cold water to reduce the inflammation; keep this up for one or two days and then apply the mercuric iodide blis-

ter around that articulation. If necessary, repeat the blister in 8 to 15 days. Remember great patience and much time and extra care in boiling and disinfecting all the water and the cotton used about this articulation, will be required to effect a cure.

DISEASES PRODUCING LAMENESSES AT THE SHOULDER.

Muscles, nerves, blood vessels, the synovial membrane, and the articulation may be diseased when there is shoulder lameness. The muscles about the shoulder, especially those on the external surface of the shoulder blade may shrink or become smaller in size as a result of non-use, due to injury of the muscle or to lameness in which the limb is not used; this is commonly called "swinney." It must be noted that this is a symptom of disease rather than a disease in itself; it may occur as a secondary result when the primary disease is in the foot. Injury of the muscles of the shoulder may be caused by kicks, strokes, running against objects, or by an ill-fitting collar. Young and soft horses are especially liable to injury of the shoulder by the collar.

Symptoms.—If a muscle or muscles are injured, in a short time thereafter the part becomes swollen, warm, and sensitive. The lameness will vary according to the muscle or muscles injured and the extent of the injury. Usually it is difficult for the animal to throw the shoulder forward or raise the foot from the ground; as a rule, the lameness is greater on soft ground than on the hard road. After the inflammation subsides, the muscles may shrink; this is largely due to the non-use of the muscle.

Treatment.—In the early stages, during the inflammatory period, apply cold water; or if the animal is in great pain, apply hot water, but do not scald the part. In chronic cases, or when the muscle has become shrunk, rub the skin over the shrunk muscles for thirty minutes two or three times a day with a good, stiff horse brush. At the same time give the horse light exercise, using light breast harness or the saddle.

PARALYSIS OF NERVES OF SHOULDER.

The supra-scapular nerve passes over the front border of the scapula, just below its middle part, and

supplies the external scapular muscles. This nerve may be injured by running against objects, by kicks, and possibly by other strokes. If paralysis follows the injury, the muscles will become paralyzed.

Symptoms.—When weight is placed on the limb, the point of the shoulder suddenly flies outward, and to the ordinary observer this appears as if the shoulder was dislocated. Scotch and English veterinarians at one time called it "shoulder slip." It is more common in young horses than old ones, and is often seen in the colt at pasture. In the course of a few weeks the muscles will shrink and another case of the so-called "swinney" is developed.

Treatment.—Rest the animal in a box stall, small pasture or paddock, rub the shoulder well three or

Fig 56.—Represents an outline made from a photograph taken of a case which had the ulna (olecranon) at the point of the elbow broken. Notice how flat it is at the elbow (e) also the flexed position of the knee. This front limb could not support weight. The position of the limb is also characteristic of paralysis of the radial nerve.

four times a day with a good, stiff brush, or apply the following blister over the middle part of the shoulder, from the side of the neck to its back border:

Pulverized Cantharides 4 drams.
Turpentine 1 fluid ounce.
Vaseline 4 ounces

Mix well and rub in well over the middle part of the shoulder as above directed. Tie the animal for 24 hours so that it cannot rub this part with its lips or against any object. In 2 to 4 weeks repeat the blister.

In old cases of several weeks' or months' standing, and especially in old horses, treatment will do little or no good. In fact, many cases cannot be cured when treatment is begun soon after the injury.

PARALYSIS OF THE RADIAL NERVE.

This is a branch of the brachial nerve, and it supplies all the extensor muscles that lie between the back border of the scapula and humerus and terminate at the elbow point on the top part of the ulna; these muscles extend the radius on the humerus and are very powerful. The nerve is injured in some way, but in some instances it is impossible to tell just how it is injured. Sometimes it is injured when the first rib is fractured. At other times it may be injured in casting an animal, possibly the pressure applied upon this nerve when the animal lies for a long time on the side may injure the nerve.

Symptoms.—The animal seems to be unable to fix the elbow and knee to bear weight; often, when the foot is placed on the ground the knee and the elbow quickly pass forward. In some cases the animal may bear weight, and after weight is put on the limb the limb will give way at the knee and elbow. (see fig. 56).

Treatment.—Rest and apply same treatment as for suprascapula nerve paralysis. The place to apply the rubbing or the blister is between the back border of the shoulder and the upper border of the arm. As in the other form of paralysis, this form is many times incurable.

DISEASE OF THE LARGE BLOOD VESSELS AT THE SHOULDER.

In rare instances the brachial artery becomes so diseased that its opening may become partially or entirely closed. Then the lower part of the limb must receive its arterial blood and nutrition by way of the small collateral arteries. The causes of this are very obscure. It may begin as an inflammation of the lining membrane of the artery. It might be a result of an injury, but this seems impossible, because the artery is so deeply situated and well protected.

Symptoms.—When the animal is put to work in the course of a short time this limb gets cold, almost completely immovable, the animal seems to suffer great pain, while the other parts of the body may be covered with sweat. After the animal stands a while this trouble will apparently pass away, but when put to exercise or work it begins as before. As a rule, this condition will be maintained as long as the animal lives. No remedy has been discovered for its cure.

INFLAMMATION OF THE MUSCLE THAT WORKS OVER THE POINT OF THE SHOULDER.

This muscle is called the flexor brachii; it extends from the lower front part of the scapula, down over the point of the shoulder, along the front and lower border of the arm, and terminates or is attached to the upper end of the radius. It may be injured by running against objects, by strokes or kicks, especially at the point where it passes over the shoulder articulation.

Symptoms.—If the lameness is intense, the animal will drag the foot forward on the toe or swing it outward and forward. In some cases, if the animal is forced to move, it will not place any weight on that limb. At rest, the limb is held backward, the foot resting on the toe. At the place of injury there is usually very little swelling. Sometimes it is impossible to observe any distinct change in the part. In fact, one is surprised at the amount of lameness and pain coming from so little apparent injury.

Treatment.—Apply mercuric iodide blister over the point of the shoulder once every three weeks, giving the animal rest. If the muscles in the upper part of the shoulder shrink, rub them as previously directed.

DEEP SEATED ABSCESES NEAR THE POINT OF THE SHOULDER.

These are caused sometimes by an ill-fitting collar, or by bruising the shoulder in hauling over rough roads or ploughing in new land among roots. It is also possible that the lymph glands of the shoulder become infected with pus-forming germs that are carried from some other part of the body.

Symptoms.—At first there may be a small swelling at the lower part of the shoulder. With rest this may nearly disappear, but with the use of the collar again, or with work, it swells up, and in time a hard, deep seated enlargement is formed that will not go away with rest. This is a deep-seated abscess with considerable hard tissue formed around it. As a rule, it does not cause lameness when the collar is not working against it.

Treatment.—It should be opened with a sharp pointed knife, cutting from below upward. After opening, clean out the pus cavities with strong creolin and carbolic acid and fill up the cavity with a piece of bandage saturated with equal parts of linseed oil and turpentine. In one or two days pull out this bandage and put in another. Keep the outside washed up with boiled water and boiled cotton containing carbolic acid or creolin. After this cavity closes up by healing from the bottom and sides, it is best to keep the collar off for two to four months, and when the animal is put to work be careful to have a good pad under the collar; also let the work be light for some time. In some cases this abscess cavity will be surrounded by an immense tumor-like development; it should be removed by an expert.

DISEASES OF THE HIP REGION.

As at the shoulder, the muscles, nerves, blood vessels, and articulation may be involved. At the hip are numerous muscles, and in order to study the lameness attending injury or disease of all of them would require more space than at our disposal. Injuries of these muscles usually, but not always, produce manifest swellings. As a rule, the treatment should be cold water applications in the early stages and later rubbing or blisters.

PARALYSIS OF NERVES.

The nerve that supplies the muscles in the front part of the thigh, the one that supplies the muscles in the back part of the thigh, and another that supplies the muscles from the back part of the gaskin may be paralyzed. The symptoms attending these different forms of paralysis are difficult to describe to a person who does not understand the physiology of the muscles of the region. It may be sufficient here for

us to say that obscure lamenesses in which the animal has lost the power of moving the muscles of the region, and to some extent the sensation of the skin is a result of some form of paralysis. Moreover, in old standing cases the muscles of the thigh may shrink; then what is called "swinney" of the thigh is present. It must be remembered that the muscles of the thigh may shrink from other forms of lameness in the hind limb. In handling and treating these cases confine your treatment to rubbing three or four times a day for one-half hour the entire thigh and gaskin. If medical treatment is desired, secure the services of an expert.

HIP JOINT DISEASE.

The hip joint is deeply seated. It is almost impossible for it to be injured from the surface, yet sometimes it is diseased or inflamed as a result of some obscure cause. It is possible for it to be diseased in rheumatism, big head, or pyaemia in some form.

Symptoms.—There is more or less lameness present when the leg is brought forward. The foot is usually swung outward and forward. In some cases the animal or the leg gives way when the animal is suddenly turned around. In lameness of long standing the muscles shrink around the hip and croup, and occasionally an enlargement about the hip joint can then be seen.

Treatment.—Outward applications are several inches away from the seat of the disease, hence they do little or no good. Some have advised very deep point firing; this should be resorted to only by the expert, since more injury may be done by the ordinary man than good produced.

DISEASE OF THE BLOOD VESSELS.

The arteries that supply the hind limb may also become plugged partially or entirely, producing symptoms just like those produced in the front limb by the plugging up of the brachial artery. If the animal is put to work in a short time, it suffers great pain, sweats over all parts of the body but the hind leg involved, and this leg is colder than usual. With a short rest these symptoms disappear and return again with exercise. There is no treatment for this trouble.

THE HIPPED ANIMAL.

This consists in a fracture of the bone at the haunch or hip point. It is caused by running against the door, gate post, tree or some other hard object. In one case I knew it to be caused by the bite of a stallion.

Symptoms.—The haunch or hip joint on that side is lower and more flat or less pointed than on the opposite side. For some time after it is done the animal is lame. The part may be sensitive or swollen. The piece of bone broken from the large pelvic bone, is pulled downward by the muscles and held there permanently. It cannot be replaced, and sometimes an abscess may form, requiring a surgical operation to remove that piece of bone before recovery can take place. As a rule, in one or two months, the animal recovers except the bone is never replaced and it always shows the hip point knocked down, or the hip point less pointed than its opposite.

DISEASES OF THE STIFLE.

Dislocation of the Patella or knee-cap.—When the patella is dislocated and caught on the upper lip of

Fig. 57.—Shows the characteristic position in which the hind limb is held (most of the time) when a mule has acute inflammation (gonitis) of the stifle joint or joint formed by the femur and tibia or leg bone. This outline drawing was made from a photograph taken of a mule which had the rheumatic form of gonitis. It was killed and the diagnosis confirmed by post mortem examination.

the articular surface on the front part of the lower end of the femur or thigh bone, the leg is locked; no articulation can be flexed until that bone slips into place. In fact, the leg remains stiff and extended backward, resting with the toe on the ground.

Good authorities now believe that the bone is not displaced but that the spasmodic contraction of the muscles locks the limb. They recommend forced exercise as a cure.

Causes.—A loose condition of the ligament that holds the patella or knee-cap and muscles in place permit it to become dislocated. It may occur in loose jointed, rapidly growing colts; it may also occur in draft horses or mules that are overworked. As a rule, it occurs in draft horses after being worked regularly for several days and then rested one or more days. Draft horses subject to this dislocation will have it occur more frequently on Monday mornings or after a day's rest than at any other time.

Treatment.—Place a rope or a hobble around the pastern and pull the foot forward. This forced flexion of the limb will permit the bone to slip into place; then give the animal exercise immediately. Never put what is called a strifle shoe on such an animal. However, that foot may be shod with the shoe that is twice as thick at the toe as at the heel. If the animal is a colt a sharp blister may be applied over the stifle to stimulate the muscles and ligaments in that region. If the patella becomes thus dislocated once it is liable to recur; one dislocation predisposes the animal to another.

OUTWARD DISLOCATION OF THE PAT- TELLA.

In this case the patella slips to the outside, possibly as a result of stretching or breaking of the internal ligament. The patella can be left on the outside. The horse can hardly support weight, because all the articulations are extremely flexed.

Treatment.—No ordinary treatment will give relief in this case. Sometimes surgical treatment by experts produces good results.

Inflammation of the Articulation Between the Lower End of the Femur and the Upper End of the Tibia Gonitis.—This articulation may become injured by a kick or direct stroke, sometimes by overwork

at heavy pulling. In other cases, the foot may be caught and in the struggle to get loose the animal may injure some of the lateral ligaments of this articulation. Trouble at this joint may be associated with rheumatism or big head.

Symptoms.—In some cases, where the lameness is severe, the limb is held flexed and raised upward and outward. In other cases an enlargement may be felt and seen in the front part of the stifle. Sometimes this enlargement is not very distinct, or it is absent. The leg is carried forward slowly and stiffly, the step becomes short, and sometimes the animal trips in the forward movement of the leg. When both right and left joints are diseased, the animal will shift the lameness from one leg to the other, and in severe cases this shifting will occur quite frequently. In some instances the lameness comes and goes something like the lameness of rheumatism, changes depending on the condition of the weather. (See figure 57.)

Treatment.—Some advise firing in lines from above to below on the outside, inside and front, and immediately after firing applying a good, stiff blister. In some cases this is followed by good results.

The farmer might try the following blister:

Mercuric Iodide.....	6 drams,
Pulverized Cantharides	2 drams,
Turpentine	2 fluid ounces,
Vaseline	4 ounces.

Mix thoroughly, apply and rub well over the outside, front, and inside of the articulation; for the first 24 hours the animal must be tied so that he cannot lie down; also apply some lard over the abdomen next to the stifle, or apply a bandage around the abdomen. This is to prevent blister from getting on the abdomen. Repeat the application of this blister in the same manner in three or four weeks. If both limbs are involved, do not treat both limbs at the same time, but apply the blister on the one about a week after applying it on the other. It should be remembered that many of the old standing cases of this trouble cannot be cured.

SHOE BOIL.

This occurs at the point of the elbow, and is caused by the horse lying down on his feet like a cow. The hoof or the shoe injures the tissues at the elbow. At first there is a soft swelling, which in the course of

weeks develops into a fibroid tumor. This tumor will vary in size, according to its age and rapidity of growth. Usually it is about the size of a man's fist, but sometimes it becomes much larger.

Treatment.—In the early stages it is best to try to prevent the animal lying down in that way and continually injuring the part. Some apply a large leath-
ed pad around the pastern; the animal lies down and the weight rests on the pad instead of the foot. Others apply a padded boot for the same purpose. But these methods are troublesome and are often neglected. Others use some short strips one inch thick, 1

1-2 to 2 inches wide, and two to three feet long; these are nailed across the middle front part of the stall; when the horse lies down on his feet these strips hurt his cannons and he rolls over on his side, taking the weight off the feet. It works very well as long as the horse is kept in his own stall. The habit is very difficult to break. The injured part in the beginning will very soon get well if the cause is removed. If a tumor is present it must be removed by the use of the knife. During the time the wound is healing the horse may learn to lie down in the proper way. But some horses produce another tumor in the same old way.

FRACTURES.

The breaking of any bone of the body into two or more parts is a fracture. They are caused by violent contacts and in rare cases by powerful action of muscles. An old animal, one with big head and sometimes animals with other bone diseases become predisposed to fracture of bones because the bones are weaker than normal or healthy bones. Fractures are classified under several heads, but here only a few of the most important will be considered. A simple fracture is one where the bone is broken without an external wound opening down to the bone. A compound fracture is one where there is a wound extending down to the fractured bone. A comminuted fracture is one in which there are a number of small pieces of bone at the place of the fracture. We may have a simple comminuted fracture, as well as a compound comminuted fracture. The fractured bone may be broken squarely across its long axis, or obliquely or lengthwise of the bone. The bone may be broken partly into two parts but usually it is entirely broken into two parts. The fracture may extend into an articulation, then it is called an articular fracture.

Symptoms.—Increased motility of the part is very prominent in places where the bones are not deeply covered by muscles. If the scapula, the humerus, the pelvis, and sometimes the femur are broken it may be difficult to detect it by the motility of the parts. Then we must depend upon the grating or crepitation caused by the moving of the broken pieces in contact with each other; often this grating sound or

motion can be heard and felt. Sometimes the parts are dislocated or displaced, and this will enable one to detect a fracture. In the course of a day the tissues around the fracture will be greatly swollen and it will then be more difficult to determine its presence or absence. Fractures of the ribs may be detected by the soreness of the part, by the absence of thoracic breathing, sometimes by displacement of the parts, and in a few instances a knowledge of the cause of the injury may help. A fracture of the back or one of the spinal vertebrae will usually cause paralysis of the hind limbs. If a horse becomes injured and is so paralyzed that he cannot stand on his hind feet, and there is no other explanation of the trouble, it may be safely regarded as a fracture of one of the bones of the back. However, before killing the animal, it may be best to secure the diagnosis of a veterinarian.

Treatment.—In old horses and horses of little value, it is doubtful whether it pays to treat fractures of the limbs in such animals. Young horses, especially those that are not extra heavy, may in many instances be successfully treated. In treating a fracture it is important to get the horse in a position where excessive movements and use of the fractured limb can be prevented. As a rule, it is best to place a horse with a fractured limb in slings. Slings can be improvised on the average farm at little expense and in a short time. Secure some cotton bagging and fold it over in four or five foot lengths, making at least three layers. Se-

"Skidoo," owned by Miss Ottley, of Atlanta, Ga.

cure four pieces of 1x4 plank about eight inches longer than the cotton bagging is wide. With one of these pieces make one roll on the end of the cotton bagging and nail another piece to this; fix the other end of the three layers of cotton bagging in the same way. Holes may be made in the end of these pieces, into which ropes one or two feet longer than the pieces may be tied. A tripod derrick may be made by tying together the small ends of three pine poles (not less than 6 inches in diameter and about 20 feet long) with a strong rope or chain; a few strong hands can raise this tripod, spreading the legs in a triangular position. Now attach a block and tackle to this tripod. It may be well to place the tripod over the horse or near the horse, so that the horse may be placed under it without much trouble. With the horse under the tripod, pass one end of the cotton bagging under the horse, letting the middle of the bagging fit up around the body. With a strong singletree or a heavy neck yoke attached at its middle to the rope of the block, the end ropes of the bagging sling may each be attached to its respective end of the singletree or neck yoke. Now by putting the rope in the block the horse may be raised and held in a standing position with its feet on the ground. It may be necessary to arrange a sort of a breast strap from one edge of the bagging around in front of the breast to the other; also another rope or strap may be passed from one edge of the bagging around behind the buttock to the other. These ropes or straps will prevent the animal from falling out in front or behind. The horse is now ready to have the fracture set, or the bones put in their natural position, and bandages and splints applied to keep them in that place. It is well to have plenty of clean cotton and a great number of bandages. Bandages can be made by buying 5 to 10 yards of cheap cotton sheeting; this may be rolled up into one solid roll, and with a sharp butcher knife it may be cut into segments 2 to 3 inches long; when cut the bandages will be 2 to 3 inches wide and already rolled. It may be well to have 3 or 4 pounds of plaster of Paris. Also

secure some pieces of paste-board, some thin strips of soft wood, and if possible, some pieces of sole leather. If the fracture is anywhere below the upper third of the forearm, or the upper half of the leg or gaskin, it can be readily held in position by the proper application of splints and bandages. After getting the bones in position, apply a layer of cotton, holding it in place with bandage from the pastern up above the fracture. See that the cotton is smooth and that plenty of bandages are used. Now apply strips of paste board all around the fractured place and confine them there with bandages. In some cases it may be well to wet the bandages and then apply some wet plaster of Paris with the hand. A thin layer of plaster of Paris may be put on all around the fracture and some distance above and below. Now put on more strips of pasteboard or thin strips of wood and apply more bandage. Then apply another layer of plaster of Paris. Over this may be applied more bandage. It is always well to see that the ends of the wood strips and the upper and lower borders of the layers of plaster of Paris are well protected with cotton. If it is a simple fracture, and the dressing does not change its place or get out of position it may remain undisturbed for 4 to 6 weeks, when it may be removed and no other replaced if the bones are united. If the bones are not united, it may be necessary to apply the bandages and other materials so that an opening will be left just over the wound that opens down to the fractured bone. This opening may be enlarged while the dressing is fresh and before the plaster of Paris has set. Sterilized cotton may be inserted around the wound and over the opening to protect and to cleanse the wound. The wound may be dressed and cleanse with boiled water, boiled cotton, and other antiseptic dressings. This may be done once a day or as often as necessary. It should be remembered that compound fractures will require more care and do not recover as readily or as frequently as do simple fractures.

WOUNDS.

An incised wound is a clean cut wound made with a sharp instrument. A lacerated wound is one that is torn and its lips are ragged. A punctured wound

is usually small and deep. It is made by a sharp pointed instrument. A contused or bruised wound made with a blunt object that does not cut but crushes

es. A gun-shot wound is very like a punctured wound, except it is usually deeper. A poisoned wound is one that is made with a poisoned instrument or by the bite of a poisonous animal. Wounds heal by what is called first intention and by granulation. When a wound heals by first intention its lips must be brought as near as possible into the natural position and union takes place without leaving very much, if any scar. When a wound heals by granulation, the granulations fill up the space between the open lips of the wound and form the scar; this scar contracts and is usually very much smaller than the original gaping wound.

Treatment.—In some cases, it may be necessary to stop the bleeding. This is best done by picking up the vessel with sterile forceps, and then tying the end of the vessel with a thread that has been sterilized by boiling it in water. But if this cannot be done, the wound may be packed with cotton or bandage that has been sterilized by boiling it in water with some creolin or carbolic acid. Over the cotton packed in the wound firmly pressing against the bleeding vessels, a bandage may be tied. This dressing may be left until the following day, when it may be removed and another applied if necessary. In some cases pressure above or below the wound will show the location of the blood vessel by stopping the flow of blood; then a piece of cork or a knot in a bandage may be made to press over this spot by the use of a bandage, and thus stop the bleeding. If the wound is not bleeding excessively, it may be dressed with a good antiseptic, being careful to have all the cotton, the bandage and the water completely sterilized by boiling and using in the water some carbolic acid, creolin or bichloride of mercury. Some wounds may be benefited by using stitches to close them. If there is no filth or dirt in the wound, and you are certain that it is clean, do not wash it, especially if you cannot use sterile material in cleaning it. Stitch up without washing. The stitches may be deep or shallow, according to the depth of the wound. Single or separate stitches about 1-2 inch apart may be used; or the whip stitch may be used, which is continuous from one end of the wound to the other. It is well to leave the lowest part of the wound slightly open, so that it may drain. Be sure to boil the thread in water for about one hour before using it to stitch a wound. It is best to use silk thread. Remember that where muscles are cut and pull the wound open.

stitches will not hold with any degree of satisfaction. If a wound becomes infected, discharging pus, it should be thoroughly cleansed with carbolic acid or creolin in boiled and cooled water and packed with stronger creolin and carbolic acid on bandages or in cotton each day, until the pus ceases to form. Then the wound need not be dressed every day. A wound that is not discharging pus should not be washed, because washing removes granulations and retards healing. Punctured wounds that are made with old, dirty instruments, especially if such instruments have soil on them, are liable to lead to tetanus or lockjaw if they are not opened and thoroughly cleaned. This is especially true of nail punctures about the foot. Sometimes deep punctures may be cleansed by inserting a small and long nozzle and washing out the wound with sterile water or with a good antiseptic solution. If in doubt about a punctured wound, inject some tincture of iodine or a solution of potassium iodide down into the bottom of the wound. After an hour or so this may be washed out with sterile water. If no syringe can be secured, saturate a small strip of bandage with the tincture of iodine or some strong carbolic acid or creolin, and with a darning needle or some other long, small instrument, push one end of this saturated bandage strip down to the bottom of the wound and leave it there until the next day. In dressing wounds that cannot be bandaged a protective and antiseptic dust powder is often useful. A good dust powder may be made as follows:

Tannic Acid 2 ounces.
Boracic Acid 2 ounces.
Iodoform 1-2 ounce.

Mix thoroughly and dust over the wound at least once a day, using enough to cover the entire wound surface with a thin layer of the powder.

Another good powder can be made of equal parts of sub-nitrate of bismuth, oxide of zinc, calomel and air-slacked lime. This is applied in the same manner as the other dust powder, and has the advantage in that it does not smell so bad.

The following may be used instead of the dust powder as a protective and antiseptic lotion for wounds:

Zinc Sulphate 2 ounces.
Lead Acetate 2 ounces.

Carbolic Acid 1 fluid ounce.

Boiled Water 1 quart.

Mix and shake well just before using.

SNAKE BITES.

The treatment following the bite of a poisonous snake must be given quickly after the bite. In some cases, depending upon the location, a piece of the tissue may be cut out all around the bite. Some advise applying the mouth and sucking out the poison, spitting it out and rinsing out with water and an antiseptic solution. This mode of treatment has proven very successful in snake bites of man. Sometimes it may be benefited by using stitches to close them. If above the bite; it can only be done when the bite is in the lower part of the limb. Strong caustics, as strong ammonia, nitrate of silver, caustic soda, have been applied, and if used immediately and all parts of the wound are reached by the caustic, the results may be good. Some claim that strong solutions of permanganate of potash, or tincture of iodine may be applied and worked into the wound. Local treatment may not do much good after the poison is absorbed; yet it may be best to apply the local treatment so as to destroy any poison that may remain unabsorbed. The swelling resulting from a snake bite may be treated by local applications of antiseptics once or twice per day. If necessary some stimulants may be given internally to keep up the strength of the animal during the action of the poison.

FISTULOUS WITHERS.

A deep-seated injury of the withers leads to a deep-seated abscess. In some cases the injury may be on the surface and infection extend from this to the deeper parts and result in an abscess. It is possible that pus germs might be transmitted by way of lymph or blood vessels to the deep structures in this region and result in an abscess. Some injuries of the withers may produce a serous cyst, in which there are no infected germs; but when this is opened pus germs may gain admission through the opening. In such cases the liquid that escapes when the swelling is opened is a kind of thick lymph, slightly stained with blood. Sometimes when the cavity is opened pieces of dead tissue and pus or serum escape.

Treatment.—It is essential to establish by opera-

tion free openings to all the cavities and to thoroughly clean out and remove all pus and dead tissue. It may be necessary to make one or more openings on each side of the withers. These openings should be made so that the resulting wound will not gape too much. In the front part of the withers it may be best to cut from below obliquely upward and forward; in the back part cut from below obliquely upward and forward. Never cut across the top of the withers. Using boiled water containing creolin or carbolic acid (1 ounce to the quart of water), and cotton that has been sterilized by boiling in water, thoroughly clean out the cavities. It would be well to have a good clean, hard-rubber, or metal syringe with a capacity of 2 to 6 ounces. This will be useful in forcing liquid to the bottom of the cavities. A pair of curved scissors are useful in cutting away pieces of dead tissue in and around the cavity. Now saturate some bandage with a mixture of equal parts of raw linseed oil and turpentine. Pack the cavities full with this bandage, leaving one end lying in one of the openings, so that it can be readily picked up when it is necessary to remove this packing. In one or two days remove the packing, thoroughly wash up the outer surface with water containing boiled cotton and a little bandaging soda. If pus is coming from the cavities pack again as before, and repeat this dressing every day every other day until pus is not formed in the cavities; then the internal dressing or packing may not be repeated more frequently than once a week. It is important in treating these cases that great care be observed in keeping out all the infection by using materials that have not been thoroughly sterilized by boiling or otherwise. Also regular and constant care and observation are necessary. When the parts have healed keep all pressure of collar or saddle from the withers for several months. During treatment it is not best to work the animal, but if necessary, use a breast harness.

POLL EVIL.

This occurs at the poll and has similar causes, presents similar symptoms and conditions to fistulous withers. The treatment is quite similar, except in opening the cavities at the poll the openings should be made nearly parallel with the top border of the neck. The opening should be made large and to the side, but never across the top. Apply the same treatment as for fistulous withers.

DISEASES OF DIGESTIVE ORGANS.

The Mouth.—In the mouth diseased teeth and inflamed or ulcerated mucous membrane may occur; the tongue may also be wounded or paralyzed. If the teeth are diseased, it may be necessary to extract one or more. This can only be done by some one who has had experience and is equipped with the proper instruments. If the mucous membrane becomes inflamed or ulcerated, we may have small ulcers on the tongue or other parts of the mouth; this may be attended by excessive slobbering and difficulty in eating and swallowing. It may be treated by washing out the mouth with water and then applying a mixture of—

Tannic Acid 1 ounce.
 Carbolic Acid 1 fluid dram.
 Glycerine 4 fluid ounces.
 Water 4 fluid ounces.

After washing out the mouth apply this by means of a cotton swab, or inject a small quantity into the mouth with a small syringe. This can be done two or three times a day. Feed the animal on soft food; cut the hay or fodder and steam it or scald it with hot water to make it soft just before feeding.

If the hard palate is swollen and the animal has lampas, resulting from cutting teeth, hard food, indigestion or sore mouth, remove the cause or treat the disease that is causing this trouble, or wait till the animal gets over cutting teeth. It is not best to cut the hard palate or to burn it for this trouble. Change the feed and wait till the cause disappears and recovery will occur.

If the tongue is cut by rope or by bit or by the teeth, remove the cause and treat the wound with the prescription advised for sore mouth. If the teeth are cutting the tongue, or the upper teeth are cutting the inside of the cheek, they should be clipped and floated or filed down. This can be done by the proper use of a chisel and float that may be secured at instrument houses.

CHOKER.

This is an obstruction in the pharynx or throat or in the oesophagus or gullet. In the horse it is usually caused by the animal eating greedily and bolting dry food, such as oats or peas in the hulls. Sometimes it may be caused by a cob or corn and cob meal. In the cow and pig, choke results from an attempt to swallow old pieces of turnips, potatoes or apples. In a dog it occurs with an attempt to swallow bones, especially fish bones. In some cases the gullet may be dilated and food collect in this dilatation in such a mass that it cannot be passed on into the stomach. In other cases the gullet becomes contracted, and this predisposes the horse to choking.

Symptoms.—The animal makes violent efforts to swallow. If water is given one or two swallows may be started but usually the water comes out through the nostrils, and may be followed by coughing. In some cases you can feel and see the enlargement of the gullet along the left side and upper border of the wind pipe. But if the choke is in that part of the gullet that lies in the thorax it cannot be seen, and, as a rule, the horse dies in a short time. The cause of the death may be due to pressure on the heart, the large blood vessels, or upon nerves. When the choke is in the neck portion of the gullet, or in the throat, the horse may live three or four days and die from systemic infection, originating in the gullet or throat.

Treatment.—Let the animal have free access to good, clean water. The water which he attempts to swallow will soften up the obstructing material and help to remove it. Some advise giving mucilaginous or oily drinks to soften up the material and make the surfaces slippery. Whatever may be used it should not be forced down the animal, except in very small quantity, and then not too frequently. In some cases the long stomach tube, called a probang, may be passed into the mouth and down the oesophagus; when it reaches the obstruction do not push heavily, or you will injure the oesophagus. If light pressure does not start the obstruction to move onward remove the probang. In some cases the mouth of the horse or the

cow may be held open by means of pieces of board or specially constructed iron placed between the teeth to keep the mouth open; the hand may be passed through the mouth and into the throat or pharynx to remove the obstructing object. There is some danger in this, but with care it can be done. Sometimes when the obstruction is in the neck part of the gullet it may be worked loose with the fingers carefully pressing on it from the outside; it is usually best to try to work it back toward the mouth. It is inadvisable to use whip stocks, fork handles, or other like objects to force the obstruction into the stomach; such implements usually injure the parts beyond recovery. Sometimes a piece of smooth wire, about 10 feet long, may be bent in the middle, the two ends being brought together, then twist the wires on each other, leaving a small loop at the middle end. If this wire is very smooth it may be oiled with vaseline or raw linseed oil and passed down to the obstruction and with care in working the wire the obstruction may be dislodged. The wire should not be too large, a No. 10 or 12 wire is about the right size. If the choke is not readily dislodged by a mild use of any of the instruments suggested, stop using them at once, for more harm will be done than good by violent use of any of the instruments. Many cases recover by the use of nothing but plenty of water, and keeping all feed, unless it be fresh gruel, away from the animal for 2 to 4 days.

INDIGESTION AND COLIC IN HORSES.

These terms are used together because these troubles are so frequently associated in actual practice. Indigestion is often the forerunner of colic. It may be acute or chronic. Acute indigestion is often confined to indigestion in the stomach proper, and sometimes it may be intestinal indigestion. It is caused by irregular feeding, improper feed, sudden changes in food, greedy eating, and sometimes an excess of cold water. It may be associated with or a sequel of any systemic disease that weakens the animal.

Symptoms.—The appetite is capricious or absent, the mucous membrane of the mouth may be dry, the breath smell sour, and the tongue coated. The animal's abdomen may become small and tucked up, the feces or manure may be passed frequently, and in

small quantities. Later it may pass into spasmodic or wind colic, as a result of the irritation or fermentation of the undigested food.

Treatment.—In many cases, when the animal first loses its appetite, proper care and proper feeding may result in a recovery in the course of a few days. In other cases it may be necessary to give a drench, consisting of one pound of Epsom salts, and one or two tablespoonfuls of table salt, both of which are dissolved in one pint to one quart of warm water. In giving this as one drench, do not choke or strangle the animal.

CHRONIC INDIGESTION

is accompanied by prolonged changes in the digestive action in the stomach or intestines. Sometimes structural changes may occur in the mucous membrane of the stomach or intestines. It is also caused by improper feeding, greedy eating and feeding decayed, rough and indigestible food. It may be associated with other diseases in which the system is reduced in strength.

Symptoms.—At times the appetite is good and at other times it is bad. Usually the animal is poor and weak, the skin is rough and dry, the tongue is coated, more or less red around the edges, and the mouth is sour and stale. In some cases the animal may have loose bowels; in others, the bowels are more or less constipated.

Treatment.—Give small quantity of the very best of feed, and feed regularly. If the animal is greedy spread the feed over the bottom of a large box, so that it cannot be eaten quickly. Always water the animal before feeding it, and salt the animal at least three times a week. The following prescription may be given:

Pulverized Gentian	4 ounces.
Pulverized Digitalis Leaves ..	2 ounces.
Pulverized Copper Sulphate ...	1 ounce.
Pulverized Sulphur	2 ounces.
Linseed Meal	1 pound.

Mix thoroughly and give one tablespoonful in the ground feed two to three times per day.

SPASMODIC COLIC.

This is usually regarded as a disease of the intestines, and is that form in which no appreciable quantity of gas is formed. But it must be remembered that colic is not always confined to the intestines, nor is there no gas formed when it is not apparent to the observer of the living animal. In actual colic conditions fast and hard lines are not drawn. By many persons any form of abdominal pain is called colic.

Causes—Over eating, especially on rest days, decayed food or other indigestible food may also produce colic. Acute or chronic indigestion may precede an attack of colicky pain. In some cases chilling the surface of the body, as exposure to a cold rain, may produce colic. Bots or grubs rarely, if ever, produce colic. In some cases small worms may produce obstructions in some of the small arteries that supply the intestines with blood. This is said to be a frequent cause of periodic colic; yet it cannot be determined until after the death of the animal. The most common cause is over feeding just before or immediately after severe exercise. A sudden change of food, as from old corn to new corn, may produce indigestion or colic.

Symptoms—The appetite is gone, the animal shows signs of abdominal pain. The signs may be manifest by pawing, lying down and rolling or continual walking, sometimes kicking at the abdomen. As a rule, there will be periods of relief, followed by periods of intense pain. During the exercise and the severe pain the pulse may be increased and the temperature may be slightly raised at that time. But during the interval of relief from pain the pulse and temperature will return to the normal. In some cases, when severe pain is present, the animal will sweat freely. The bad or unfavorable signs consist in a rapid and wiry pulse, cold limbs and ears, and cold sweats, trembling muscles, anxious expression, dilated pupils, dark colored mucous membrane, and in some cases general depression.

Treatment—If the animal is in great pain, relieve the pain by giving 3 to 7 grains of morphine dissolved in a small quantity of water, or give 1-2 to 1 oz. of chloral hydrate dissolved in one pint to one quart of water. These should not be repeated for 10 to 12 hours. If it is known that indigestible or irritating food is causing

the colic, give a purative. One pint of raw linseed oil, or 1 pint of castor oil, or cotton seed oil may be given at one dose, being careful not to choke or strangle the animal. Never drench the horse through the nose. One pound of Epsom salts dissolved in one pint of water may be given instead of one of the oils. Purgatives should not be repeated under 12 to 24 hours. In some cases the drug to relieve pain may be mixed with the purgative. For example:

Chloral Hydrate	1 ounce.
Creolin	2 drams.
Glycerine	4 fluid ounces.
Water	1 pint.

Mix and give as one drench. This should not be repeated under 12 to 24 hours. Some veterinarians prefer to give 1 ounce aloes made into a ball or large pill and administered by oiling it and then pushing it with the fingers as far as possible on the back part of the tongue, thus causing the horse to swallow it. This can only be done after learning by trial or experience. In some cases, where the animal is constipated, it may be well to inject one to four quarts of warm water into the rectum once or twice per day. While the animal is suffering pain it should be kept in a place where it cannot injure itself, or it may be slowly walked around. Never should it be abused by running or excessive motion of any kind. In all cases of colic decide on a single line of treatment and do not give everything that may be recommended. Remember that many cases of colic are killed by overdosing. Wait with patience a sufficient time for medicine to act before repeating doses, or giving another remedy.

FLATULENT OR WIND COLIC.

This involves chiefly the intestines, but like spasmodic colic, its action is not limited to the intestines. Its causes are very much like the causes of indigestion and spasmodic colic, except there are germs or chemical substances coming in contact with the undi-

gested food which produce fermentation and thus eliminate or set free gas.

Symptoms.—The manifestations of pain are quite similar to those of spasmodic colic. In addition to the symptoms of pain, the abdomen becomes enlarged or distended by the excessive gas in the intestines and stomach. The distension is usually larger or more prominent in the right flank than in the left. When the abdomen becomes distended the breathing becomes short and rapid. This is due to the absorption of poisonous gas by the blood and to the pressure of the abdominal organs against the diaphragm. The grave or bad signs are rapid pulse, say 80 to 120 per minute, cold surface of the body, dark colored mucous membranes and cold sweats.

Treatment.—In the early stages the treatment may be the same as for spasmodic colic, except that it is always well to give something to stop fermentation. For this 1-2 ounce of strong creolin may be mixed with one pint to one quart of water, and the whole given as one drench. In some cases 1 quart of warm water in which has been dissolved as much salt as it will take up may be given as a drench. Sometimes the gas will be formed so rapidly that its rapid absorption will in a short time kill the animal, providing relief is not obtained. In such cases it is advisable to use the trocar and canula to let out this gas and relieve the animal. This instrument can be obtained at instrument houses, and should be kept in a clean, sterile condition, at all times ready for use. To use it, clip the hair over the right flank and wash thoroughly with boiled and cooled water, containing creolin or carbolic acid. With a sharp knife cut an opening through the skin about 1-2 inch long; now push the trocar and canula down into the intestines 3 to 5 inches; pull out the trocar and the gas will escape through the canula. If the horse is standing, it is usually best to make the opening through the skin and insert the trocar and canula rather high up on the flank, but if it is lying down it may be made somewhat lower on the flank. In some cases the animal will be inclined to kick. Then a hobble should be placed around the pastern of that limb and the foot held so that the animal cannot kick the person doing the operation. The canula may be kept in place as long as any gas escapes—say for one hour, if necessary. In some cases a small rubber tube and funnel

may be attached to the canula and one pint or more of diluted creolin may be passed into the intestines; this is done to stop the fermentation. Before withdrawing the canula, insert the trocar. This will prevent some of the intestinal contents following out the canula and infecting the wound. If in the course of time the horse becomes badly distended again with gas, the trocar and canula may be used in the same way, but not in the same place. Choose some other spot in the right flank. Remember that this instrument is used in the right flank of horses, and the left flank of cattle and sheep. If a purgative has not already been given, it is well to give one of those recommended for spasmodic colic.

WORMS OR ANIMAL PARASITES THAT LIVE IN THE STOMACH OR INTESTINES.

Numerous small, round worms and large round worms may be found in the intestines and stomach of the horse. These parasites are more frequent in horses and colts at pasture than animals fed continuously in barns or stables. This is probably due to the fact that pastures may become infested by scattering infested manure over the grass. In this manner the animals become more frequently infested than those kept in barns. These parasites cause more or less irritation and disturbance depending upon the number and to some extent upon the mode of life.

Symptoms.—The only positive sign of worms in the alimentary canal is the presence or observation of some of the worms in the manure passed by the animal. It is true that excessive numbers may interfere with digestion and absorption of food, and the animal become emaciated in consequence. Some assert that these parasites may produce an injurious or poisonous product, which is passed in the feces from their bodies and absorbed by the membranes or tissues of the horse. This has never been positively established.

Treatment.—If animals are kept well supplied with salt, they do not, as a rule, suffer from excessive infestation by worm parasites. An animal in good health seems to be able to throw off many parasites but an animal that is weak usually becomes very badly infested. The following prescription may be used to destroy the ordinary round worms found in the intestines and stomach of the horse:

Miss Marion Peel of Atlanta, Ga., on Anna Bain, Nym McCollough's blue ribbon horse.

Pulverized Gentian 4 ounces.
 Pulverized Sulphate of Iron .. 2 ounces.
 Pulverized Copper Sulphate .. 1 ounce.
 Pulverized Sulphur 2 ounces.
 Linseed Meal 1 pound.

Mix thoroughly and give one to two tablespoonfuls in ground feed two times per day, according to size and age, doses for colts should be 1-4 to 1-2 as much as the horse.

BOTS OR GRUBS IN THE STOMACH OF THE HORSE.

This so-called worm represents one of the stages in the life history of an insect, commonly called the bot fly (*Gastrophilus Equi*.) In order to understand its relation to the horse, its complete life history must be known. In the summer, from June to November, bot flies may be found depositing eggs on the hairs about the front part of the body, usually on the forearm, knee and cannon. Each egg is cemented to a hair, and in about 24 hours it may hatch and the young worm-like embryo may crawl on the skin, producing some irritation, causing the horse to lick the part with his tongue. In so doing he may carry away the embryo to the mouth. From the mouth it passes to the stomach, and there it attaches itself by means of the hooks about its mouth to mucous membrane, usually on the left side of the stomach. Here it remains and grows by absorbing food from the stomach's contents, until late winter or early spring, when it lets loose, passes out with the manure and enters the ground. In a short time it takes on the pupa stage of insect life. This stage continues for 30 or 40 days, varying with the temperature; and then it molts or changes and comes out of the ground as an adult bot fly. This fly is about the size of a honey bee, and makes a noise very much like a honey-bee. When the egg is laid and attached to the hair of the horse it does not hurt the horse. But as a rule horses and mules fight and kick at the fly because they must mistake it or think it is a bee that will sting and hurt them. It will be seen from the life history that one stage of its life is spent as a parasite in the horse's stomach, and this is commonly called the bot stage. Usually, the bots attach themselves to the skin-like portion of the mucous membrane of the stomach. In doing this it may make a small hole in the lining

membrane. But this part of the membrane is rather tough and does not secrete gastric juice. As a rule, a few of these bots do little or no damage. An excessive number of them may cause some irritation and might in rare instances be associated with indigestion. Occasionally they collect in such large numbers and attach about the outlet of the stomach at the place where the stomach opens into the small intestine, that they occlude or plug up this opening. Sometimes they may collect in large numbers in the beginning part of the small intestines and there obstruct the passage. If such obstructions remain for any period of time, they might result in the death of the animal, but no one could be positive that such conditions existed before the death of the animal. In some cases of colic the stomach of the horse becomes ruptured, possibly from violent attempts to vomit. The rupture occurs along the bottom or greater curvature of the stomach. Then the contents of the stomach escape into the abdominal cavity, producing death in the course of 12 to 24 hours. When the animal is opened and the ordinary observer sees this hole in the stomach and some of the bots out in the abdominal cavity, and a few of the little holes in the mucous membrane on the left side of the stomach, where bots have been attached, they readily say that bots have eaten through the stomach. This is by no means the case. Previous to the death of the animal bots never eat entirely through the walls of the stomach. The disease commonly called bots is usually some form of colic; in fact, there is no such disease as bots. It is true that bots may take some food from the stomach, and sometimes obstruct the outlet of the stomach or the beginning of the small intestines, but the disease produced by such conditions should be called indigestion, colic, or obstruction in some part of the alimentary canal. Remembering these facts the bots can only be responsible for one death out of 1,000 of the so-called cases of bots. In order to prevent bots from entering the stomach, the eggs must be singed or clipped off and burned every few days from the hairs on the body of the horse. After the bots have entered the stomach and become attached to it no medicine will make them let loose without injuring the stomach. It is true that they will let loose and pass out when that stage in their growth is completed; hence all remedies for removing the bots from the stomach should be avoided. This is especially so if the horse is sick with the colic or indigestion; be-

cause any medicine strong enough to destroy the bots in the stomach would only injure the horse and make it more sick.

DIARRHOEA.

This is sometimes called purging.

Causes.—Changes in food, soft food, indigestible food, over-eating and frozen food. It is sometimes associated with indigestion or colic. Occasionally large draughts of water and sometimes overdoses of purgatives may produce it. Some horses seem to be predisposed to it.

Symptoms.—The bowel discharges are soft, watery and frequent, and this may continue from one to several days. If continued long the animal gets weak and poor.

Treatment.—Correct the faulty feeding and remove all the attending causes. Sometimes starch is given in the drinking water, or the quantity of water allowed the animal for drinking is reduced. Sometimes chalk is given in the drinking water. One-half to one dram of pulverized sulphate of iron may be given in dry ground feed once per day until the diarrhoea stops. Other astringent antiseptics may be used internally, but as a rule it is inadvisable to check the action of the bowels too suddenly. If there is some irritating and fermenting food in the alimentary canal causing the diarrhoea, a small purgative, as 1-2 pint of castor oil, might be given in order to remove this irritating food from the alimentary canal. Then this is followed by the treatment previously suggested. If the animal is weak it should rest during the treatment.

INFLAMMATION OF THE BOWELS.

This is sometimes called enteritis. It is an inflammation of the intestines, most frequently involving the lining membrane of the small intestine. It may, however, involve any part of the large intestine. Sometimes the inflammation may extend to all the other coats of the intestine.

Causes.—It is usually caused by irritating drugs, such as poisons, strong alkalies, acids, and other caustic substances. It is possible that it might result from the action of some germ, but these cases are uncommon. It may attend a strangulated bowel, as an ir-

reducible rupture, and some claim that cases of colic may pass into inflammation of the bowels. This may be true when the bowels become obstructed, telescoped, or twisted, or when too strong and irritating drugs have been used. A few castor beans will cause violent inflammation of the stomach and the bowels; an overdose of croton oil will also produce the same result.

Symptoms.—The pain resembles the pain of colic, but in this case it is continuous. The temperature will rise to 104 or 105 degrees Fah. After a day or so it may go down to about 103 and remain about that place until recovery takes place. The pulse is rapid, small and weak. Respirations are more or less rapid and confined to the thorax. Abdominal breathing is very limited or absent. The animal does not lie down and roll around as in cases of colic. The abdomen is too sore to permit it. Sometimes the animal will stand and rub against the wall or side of the stall. In other cases pain is so severe that it may prefer to walk around rather rapidly or continue to change its position. In some cases diarrhoea may be present. This, however, is not continuous, because the bowels, especially the effected part, become paralyzed; then the ordinary rumbling noise that may be heard in the abdomen of the healthy horse is absent, because the intestines are not moving as they do in health. As a rule, the animal will not lie down for any great length of time, and in some cases it will stand until he dies or recovers.

Treatment.—Keep the animal quiet and relieve the pain by giving 8 to 10 grains of morphine every four hours until the animal is relieved. If the animal desires food let it be well cooked and given soft. Never give irritating hay or rough forage of any kind. Cold water should not be allowed. The chill should be taken from all drinking water before it is given. Do not get alarmed if the bowels do not act for several days. Keep down the tendency to fermentation by giving creolin, 1 dram; glycerine, 1 ounce, and water, 3 ounces, 3 or 4 times per day. Remember that it will require 1 to 3 weeks for the animal to recover. When the animal's appetite begins to return be careful to avoid overfeeding and rough feed. Most cases of inflammation of the bowels die, and many of them are killed by improper treatment and improper feeding.

DISEASES OF THE RESPIRATORY ORGANS.

The respiratory organs consist of the nasal passages, the throat, the larynx, the wind pipe, the bronchial tubes, the air sacs, the lungs and the thorax. The nasal passages in the horse are peculiarly enlarged by their connection with cavities called the frontal sinus, the superior and the inferior maxillary sinuses. The mucous surface of these passages are also enlarged by the scroll shaped bone, called the turbinated bones. It is possible that this enormous surface of mucous membrane connected with the nasal passages is so arranged to warm the air before it enters the lungs. At any rate, this immense surface gives great opportunity for the action of germs or irritants in the air to produce inflammation. Cold or catarrh in the head involves this mucous membrane. It is caused by exposure to cold, irritating gases, germs, and irritating drugs when the horse is drenched through the nose.

Symptoms—At first the mucous membrane of the nose is dry, the animal is dull and sleepy. Its appetite is decreased, it may shiver, and sometimes the temperature rises one or two degrees. Usually the skin is dry and rough, and sometimes the bowels constipated. Later an excessive watery discharge comes from the nose. This may become thicker and opaque or whitish in color; sometimes it may be yellow. In some instances the eyes become inflamed. At first they are red and discharge thin, watery material, which later becomes thicker and pus like. This disease is more common in old horses and mules than in young horses. If the case is acute, it may last a week, but it may become chronic and last several weeks.

Treatment.—When it is first discovered that the animal is cold and chilly, rub the entire body and cover with a good blanket. Keep the animal in a well ventilated stall protected from drafts and rain. Steam the animal two or three times a day in the following manner: fill a bucket 1-3 to 1-2 full with hot water; put one teaspoonful of creolin, carbolic acid, or lysol into

this water; place the bucket in the bottom of a large sack; put into the bucket a red hot iron weighing four or five pounds. Hold the top of the sack under and over the horse's nose for ten to twenty minutes, permitting it to breathe this hot steam. It may be necessary to force the horse to hold its head over this steam at first, but soon it will learn to like it. Be careful that the horse does not become scalded with the hot water. Most cases will recover with no other treatment. Some cases may be associated with some other disease or become chronic. In chronic cases the discharge from the nose may continue for weeks; in fact, some chronic cases never get well. Chronic catarrh should be treated by trying to build up the body of the animal with good food, good care, and light work. Sometimes the following prescription may help:

Pulverized Belladonna Leaves.....	1 ounce
Pulverized Digitalis Leaves	2 ounces
Pulverized Gentian	3 ounces
Pulverized Copper Sulphate	2 ounces
Linseed Meal	1 pound

Mix well and give in ground feed three times a day, 1 to 2 tablespoonfuls. Remember that chronic cases of catarrh may be in fact cases of glanders, and it is safest and best to have an expert veterinarian make repeated examinations of such an animal.

DISTEMPER OR STRANGLES.

This is an infectious disease, involving primarily the mucous membrane of the nose, and secondarily, it may involve the subcutaneous connective tissue in the space between the branches of the lower jaw. Sometimes it may involve the lymph glands about the throat and extend to the various parts of the body, producing a form of pyaemia.

Causes.—The exciting cause is a germ called streptococcus equi. The attending causes are exposures

cold and possibly irritating gases and drugs.

Symptoms.—In the early stages it appears like cold of the head or catarrh. The animal is dull, sluggish, sometimes chilly, and again feverish. At first the mucous membrane is red and dry; later an excessive watery discharge, followed by a heavy pus-like discharge. Usually a swelling appears between the borders of the lower jaw and in the course of a week an abscess forms at this place, which usually erupts on the surface and discharges pus. Sometimes an abscess may form about the throat, and occasionally one or more abscesses may form in different parts of the body. Sometimes abscesses may occur in internal organs. This disease was at one time called strangles, because large abscesses forming about the throat will often choke or suffocate the animal. It occurs more frequently in colts and young horses than in old horses. Some claim that one attack produces an immunity which prevents a second attack.

Treatment.—Steam the animal as directed for catarrh and repeat this three times per day. Feed soft food and give good care. When a soft fluctuating place is found in the swelling between the borders of the lower jaw, it may be opened and washed out with boiled water, containing lysol, carbolic acid, or creolin. This cavity should be cleaned out daily until it heals from the bottom. If an abscess forms about the throat, be careful in opening it, lest you cut some large blood vessels. In opening an abscess at the throat, be careful to cut just through the skin with the knife. Then with your index finger work it into the abscess. After opening it wash it out as previously directed. Where pyemia occurs, the surface abscesses may be opened and treated as directed, but usually such cases terminate fatally. Remember that this disease is contagious, and will extend from one animal to another, especially among colts, until all have contracted the disease. In many cases this can be prevented by isolating or separating the first cases from all other animals.

BRONCHITIS.

This involves the bronchi and sometimes the windpipe and may be associated with distemper, catarrh of the head, or pneumonia. Usually it involves only the lining membrane of these air passages, and is a form of catarrh inflammation.

Causes.—Undue exposure to cold, germs, irritating gases and irritating drugs administered in such a way that the horse strangles when being drenched and much of the medicine passes down the air passages into the trachea and bronchial tube. Occasionally some irritating food may accidentally pass down through the larynx into the wind-pipe and bronchial tube and produce inflammation.

Symptoms.—In the beginning the animal may have a chill, subsequently develop fever or a high temperature, throat may be sore and a cough may be present. At first the cough is dry and later it becomes moist. The pulse is soft and weak, but quick. The respirations are more or less rapid and labored. In some cases the temperature may be quite high, 105 or 106 degrees Fah., in the early stages. Sometimes the appetite is lessened, the animal is thirsty, the mucous membranes are congested and redder than usual, the bowels may be constipated, and the urine smaller in quantity than usual. In the course of a few days a profuse discharge of a mucous-like nature may pass from the nostrils and there may be a sort of a moist, rattling breathing in the throat and bronchial tubes.

Treatment.—In the early stages, when the animal is chilled, rub the body until warm and apply a warm blanket. Steam the horse as recommended in catarrh of the head. If the animal is weak give one dram of carbonate of ammonia in 2 or 3 ounces of water once every 3 or 4 hours. Other stimulants may be used instead of this, such as alcohol in 1 to 2 ounce doses, or turpentine 1-2 ounce, mixed with 1 or 2 ounces of raw linseed oil. As a rule, stimulants are not necessary in the early stages. Sometimes, when the kidneys are inactive in the early stages, 1-2 ounce doses of potassium nitrate may be given in the drinking water night and morning. This should not be continued after the high fever passes off. The animal should have soft food, in order that the bowels may be kept open and prevent constipation. Sometimes, when the bowels are constipated, it is well to give 1-2 pint of warm castor oil once a day or as often as found necessary to keep the bowels open. Good care, good nursing, and careful feeding are big factors in treating this disease. Remember that a clean stall, plenty of fresh air, without drafts, are very essential.

PNEUMONIA OR LUNG FEVER.

This disease may involve the air sacs, the small

bronchial tubes, and sometimes the larger bronchial tube, and all other air passages, as well as the other tissues in the lung. It usually involves the right lung, but may involve both lungs at the same time. The inflammation usually begins in the lower parts of the lung.

Causes.—It is now generally believed that lung fever is a germ disease. At least, it is conceded that certain germs are always present in the lungs in pneumonia. It is true that exposure to cold and anything that will reduce the vitality or vigor will predispose the animal to lung fever. Many of the causes that produce bronchitis, such as irritating gases, foul air, foreign bodies, and particles of food and irritating gases and drugs may cause pneumonia. It may also be associated with bronchitis and other respiratory diseases.

Symptoms.—Usually it is ushered in with a chill, but in many cases the chill is passed before the disease is observed. The temperature may be high, extending as high as 105 or 106 degrees Fah. In the course of 2 or 3 days the temperature may come down to 103 or 104. The pulse is usually full and bounding at first, but later it may become softer and less frequent. The normal pulse, varying from 36 to 44 per minute, may rise to 50 or 60, or even higher in the early stages. At first, the respirations are accelerated, and sometimes the nostrils dilate so much at each inspiration, that it appears as if the horse was grasping for air. The visible mucous membrane are usually red and congested in the early stages. Later they may become lighter or less red in color. The appetite is almost lost, the thirst is great, and nearly all secretions and excretions are diminished. The urine is small in quantity and thick; the bowels are constipated; and the skin is dry and rough. There may be a short, shallow and dry cough, which later becomes moist. In severe cases the mucous membrane lining the eyelids becomes mahogany colored in spots, and between these spots it is yellow. The crisis is usually reached about the eighth day. At this time, if the animal is getting better, the temperature may fall quite rapidly. In some cases it may fall at this time when the animal is dying, but generally, when the animal is getting worse at this period, the temperature does not fall. In some cases the fever gradually comes down. A reduction of temperature is usually attended with beginning recovery, the animal's appetite gets better,

the bowels, the kidneys, and the skin act better and every organ seems to be recovering its normal activity. In some cases a discharge more or less severe may occur from the nose after the third or fourth day and continue for several days, or until recovery takes place. In examining the lungs by listening to the lower rib region, just behind the arm, one may hear various sounds at different stages in the disease. In the early stage, by placing the ear in contact with the lower rib region, a sound may be heard that resembles the rubbing of hair between the fingers, or the crackling of salt when it is thrown on live coals. For the next three or four days, until the crisis is reached, the inflamed part of the lung is solidified and no air enters it; during this time the respiratory murmur cannot be heard in that part of the lung. But immediately after the crisis, when recovery begins, a moist crepitating sound may be heard along the line between the healthy and solidified part of the lung. This last stage of lung fever is often called the resolution stage, because the solidified parts are being changed into liquid or semi-liquid material and carried out. The moist crepitating sound is made by the air passing through some of the liquid, or semi-liquid formed in this process. As a rule, the horse persistently stands in pneumonia until recovery begins, because it cannot breathe easily while lying down.

Treatment.—It should be remembered that pneumonia usually runs its course, and it is rare that it can be cut short by treatment. As a rule, in the hands of the ordinary man, good care, good nursing, a clean stall, and plenty of fresh air are the best means applied in curing a case of pneumonia. Much of the time of the attendant can well be spent in rubbing the horse's body and limbs, keeping the limbs warm and skin active. When not rubbing it may be well to apply woolen flannel bandages from the feet up to the body, and a good warm blanket over the body. In the early stages, when the animal is thirsty, let it have cold water, but not too much at one time. As a rule, it is best to give soft feed to keep the bowels open, but if the animal will not eat soft food, let it have good, dry feed in small quantities. In the early stage, when the temperature is high and excretory organs are inactive, give 1-2 pint of warm castor oil once per day and also give in the drinking water at night and morning 1-2 ounce of nitrate of potassium. This may be kept up for two or three days, then it may be necessary, if the animal is weak, especially

ally if the heart is weak, to use some stimulant. One-half ounce of turpentine or spirits of camphor may be given 3 or 4 times a day in 2 or 3 ounces of warm castor oil or warm raw linseed oil. Or one to two drams of carbonate of ammonia may be given in two or three ounces of water three or four times per day. In some cases, where the weakness of the animal is quite marked, it may be necessary to keep up the animal's strength by giving a mixture of milk, well-beaten eggs and whiskey. This may be repeated as often as the indications require. But if whiskey produces a high temperature, an excessively rapid heart or a dry and rough skin, it should not be used. Remember that there are no fixed rules for treating lung fever. It will run its course, and if the animal can be made to hold out by good nursing and good care, it may recover.

PLEURISY.

The membrane that lines the thorax and covers the outer surface of the lung is called the pleura. It forms a closed sac which secretes a water-like liquid that lubricates the inner surfaces of this sac and prevents friction. Pleurisy may be associated with pneumonia.

Causes.—It occurs more frequently in young than old horses. It may result from injuries to the thorax, caused by strokes, kicks, or penetrating wounds. In some cases it may be associated with influenza, or colic, or lung fever. Prolonged exposure to cold, especially following the time of clipping. As a rule, worms are present and probably are exciting factors in the cause.

Symptoms.—It may occur on one or both sides. In the early stages the animal may suffer pain and act very much like a horse with the colic. It may begin with a chill, the animal becoming dull, the hair rough and skin dry, the limbs and ears cold; these conditions are followed with a high fever. The pulse is small, quick and hard, and rapid in the early stages. Later it may become softer and weaker. The temperature in the early stages will range from 104 to 106 degrees Fah. But after effusion of liquid into the pleural sac it may drop to 101 or 103 degrees Fah. At the same time the respirations are short and abdominal. There may be an abrupt stop in the inspiration. This is relieved by the rubbing of the dry pleural surfaces over

each other in the early stages. Sometimes there is a double expiratory movement after the effusion. In many cases the animal grunts and may move as if he was foundered or had rheumatism in the muscles of the shoulder and breast. This is very prominent in the early stages. After the effusion it may disappear. Nearly all cases of pleurisy may be divided into three stages. In the first stage there may be a high fever, quick and hard pulse, and great pain. In the second stage an excess of liquid is thrown out into the pleural sacs, the fever drops, the pulse becomes softer, the pain is less severe, and sometimes the double expiratory movement is shown by the double inward dropping of the flanks. In the third stage the liquid becomes absorbed, the breathing less difficult, and the animal improves in strength and condition. If we place the ear to the side of the thorax, in the first stage, a rubbing, friction sound may be heard; this is caused by the rubbing of the dry and inflamed pleural surfaces over each other. In the second stage or effusion period, respiratory murmur cannot be heard in the lower part where the liquid is found. Sometimes there is a tinkling or a water dropping sound that is produced by the movements of the excessive liquid in the pleural sacs. In the third stage this water dropping sound grows less, and the friction sound may return and finally it disappears. The first stage may last one or two days; the second stage three to eight days or longer; the third stage until the animal recovers.

Treatment.—In the early stages many advise mustard or other forms of blister to the sides of the thorax. But this is not now recommended by the best authorities. Sometimes, in the early painful stage it may be necessary to give one or two doses of morphine, but this should be avoided if possible. After the effusion is formed, it may be gotten rid of by the use of purgatives and stimulants to the kidneys. In giving purgatives, such as oils, epsom salts, or aloes, remember that large doses may lead to excessive purgation or laminitis; hence, give small doses about 2 times per day rather than one large dose. To stimulate the kidneys give one-half ounce of potassium nitrate dissolved in the drinking water night and morning; this drug may depress the heart and must be discontinued if the heart becomes weak. Sometimes it may be followed by giving one to two ounces of tincture of digitalis three to four times per day; this drug will increase the force of the heart and stimulate the kidneys. If the appetite becomes poor,

and it does in many cases, it may be stimulated by the use of 10 to 20 grains of quinine two to three times per day. If at any time the animal becomes extremely weak 1 to 4 ounces of whiskey in milk and well-beaten eggs may be given; but it must be discontinued if it produces a high temperature and a rough, dry skin. Do not forget to rub the entire body frequently and keep it from becoming chilled. Keep the stall clean, protect the horse from drafts, but give it plenty of good, fresh air. In some cases the pleural sac will fill up so completely that the pressure of the liquid on the lungs produces suffocation. Sometimes this may be prevented by the use of a trocar and canula, which is inserted between the eighth and ninth ribs, about the upper part of the lower third of that surface. This is usually done on the right side. After inserting the trocar and canula one or two inches, pull out the trocar and allow the liquid to escape. Remember that it is best to thoroughly cleanse and disinfect this region before inserting the trocar and canula.

THE "BELLOWSED" HORSE, OR HEAVES.

This is a disease involving the lungs, the nerve supply of the lung, and possibly of the stomach and the muscles of respiration. It resembles asthma in man. In old standing cases the air sacs in the lungs become enlarged; also there may be spasmodic contraction of the small muscles around the smaller bronchial tubes.

Causes.—The real and exciting cause is unknown. Some assert that dusty hay is the most prominent cause; others claim that overwork of the lungs, especially violent and prolonged, fast driving in hot weather. Still others believe that dilatation of the stomach from over-eating of forage, especially hay, will produce it; this habit of over-eating must be continued for some time in order to produce the disease. Many believe a tendency to this disease is inherited. It is suggested that violent attacks of coughing may rupture and enlarge the air sacs. In many cases it is a sequel of pneumonia, pleurisy, or distemper, and at other times it is found associated with glanders.

Symptoms.—In the early stages the animal may have an attack of rapid, short breathing. This will occur usually when the weather is warm and sultry. It may pass off in the course of a few days, especially

if the weather becomes cool. But when the weather becomes warm and sultry again another attack of rapid and short breathing may appear without any apparent cause and may last for one or more days. In the course of a few weeks, or two or three months, this rapid breathing and shortness of breath will occur every time the animal is given a little rapid exercise. In due time there will appear the double expiratory action, which may be observed at the movable part of the flanks. In order to make this abnormal breathing more prominent, give the animal a good, large feed, and then give it rapid exercise. This treatment will bring out the difficult breathing so characteristic of the bellowsed horse. The "bellowsed" horse is usually a greedy eater and always has a bad cough.

Treatment.—When the disease is once well established it cannot be cured. When the first attack of rapid breathing appears give 1-2 ounce of nitrate of potassium in the drinking water night and morning. Reduce the quantity of hay and grain, always sprinkle the feed with water before it is given, in order to lay the dust. If care is taken in working and feeding a horse that has had only one or two attacks of rapid and short breathing, it may be kept from the third attack for some time, and possibly all the time. But when sultry and warm weather appears look out for another attack. In old standing cases feed grain frequently in small quantities and reduce the size of the abdomen by feeding small quantities of hay or forage. Also never allow the animal to drink large quantities of water. Always lay the dust in the grain and the hay by sprinkling before feeding. Carefully and continually observing these precautions will enable one to get considerable work out of a "bellowsed" horse. If the cough is very bad, put 1 ounce of fluid extract of belladonna into 1 pint of boiled water and give the animal 1 tablespoonful in ground feed night and morning. This will help the cough and may relieve temporarily the difficult breathing.

SPASM OF THE DIAPHRAGM.

This corresponds to hiccoughs in man and is sometimes called "thumps" in animals. It is produced by some nervous irritation occurring in the stomach or other organ, and this nervous impulse is reflexly transmitted to the diaphragm, producing a spasmodic

Hilda and Hildagarde, property of J. K. Ottley; have won many blue ribbons in Southern shows.

contraction. Usually it is due to overloading the stomach with food or cold water. Sometimes it is a sign of indigestion. In other cases it may be a result of inflammation in the stomach, or some other abdominal organ. It is not very common in horses, but is quite frequently found in suckling pigs that do not have much exercise and obtain a good supply of milk.

Symptoms.—It is characterized by an intermittent

and sudden contraction of the diaphragm, and a convulsive movement of the whole body, producing a thumping sound that may be heard some distance.

Treatment.—In young pigs get them out and let them have plenty of exercise in pasture and the trouble will disappear. In horses give 1-2 to 1 dram of fluid extract of belladonna in the drinking water night and morning. If necessary, put the drug in a small quantity of water and drench the horse with it.

DISEASES OF THE URINARY ORGANS.

INFLAMMATION OF THE KIDNEYS.

This involves the kidneys, the blood vessels, the secreting cells, and the connective tissue frame-work may all be involved.

Causes.—It may be a primary or a secondary disease. If secondary it is a result of a disease in some other organ. Prolonged exposure to cold and wet weather, large doses of turpentine, carbolic acid, potash, phosphates, or cantharides may produce inflammation of the kidneys. The kidneys may be inflamed in fevers caused by special germs. In some cases they are inflamed in pneumonia, peritonitis and other inflammatory diseases.

Symptoms.—Inflammation of the kidneys as a primary disease is very rare. So many observers of a horse with the colic assert that the kidneys are diseased, because the horse frequently passes urine or strains to pass urine. These frequent attempts to urinate in colic attacks are due to reflex stimulation of the kidneys and bladder, and not to inflammation of the kidneys. If the inflammation of the kidneys is due to exposure in cold and wet weather, a sudden chill, followed by a slight fever may appear. The urine is diminished in quantity, highly colored, may contain blood and albumen. If some of this urine is collected in a small glass vessel and allowed to stand, it will show a heavy deposit at the bottom, which consists of blood corpuscles, secreting cells, and albumen. The pulse may be hard and rapid and the skin dry. Some assert that the animal is sensitive to pressure over

the loins. This, however, is not constant or reliable, because some horses are abnormally sensitive in this region when in health. If the inflammation is caused by over doses of the drugs mentioned, the fact that such drugs have been given will help in the diagnosis.

Treatment.—Give the animal rest, stimulate the skin by rubbing, allow the animal plenty of water to drink, and give a purgative. If associated with another disease, the other disease must be treated before the kidneys can be relieved. Some advise the application of blisters to the loins. It is doubtful if such treatment is of much value. It would be better to apply hot cloths to the loins, or hot water, than to apply blisters. A woolen cloth may be dipped in hot water and the excess of water wrung out with the hands, and then it may be placed over the loins. Over this place a piece of oil cloth, and then another dry blanket. When the wet woolen cloth becomes cool, wring it out again in the hot water and replace it. Keep this up for several hours. When it is removed permanently rub the skin till dry and then cover with a blanket.

IRRITABLE CONDITIONS OF THE BLADDER.

In some cases drugs that are given in regular doses are eliminated in the urine, irritating the kidneys and the bladder. In other cases some of the solids of the urine may become deposited, first, in small quantity, and this small beginning may grow in size by repeated or continual deposits until what is commonly known as a stone in the bladder.

in the kidneys, the ureters, or in the bladder are composed of uric acid, which is deposited in acid urine, but kept in solution in alkaline urine. The small stone may begin in the kidney or the ureter and pass down into the bladder, and there become in time a large stone by additions to its surface. In some cases there are numerous small, hard particles that appear like sand. A large rough stone may irritate the bladder or it may get down at the outlet of the bladder and obstruct the free flow of urine.

Symptoms.—Ordinary irritation of the bladder is indicated by frequent attempts to urinate, and sometimes by colicky pains. If a stone obstructs the flow of the urine, the urine may come away very slowly or in drops. In such cases the animal suffers considerable pain. In order to determine the presence or absence of the stone when such symptoms are presented, roll up the sleeves, cover the hand and arm with oil, and insert the hand into the rectum; now feel through the floor of the rectum for the bladder and its neck; if a stone is present you can feel it, and sometimes work it back into the body of the bladder and thus allow the urine to escape. In order to remove a stone

from the bladder it will require an expert to perform the operation. If the trouble is in a mare the hand must be inserted into the vulva and vagina in order to feel for the stone in the bladder of the mare. In order to relieve ordinary cases of slight irritation of the bladder, place 1 ounce of fluid extract of belladonna into 1 quart of water and give 1 tablespoonful in ground feed night and morning.

Some mules and horses may make a strong attempt to urinate, or be unable to urinate until after several attempts are made. This may be due to a stone in the bladder or spasms of the neck of the bladder. These spasms may be caused by exhaustion from overwork or by the animal being forced to go too long without permitting it to stop and pass the urine. Some horses and mules persistently refuse to urinate except in the bedded stall or some other accustomed place. This will cause the holding of the urine an undue time and may result in spasm of the neck of the bladder. In treating this trouble it is not good to give nitre, rosin, or any other drug that will stimulate the kidneys. Always remove the cause, if possible. Sometimes the belladonna solution recommended for irritable bladder may give relief.

INFECTIOUS AND CONTAGIOUS DISEASES

GLANDERS.

This disease is caused by a specific germ called *bacillus mallei*. Sometimes this disease involves chiefly the mucous membrane of the nose and then it may be designated nasal glanders. At other times it may involve the skin, and then it is termed skin glanders or farcy glanders. In other cases it may involve principally the lungs, and then it is designated pulmonary glanders. But it must be remembered that the same specific germ is found in all the different forms of glanders, and that in some cases all the forms of the disease may be found in one horse or mule. Moreover, other organs may be attacked by this disease besides the ones already mentioned.

Symptoms.—If the nasal mucous membrane is involved, it may first become inflamed and appear somewhat like an ordinary case of beginning cold in the head or strangles, but sooner or later small, pimple-

like nodules will appear, which in a short time become soft and yellowish, and finally break open and discharge an oily liquid which resembles raw linseed oil. The eruption of these nodules usually produce raw, deep, ragged-edged ulcers, which get larger and larger as successive crops of these nodules form and erupt. Sometimes these ulcers heal, and then they form irregularly shaped scars. The discharge from the nose is at first thin and watery; later it becomes yellowish, thick and sticky. As a rule, the discharge does not smell bad in glanders, especially in the early stages. Sometimes the ulcers in the nose and the discharge are only on one side. The lymph gland, which is found on the inside and back part of the branch of the lower jaw, up near the base of the tongue, becomes enlarged as a result of its receiving some of the infectious material that comes from a glandorous ulcer on that side. If both sides of the nose are involved, the glands on each side will be enlarged. These glands never form

abscesses and break open as in cases of strangles or distemper. The discharge from the nose may be smeared over the leg or the skin of other parts of the body by the horse wiping its nose, as it were. In some instances the skin becomes infected in these places. In the early stages the breathing through the diseased nasal passages may be normal, but when the mucous membrane becomes swollen and extensively ulcerated, the discharge and swelling may interfere with the passage of air. If the skin is involved nodules will develop in the skin, usually along the course of the blood vessels and lymph vessels. These nodules are most frequently found along the inside of the thigh, along the sides of the neck, and in the lower part of the hind limb. But they may occur in any region where infection occurs. The nodules usually break open and discharge an oily liquid that resembles raw linseed oil. From the original seat of the infection in the skin or blood vessels the disease may extend along the lymph or blood vessels. Sometimes large, deep ulcers result, the skin becomes swollen, and infection may extend rapidly in all directions. Sometimes the first crop of ulcers may heal and no others appear, or other ulcers may appear in this same region and the part become irritated or conditions favorable. In some cases the lower part of the hind leg may be enlarged and the characteristic ulcers and nodules of glanders appear. Successive outbreaks of nodules and ulcers may develop in this region and no other part of the body become involved, for several months or years. If the lungs become involved, acute cases may resemble pneumonia. In chronic cases the symptoms may resemble those found in a "bellowsed" horse.

Treatment—It is not advisable for the ordinary man to attempt to treat a case of glanders, because man can contract this disease. Moreover, the ordinary man is unable to know when a case of glanders is so completely cured that it cannot transmit the infection to another animal or to man; hence it is best that all horses and mules that are positively known to have glanders should be destroyed and their carcasses burned or buried 4 to 6 feet under the surface of the ground.

This disease is transmitted from one horse or mule to another by infected hitching post, public watering troughs, infected harness, infected stalls and not infrequently by one animal licking the glanderous ulcers of another; hence it is best to thoroughly disinfect all buckets, harness, watering troughs, and stalls that

have been infected by cases of glanders. Old and worthless infected materials may be burned; stalls can be disinfected by cleaning them out and applying whitewash made of 5 lbs. of lime, 3 lbs. of bluestone, dissolved in 4 gallons of water. It is best to apply this hot and completely cover all the manger, walls, and ceiling. It may be well also to spray these parts with a hot 5 per cent. solution of creolin or carbolic acid. For safety, keep all animals out of that stall for one or two months. When animals are suspected of having glanders they should be isolated or quarantined until a positive diagnosis can be made. To do this a small pen or shed may be made in some place, some distance from, and inaccessible to, all other animals. Remember that cats, dogs, horses, mules and man are susceptible to glanders; but cattle, sheep, goats and hogs are insusceptible.

In most of the States there are specific laws which prevent the use of horses or mules having glanders on public highway or in any way that would expose other people's horses or mules to infection. Some States require animals with glanders to be quarantined, and hold the owners responsible for the infection of other people's stock that may result from the non-observance of the quarantine law. Other States require the destruction of all mules and horses having the glanders. Horses and mules that have been exposed to glanders should be kept and worked by themselves or separately for one or two months.

INFLUENZA.

This is a highly infectious disease, the specific cause of which has not been positively discovered. Some investigators claim to have found a specific germ, but the positive proof that this or that germ causes influenza in horses has not been established. Influenza is sometimes called pink-eye, horse disease, contagious epizootic, typhoid fever in the horse, catarrhal fever, and sometimes LaGrippe in the horse. This disease may involve a great number of organs. The organs of respiration, of digestion, of the nervous system, of vision, and of circulation may be involved; also the skin and the urinary organs may be involved.

Causes.—The specific cause is very probably one or more germs. The predisposing causes are numerous. It attacks young animals and weak animals usually more severely than old animals or strong and vigorous animals. It is said to attack the horse, the don-

key, the mule, the dog, as well as man. The cause seems to travel in the air, especially during certain years or seasons. The disease will appear in one to seven days after the animal has been exposed. One attack is said to protect an animal from a second attack; in other words, one attack produces immunity in horses.

Symptoms.—Depending upon the chief parts involved, the disease is said to be catarrhal, pulmonary, abdominal, nervous, or the rheumatic form. The catarrhal form resembles cold in the head, except the depression of the animal is much more severe. The pulmonary form is somewhat like pneumonia, but it is usually more prolonged and more frequently fatal. The abdominal form involves the abdominal organs, the stomach, intestines, the liver, and spleen. In this form the liver may become congested and the visible mucous membranes become yellow in color; at first there is constipation, followed by diarrhoea, the breath is sour, and sometimes colic pain is present. In the nervous form the spinal cord may become involved, there will be loss of power in the hind limbs, or paralysis, and sometimes there is paralysis of all the limbs. In the rheumatic form the lamenesses of the limbs will resemble rheumatism, articulations may become inflamed, and inflammation of the synovial sacs are not uncommon. It might be well to mention that in the catarrhal form the legs may swell. Great prostration occurs, and the temperature rises for a time to 104 or 106 degrees Fah.; it may remain high for six or seven days. Sometimes the catarrhal and pulmonary form of this disease may occur in the same animal; also other forms may be combined in one animal. This disease is often called pink-eye, because the eyes become congested, especially in the catarrhal form. The simple catarrhal form may recover in 1 to 2 weeks. In complicated cases the disease may last three or four weeks.

Treatment.—The treatment in the catarrhal form may be the same as recommended in cold in the head. When the fever is low stimulants may be required, such as carbonate of ammonia 1 to 2 drams in 1 to 2 ounces of water, of turpentine 1-2 ounce in 2 or 3 ounces of castor or raw linseed oil; these may be repeated three or four times per day. If symptoms of paralysis are not present, and the animal is weak, whiskey, eggs and milk may be given. If the fever is

high, it may be reduced by giving 20 to 30 grains of quinine three or four times per day. Keep the bowels open by giving 1-2 pint of warm castor oil or raw linseed oil once per day. If the legs swell and the heart is strong, give 1-2 ounce of potassium nitrate in the drinking water night and morning. Always keep the legs and body well rubbed with brush and cloths to keep the skin active and the surface of the body warm. If the eyes are inflamed, bathe them frequently with water that has been boiled and cooled.

RABIES IN THE HORSE.

This specific disease has been known as long as almost any other in medical literature; yet its cause has never been discovered. It is an infectious disease occurring in the dog, the cat, the wolf, and the fox and may be transmitted to man and many other animals by inoculation. The inoculation usually results from the bite of a rabid animal. In many cases, from the time of the bite to the time when the disease appears will vary very greatly in the different kinds of animals. In the horse it is said to vary from 2 to 8 weeks; in the dog, 1 to 6 months; in the ox, from 2 to 4 weeks; in the sheep, 3 to 6 weeks; in swine, 3 to 6 weeks, and in man, 2 to 9 weeks. Remember that these periods of incubation are not regular and constant. Some claim much wider limits, and as long as the cause remains undiscovered the exact period of incubation will remain indefinite.

Symptoms.—In most cases the nervous and excitable form of the disease appears in horses. The animal kicks and bites at its stall or at all objects within reach, often severely injuring itself. Sometimes it runs until exhausted, or until it becomes paralyzed. Usually the least excitement or irritation brings on convulsions. When the disease is well developed, the animal is so paralyzed that it cannot swallow, and all attempts at swallowing may bring on convulsions. Sometimes the animal will bite and tear its own body. The animal will die in six or seven days after the beginning of the attack. In some cases the stage of excitement is very short or absent entirely. This is sometimes called dumb rabies.

Treatment.—Ordinarily little can be done to check the progress of the disease when once established, but often it can be prevented if the wound is prompt-

ly treated immediately after the animal has been bitten. Apply any good strong antiseptic to the wound, being careful to get the antiseptic into the bottom of the wound. If possible, cut out the tissue around the wound. A strong antiseptic may be applied 2 or 3 times during the first 24 hours after the bite. In some localities it may be possible to secure what is called the Pasteur treatment, but this is usually too expensive to be secured for the average horse. The horse that has been bitten should be watched closely for one to two months, and when any beginning symptoms appear the animal should be placed in a good strong lot or box stall where it cannot injure other animals or people.

CEREBRO-SPINAL MENINGITIS.

It is a specific infectious disease characterized by an inflammation of the membranes covering the spinal cord and sometimes those covering the brain.

Causes.—It is caused by a germ. It is possible that damp, ill ventilated stables may predispose an animal to the disease. But the disease cannot exist without the germ that produces it. Overwork, excessive heat and other depressing causes may also predispose an animal to the disease.

Symptoms.—In many cases the attack will come on suddenly and in a short time, 6 to 12 hours, the horse may be down or dead. Other horses in the barn may refuse the food, be unable to swallow on account of paralysis of the throat, and in a few hours the paralysis may extend to the posterior parts of the body. The animal can stand only with difficulty, and when moved drags along, the feet on the toes. In some outbreaks as many as eight or ten horses may die in a few days in one barn. As a rule, the disease may attack a number of horses in a community and sometimes extend over a more or less wide territory.

Treatment.—Most cases are fatal in spite of all forms of treatment. Purgatives, bleeding from the jugular, potassium iodide, potassium bromide, morphine, and many other drugs have been used, and yet most cases have died. One authority advises large doses of purgatives when the animal is able to swallow. This may be tested by first trying to drench the horse with water. One to two drams of potassium iodide may be given once or twice per day, especially in the advanced or convalescent stage. In

the early stages some recommend cold applications to the head. When an outbreak occurs in a barn or locality it is best to move all healthy animals to some other locality, and before using the barn again it should be thoroughly cleansed, disinfected and white-washed or sprayed with some good disinfectant, and then kept vacant for 2 to 8 weeks. (See directions for this under subject of glanders.)

POTENTIAL FEVER.

The other names applied to this disease are dropsy of the connective tissue, purpura Haemorrhagica, and morbus maculosus. It involves the blood and capillaries, usually in the sub-cutis of the skin, and sub-mucous of the mucous membrane.

Causes.—It is very likely a germ disease, but the specific microbe has not been discovered. It may follow strangles, influenza, pneumonia, pleurisy, and possibly other diseases that seriously depress the vigor and resistance of the body. It seems quite possible that the specific germ produces a poisonous chemical substance, which acts on the tissues, especially the blood and the capillaries. It also appears probable that the germ is unable to grow and produce this toxine in the body until the body is weak or the tissues cannot resist its action. Bad drainage, poor ventilation, dark and wet stables seem to favor the development of this disease.

Symptoms.—It comes on suddenly. The appetite becomes poor, there is a tendency to diarrhoea; a slight fever is present, the animal is dull and more or less stiff. In a short time the temperature may rise to 104 or even to 107. In other cases the high fever may be absent or be overlooked. Within two days, or about that time, the skin may swell in the form of round, abruptly elevated nodules, 1-2 to 3 inches in diameter. These swellings are more common about the limbs, abdomen, breast, nose, lips, and face, but may occur in any region of the body. Later these swellings run together, forming large swellings in one or all the limbs, and usually on the under surface of the body. Sometimes the head swells so that the animal can hardly see and the head is almost double its usual size. Sometimes these swellings are hot and painful, but not always. In the mucous membranes of the nose are small red spots, which later form extensive red patches, giving the mucous membrane an

appearance as if spotted with purple. The surface over these spots is usually not elevated, but immediately around them a pink or yellow fluid oozes out. The pulse is not very rapid at first, but later becomes accelerated, respirations are labored and difficult, especially when the head is swollen. In some cases immense swellings that develop in the course of a day will have disappeared in the course of a few days—sometimes in one day. Many cases suffocate from obstruction of the air passages by swellings about the head or the larynx and by excessive infiltration of the lungs. The animal may die in a few days, or the disease may run from one to four weeks and the animal then die or recover. In some respects this disease resembles glanders, but in glanders the swellings do not form so rapidly and there are deep, ragged, pit-like ulcers in the nasal mucous membrane, instead of purple spots.

Treatment.—Improve the surroundings of the horse, get it into a dry, clean, and well ventilated place. Give internally 1 to 3 drams of chlorate of potash, and 1-2 dram of tincture chloride of iron in 3 ounces of water. This may be repeated every four to five times per day. Some recommend strong coffee, 1 pint; potassium iodide, 1 or 2 drams; mix and give as one drench. This may be given three times per day. Others advise the following mixture: Fluid extract of nux vomica, 1-2 fluid dram; turpentine, 1 dram; alcohol, 1 ounce. Give this mixture every three hours by injecting it into the mouth with a small syringe. This is said to be especially valuable when the head is badly swollen. Some advise rubbing and kneading the swellings with the hands or with a cloth and brush; others apply stimulating liniment and cold or hot water, but it is doubtful whether these do much good. A little exercise, if the animal is not too weak, is recommended. About 50 per cent. of the cases are fatal in spite of treatment.

ANTHRAX.

This is a specific disease caused by the microbe (*bacterium anthracis*). This germ was one of the very first to be discovered as a cause of disease. Horses, cattle, sheep, hogs, man and many other animals are susceptible. When it occurs among horses or mules in any locality, cattle and sheep are very liable to have the same disease; and occasionally a man may become infected and die in that locality. The

germ is communicated or transmitted by means of infected feed and water, and by flies. If a pasture or farm becomes infected it may remain in that condition for years, especially so if susceptible animals are kept and bred on that farm each year. In some way the germ may remain in the soil for periods longer than one or two years. I have dried blood obtained from an anthrax patient, and this blood has been kept in an air-tight bottle for 16 years; a little of it mixed with water and injected into a guinea pig or rabbit will usually kill in 24 to 48 hours.

Symptoms.—Some cases may die in the course of one to two days after infection, especially if the lungs or the abdominal organs become infected. In other cases a small swelling may start on any part of the surface of the body as a result of an inoculation by a fly or some other insect. This swelling will gradually enlarge until it becomes quite extensive and the germs invade or enters the circulation and be carried to all parts of the body. Sometimes the invasion of the germs is checked by the action of the cells and tissue, and the animal may recover. Usually the first cases that appear in an outbreak of this disease are more severe and more frequently fatal than the cases that appear later. An absolute diagnosis in many cases can only be made by an expert who can collect some of the fresh material and make cultures and inoculations that will enable him to isolate the germ. In examining a carcass after death the blood will be black and tar-like in color and does not coagulate quickly. The liver is usually greatly enlarged. The spleen is likewise enlarged. Kidneys are often inflamed. It is said that chickens which eat the carcasses of animals that have died of anthrax will also contract the disease. It is possible that buzzards carry the disease from one farm to another. Anthrax carcasses should always be buried deeply or burned. In some States the law requires that the carcasses shall be buried in a special manner or burned, and persons failing to do as required by law are held responsible for the infection of other people's live stock resulting from a failure to comply with the law.

Treatment.—When the lungs or abdominal organs are involved little can be done. When the infection is local and external or in the skin inject into the swellings a 5 per cent. solution of carbolic acid; this may also be applied over the swelling on the outside.

In localities where this disease appears annually, it is best to employ protective inoculation. This consists in one or two injections of weak or attenuated cultures of the germ. Preparations, instruments, and full directions for their application may be obtained at almost any wholesale drug house. Remember that this preventative inoculation should be practiced only on farms where the disease has already appeared.

TETANUS.

This specific infectious disease is commonly called lockjaw. But the name lockjaw is many times inappropriate, because the disease may be present and the jaws not locked.

Causes.—The specific cause is the germ bacillus tetani. This microbe or plant parasite lives in soil and water. It is found in certain localities more frequently than in others. In some places a little soil—say from the garden—may be mixed with a little water and some of this mixture injected in very small quantities under the skin of a house mouse and 12 to 48 hours this mouse will have a typical case of tetanus. The tetanus germ grows best in close and deep wounds, away from air. The germ produces a very violent and active poisonous product, and it is possible that a sufficient quantity of this poison may be introduced into a wound at the time the wound is made and it kills the animal without any more of the product being made in the animal; but in most cases the germ grows and produces the poison in the deep wound and possibly sometimes in a shallow wound when it is protected from the air. In horses it occurs usually in connection with nail punctures, wire punctures, or other deep penetrating wounds about the foot. But a deep wound in any part of the body may have this germ carried into it at the time the wound is made.

Symptoms.—At first there may be a slight stiffness of one limb or of any part of the body near the wound. In a short time the muscles in various parts of the body will have spells of very rapid contractions. Sometimes these contractions are so rapid that the muscle, or muscles, cannot relax between contractions, and then appear as if continuously contracted. As the disease progresses all or nearly all of the muscles of the body will become involved. Then it will be difficult for the horse to move, each leg will ap-

pear stiff and inflexible, and the upper border of the neck concave instead of convex, and the head may stick out in front in a horizontal position. The animal may breathe short and quick. If the head is raised the eye washers or third eyelids will extend over the eye and the ordinary observer will say the horse has the "hooks." This is due to the continued contraction of the muscles which pull the eyeball back into the orbital cavity and push the eye-washers out over the eye. The animal cannot prevent or control this action. A little noise will often excite the animal and produce a series of spasmodic actions. In many cases the animal cannot swallow, cannot pass urine, or discharge manure from the rectum. Usually it will stand persistently until it falls. When down the legs will stand out from the body stiff and straight like the four legs of a stool. In some cases there may not be sufficient poison to affect all the nervous system of the animal; then only certain regions or parts, and usually those nearest the wound, will be involved. The symptoms will then vary according to the nerves and muscles involved.

Treatment.—Prevention is the only safe and successful means of handling this disease. If all deep wounds, especially those made with dirty objects, are thoroughly disinfected immediately after the wound is made and thereafter kept free from infection, tetanus will not occur. If there is no other means at hand, saturate a small piece of bandage in tincture of iodine, and with a clean knitting needle, or some other slender, clean rod, push this saturated bandage down to the bottom of the wound, leaving one end of the bandage extending out of the wound. It may be left in until the next day, and if necessary then remove and put another in its place. Usually the disease develops from wounds that are not observed. After the disease has appeared a thorough search will find the wound, usually somewhere about the foot. At this time treat the wound as previously suggested, but in all cases get the wound open so that it can be handled and cleaned and thoroughly disinfected. It is usually best to place the animal in a quiet, dark stall; give it water and gruel or milk to drink. Give in the water, 2 drams of barium chloride once per day until the bowels move freely. Remember that it is rather dangerous to drench a horse with tetanus, because in giving the medicine the animal becomes excited and the drug is often poured into the wind pipe and lungs; this only hastens the death of the animal. Some ad-

Miss Hilda Fletcher, of Gallatin, Tenn., who has won many blue ribbons driving Grandma Locke and Horace, Jr.

vise giving hypodermically or per mouth, 1 ounce of a 5 per cent. solution of carbolic acid. This may be repeated every four or five hours. In bad cases it is of no value. Others advise the use of tetanus antitoxine, which may be secured at wholesale drug houses. In bad cases this treatment is unsuccessful and is usually too expensive to justify its use. A few cases will get well without any treatment, except careful and frequent feeding of gruels or soft feed, with plenty of salt in it. Most of the cases will die if they are continually stuffed with drugs.

BIG HEAD IN HORSES AND MULES.

Technically speaking, this bone disease is known as osteo-porosis. It may involve all the bones and articulations of the body.

Causes.—The real exciting cause is unknown. In Switzerland, it is called the "bran-disease" because it is most frequently found in millers' horses that are fed largely on bran. Some say it is caused by an unknown malaria-like parasite. Others say it is due to indigestion; imperfect assimilation of lime salts and want of sufficient lime in the food. In some cases it presents striking characters that mark it as an infectious disease. This is observed in the way it occurs in stables. If a horse with big head is kept in a stall or stable for some time, other horses in the same stable, especially if kept in the same stall) are liable to contract the disease. Some assert that feeding too much corn to the growing colt will produce it. Others say it is a form of rheumatism. Still others claim that it is a special form of rachitis (rickets).

Symptoms.—The first signs usually observed are symmetrical and smooth or even enlargements of the bones of the face (upper jaw) and the lower jaw. Sometimes both sides of the upper jaw alone or the lower jaw alone may be equally, smoothly and evenly enlarged. In other instances the facial bones may not be perceptibly enlarged and the prominent signs may appear first in the limbs in the form of shifting rheumatic lameness. Mules having osteo-porosis rarely have facial enlargements but horses with this disease nearly always develop the characteristic symmetrical enlargements of the upper and lower jaws. At first the bone enlargements are soft, so soft that a pointed instrument like a cobbler's awl can be easily pushed into the substance of the enlarged bone of the

face. All the bones of the head may become thicker and more spongy than in health. If the case is of long standing the bones become hard and heavy. Later the bones of the limbs, the ribs and the vertebrae (bones of the back) may be involved. Sometimes the ribs become so soft that the rib region may become indented by the horse lying down on uneven ground or in an uneven stall. Occasionally one or more ribs may be broken and will not unite as quickly as in health. Lameness is often present and many times, the lameness "comes and goes" or shifts from one

Fig. 59.—Outline made from a photograph of a horse that had a bad case of osteo-porosis (big head). It shows a distinct dropping of the loins that sometimes occurs in long standing or chronic cases of osteo-porosis. This animal was so weak that it could not get up by itself. It also had well marked indentation in the rib region.

limb or place to another as in rheumatism. The lameness is usually due to the ulcers in the articular cartilage that covers the articular surfaces of the bones. (See fig. 61.) Nearly every articular surface of the limbs in old standing cases will have one or more ulcers. Exposure to cold and changes in the weather produce changes in the degree of lameness. Sometimes the limbs will be drawn out of shape and occasionally the loins will have dropped down to an abnormal degree. (See fig. 59.) When lameness is severe in old standing cases, or in mares in foal or just after foaling the diseased animals may get down and be unable to rise without assistance. This may occur every night or two or three nights out of a week.

Usually indigestion and poor or deficient assimilation are associated with this disease and in consequence the animal becomes poor, weak and sluggish.

the appetite will vary from good to bad; and in some cases the animal will be subject to periodic attacks of colic.

Fig. 60.—Lower jaw and face bones in osteoporosis or big head in a horse.

Treatment.—There is no specific for this disease. In nearly all cases of big head will improve with a long period of rest in a good pasture, especially in the summer time; also careful feeding on ground corn and oats with peavine hay or other good hay, with good rub-

bing and with light and regular exercise, may improve many cases. Sometimes good care may restore a horse so that it may be used at slow work, especially on the farm. Many advise blistering the enlarged places of the face and lower jaw and the diseased joints; about all the good that such treatment does is due to the local stimulation and the slight absorption of the mercuric iodide. Doses of two to three drams of barium chloride in the drinking water once or twice a week for two or three weeks during periods of great stiffness or lameness, may "limber up" the horse and stimulate the muscles, produce purgation and improve digestion, and assimilation. Some advise the use of lime in the drinking water, especially if the water is free of lime (free-stone.) Others advise the use of phosphate of lime in one to four dram doses given in the ground feed, nights and morning. At noon give one dram of pulverized iron sulphate. Remember that a case of big-head should be kept in a stable entirely separated from all other horses and mules; but it may be worked with well animals. The big-head horse and all others should be kept in dry stables having proper ventilation. Damp, wet, and poorly ventilated stables will make all cases worse and possibly aid in causing the disease. Good care, regular and frequent rubbing; light and regular exercise with properly balanced and regular rations, will do much to prevent it and will also materially assist in curing it. It is not best to breed mares having this disease because it may be transmitted to the offspring, and it also intensifies the progress of the disease in the mare. When the affected animal has chronic indigestion, the treatment suggested under that head may be used. In this disease pin your faith on the long run at pasture and good care in the form of good feed, plenty of grooming, well ventilated and well drained and clean stables.

SKIN DISEASES

Small parasites often live on the surface of the skin, and some forms burrow into the outer layers of the skin. The various forms of mange or itch in horses are caused by small animals called mites. The places infested become dry, sometimes wrinkled and thickened, and in many cases the hairs fall out. Intense itching may cause the animal to rub off the

hair and in some cases injure the skin. With a small magnifying glass the small mites may be seen on the roots of hairs and among the scales of the skin. It is usually best to stand the horse where the sun may shine on the infested part, and in a short time scrape off some of the scales of the skin and hair and place this on a piece of black paper and examine it with a

lense. The mites may be seen as long as they are warm making motions or crawling. If the skin disease is due to the variety of mites that burrow into the skin, it will be necessary to scrape the skin until you get some of the material or scales from the deeper layers of the skin.

Treatment.—Scrub all the parts affected with soap, water and a good brush. Remove all the rough scales and scabs and loose hair. Now apply a 5 per cent. solution of creolin or carbolic acid, or a weak solution of blue stone. A good ointment may be made with 2 pounds of lard, 4 ounces of sulphur, and 1 ounce of carbolic acid. Melt the lard and add the sulphur and carbolic acid, mix thoroughly and apply over the infested skin once per week. It is also necessary to thoroughly disinfect the stalls in which horses having the mange have been kept. This can be done by thoroughly cleaning the stall and the free application of white wash.

LICE.

Lice are found on horses, mules or colts more frequently in winter or spring, when the hair is long. They are liable to become very numerous on weak colts. They may be seen along the back in the mane and sometimes in the hair of any region of the body. They irritate the skin, cause the animal to rub and may check the growth of a colt.

Treatment.—In the middle of the day apply over all of the body a weak solution of creolin. Be careful that the animal does not chill following this application. Repeat the application in the same way in 8 or 10 days. If the skin becomes rough and the hair dry, frequent rubbing or the occasional application of a little lard and sulphur may relieve this condition if the weather is suitable. Clipping the animal all over will be a great aid in getting rid of lice, but in doing this be extremely careful that the animal does not contract pleurisy or pneumonia as a result of a sudden change from warm to cool weather.

SKIN TUMORS.

These are abnormal growths that may appear in any part of the skin or the body. The causes in many cases are unknown, but wounds are often followed by

excessive growths, which result in the formation of a tumor. Many of these new growths are developed by frequent irritation from rubbing or biting and gnawing. Sometimes germs and other plant parasites may get into the wound and by their growth irritate it and produce an excessive growth of granulation tissue. The so-called "Jack" sores that are so commonly found in summer time on jacks, are likely due to infection of the skin by certain forms of plant parasite. A slight wound or scratch will permit the

Fig. 61.—Photograph of (a) the lower articular end of the cannon bone and the (b) two articular condyles on the lower end of the femur. These articular surfaces exhibit ulcer in the articular cartilage that are usually present in case of osteoporosis.

parasite to gain admission to the skin and constant biting and gnawing stimulates the growth of a raw and bleeding tumor. This tumor usually gets large and more extensive during the hot weather and when cold weather comes on it may partially or entirely disappear and reappear again the following summer, to become larger and more extensive than ever.

Treatment.—When possible the tumor of any kind

should be removed with the knife or scissors. In some localities this can only be done by the expert. Usually an inexperienced man can confine the animal by casting it or otherwise, and cut away the tumor down level with the skin, or down as deep as the thickness of the skin. Then this surface may be well canterized with a red hot iron. If the animal can be kept from rubbing, biting or gnawing this place it may recover. Some advise the use of strong caustics, like arsenic, caustic potash, or strong acids. But these are dangerous, because in the hands of the ordinary man more tissue may be destroyed than is necessary and great injury result. Sometimes small wart-like tumors may disappear if they are covered frequently with castor-oil. But this will not appreciably affect a large tumor.

AZOTURIA.

This is a serious and somewhat common disease occurring most frequently in the larger and heavier horses; yet it may occur in light horses. Horses that are working regularly and are in good condition may be rested and fed on a Sunday or a holiday the same as when at work, but on Monday morning or the morning after the holiday the horse may be brought out showing no signs of illness and often exhibiting an excess of vigor and life. The animal may be driven a short distance and then show signs of weakness about the hind limbs; sweat over the croup and thigh, the muscles tremble and twitch. Finally the horse may stagger and fall and struggle considerably after it is down. As a result of this struggling it may sweat considerably over various parts of the body, and the muscles over the loins, croup, and thighs may be more or less hard and rigid. If the animal passes urine its color is usually dark red, or almost black. This abnormal color is said to be due to the presence of an excess of the coloring matter coming from the broken down muscle material, or from the disintegrated blood corpuscles. During the struggling or immediately after the struggle is over, the pulse may be accelerated and the temperature may be raised two to four degrees. Some time after the struggling is over, the pulse and the temperature become normal. Attempts to get the horse to rise will develop the fact that it is paralyzed in one or both hind limbs. This paralysis may pass away in a few days, or the animal may be permanently paralyzed. In many cases the animal cannot pass urine, owing to paralysis of the

bladder or spasms of the neck of the bladder. In some cases, where the driver stops the horse early before it falls down and rubs the legs well, the animal may be gotten back to the barn and only a mild attack will occur, and recovery will take place in a few hours or a day. Many ordinary observers will say the kidneys are diseased and others will say the horse has the colic. In rare instances the paralysis may be in one or both front limbs or in one hind and one front limb.

Causes.—The predisposing causes are rich diet, especially excessive eating of proteid or nitrogenous feeds, high condition of the animal, and full rations during a day of rest following a period of regular work. Mares are said to be more liable to this disease than geldings or stallions. It is also said to occur most frequently in the prime of the life of the animal. The exciting cause is unknown. Some attribute the cause to a germ; others believe that in some way sufficient lead has been taken into the body to produce lead poisoning. Others claim that the high condition of the system, containing an excess of nitrogenous material, prevents or interferes with the rapid elimination of waste materials from the body, that are thrown into the circulation at the time the horse is brought into the full exercise after the period of rest. This waste material accumulates so rapidly and in such quantity, that it acts as a poison and produces the paralysis. Others assert that exposure to cold after being kept in a warm stable produces the change in the muscles; this, however, is largely theory.

Treatment.—As soon as possible get the animal in a comfortable position and in a place where it will not be injured by struggling or by attempts to rise. In many cases it may be necessary to pass the catheter and draw off the urine regularly two or three times per day. Some German authorities advise giving 3 to 4 ounces of carbonate of soda, dissolved in 1-2 to 1 pint of water. This may be repeated 3 or 4 times per day. A purgative, such as recommended in cases of colic, may be used here. Recently some practitioners have met with marked success by giving 1-2 to 1 ounce of potassium iodide dissolved in 3 ounces of water. This is followed every 2 hours by giving 1 dram of potassium iodide in 1 ounce of water. This treatment should not be kept up beyond 1 or 2 days, because it is liable to lead to potassium iodide poisoning.

It is always well to keep the animal rubbed and in a comfortable position. As long as it is unable to rise it should be turned over from side to side every 3 or 4 hours. When the animal makes attempts to rise the attendants should aid it, and when it gets on its feet rub the legs and body and try to keep it on its feet. The feed should be soft, in order to keep the bowels open and active.

Preventative treatment is more effective in the hands of the average man in this disease than cura-

tive treatment. Horses that are worked regularly and in high condition should be fed less on rest days than on work days. Sometimes a soft feed may be given the night previous to a rest day. When the animal is it taken out on the morning following a rest day, watch it very carefully, and if any signs of this disease should appear, stop the horse at once, give it a thorough rubbing and return it to the barn or some convenient place where the rubbing may be continued and a purgative given if necessary.

CONDITIONS AND DISEASES OF COMMON INTEREST OCCURRING IN BREEDING ANIMALS.

The Organs of Reproduction in the Mare.—Beginning at the outside, the first is called the vulva. It has two lips and two corners, and at the lower corner, or just inside of the lower corner, is a small bunch of erectile tissue called the clitoris. Four to six inches forward and inward through the vulva is the vagina. On the floor, at about the union of the vulva and the vagina, is the opening of the tube that is the outlet of the bladder. The vagina is from 6 to 10 inches long and is separated from the body of the womb or uterus by the neck of the uterus. The neck of the uterus is the contracted part of the beginning portion of the wall of the uterus. Usually this neck presents a teat-like projection into the vagina and through the center of the projection is a small opening which leads from the vagina into the uterus. Just before and at the time of the delivery of the young at birth, this neck is so expanded that there is no line of demarkation between the wall of the vagina and the wall of the uterus. The uterus has a body and a right and a left horn. The cavity of the body is continuous with the cavity of each horn. Extending from each horn is a small tube, which runs from the horn up to the ovary on its respective side. Here this tube ends in a rather wide, cup-like expansion, close to the ovary. There are two ovaries, one on each side. The uterus, the tubes, and the ovaries are held in place by broad expansions of connective tissue, sometimes called ligaments. When the animal is in "heat", an ovule may

erupt from the ovary and fall into the mouth of the tube, pass down the tube into the uterus. There it meets the spermatozoa that comes from the male when the mare is served by the stallion. The fusing or union of the spermatazoa with the ovule may be designated fertilization. A fertilized ovule is the beginning of the embryo. The period of gestation in the mare is about 48 weeks in length. This period represents the time between the fertilization of the ovule and the birth of the colt. It may vary, occupying more or less time than the average, which is about 340 days.

The periods of heat in the mare occur more regularly in the spring or fall than any other season of the year. Usually these periods occur about every 21 days, and last each time from one to three or four days. After the birth of the colt the first period will occur in 7 to 9 days, and thereafter every 21 days until the mare gets in foal again. In some abnormal cases the periods of heat may appear more or less regularly after the mare has become pregnant.

The common signs of pregnancy are cessation of the periods of heat; the mare becoming more docile and quiet taking on more flesh; a gradual increase in the size of the abdomen; after 6 or 7 months movements of the kicking colt in the uterus may be observed in the flanks, especially just after the mare has had a drink of cold water. With a little experience, one can make a positive diagnosis by inserting the hand into the rectum and feeling for the colt in the

terus through the walls of the last part of the intestine. This should be done with care lest injury result. The foetus will not be large enough to distinguish until three or four months old.

Sterility in the mare is not uncommon. It is a condition of the mare in which she does not breed. It may result from various causes. Sometimes it may be due to a disease of the ovaries. This, however, could not be discovered in the living animal. At other times it may be due to some disease in the uterus. This might be apparent by excessive discharges coming from the uterus through the vagina and vulva. In that case it may be best to secure an expert to treat that disease before the animal is bred. In other cases the neck of the uterus may be closed, so that the spermatazoa cannot reach the ovule. In some cases the neck of the uterus may be opened by gradual twisting and firm pressure with the index finger. Remember that the index finger should be thoroughly cleansed with soap and water and disinfected before this work is attempted. In case an opening cannot be produced without violent pressure, secure the services of an expert veterinarian. Usually it is best to open the neck of the uterus when the mare is in heat and just before she is served by the stallion. A mare that is excessively fat or very poor is often predisposed to sterility. In some cases sterility is said to be due to a condition of the uterus or vagina, which can be remedied by inserting a small quantity of yeast in the vagina. The pure yeast used in making bread may be used for this purpose. Just how it acts has never been satisfactorily explained, and its value seems rather doubtful. Sometimes the apparent sterility in the mare is due to the stallion. When other causes cannot be found to account for this condition in the mare, it is well to take her to another stallion, preferably a young stallion or a jack. In some instances apparently sterile mares may be gotten with foal by the use of an impregnator, but there are cases for which there is no remedy.

During the period of pregnancy or gestation, the mare can do work in the hands of a careful man. No doubt pregnant mares are better off at light work than standing idle in the stable. In many cases they are kept at light work right up to the period of delivery; however, it is better to let them have rest in pasture at least one month before the birth of the colt. If from any cause the foetus is expelled before the time when it can live independent of the mother, the mare

is said to abort. The causes of abortion are numerous. Over work and rapid, violent exercise may induce abortion. Kicks and injuries are also prominent causes. Heavy doses of purgatives may produce abortion. Certain grasses, such as wild rye, may contain ergot, and this may cause abortion. Colic attacks, in which the animal tumbles and rolls, may result in abortion. Sometimes infectious germs may produce what is called infectious abortion. In this form of the disease several mares are liable to abort in the same stable or pasture. One abortion predisposes a mare to a second, and the second abortion usually occurs about the same time in the period of gestation that the first abortion occurred. Sometimes drugs that irritate the kidneys will also irritate the reproductive organs, and result in this trouble. Sometimes the service of the stallion when a pregnant mare is in heat will produce abortion. If a colt is born before the proper time, and can live, that is termed premature parturition or birth of the colt. Prevention of abortion is the only logical treatment. As a rule, it will not be discovered until after it is too late to prevent it by use of drugs. Usually it is not best to breed mares that have been exposed to infectious abortion, or that must be kept in barns or pastures where that disease is of common occurrence. Mares that are in foal and have been subject to any other ordinary causes that might lead to abortion, should be watched closely and kept quiet until the danger period shall have passed. Some advise giving drugs, such as morphine, chloroform to quiet and prevent contractions of the uterus.

In breeding mares an accurate record should be kept of the time when the mare became in foal, so that the time of delivery or birth could be determined. When the period of delivery is at hand a careful attendant should be present to watch and see that all conditions are favorable. If the mare is in the barn she should be in a large, well bedded, box stall. If the colt is being delivered normally, and without delay, no assistance will be required. Immediately after it is born the naval cord should be tied with a piece of silk cord, or any other strong cord that has been disinfected by boiling it in water, or by some other strong disinfectant. The naval cord is tied about 3 inches below the abdomen and the part below the tie is cut away. Then cover the naval cord with either of the dust powders recommended under the subject of wounds. Apply this dust powder to the naval and the cord two or three times per day, until the cord be-

German Army Horse, bred by Oltman Bros., North Fort Worth, Texas.

Mr. Fleming, of Augusta, and One of a string of Horses.

Mr. J. Lee Barnes, of Atlanta, Ga. His roadster one of the best in the South.

FIGURE 62.

Shows the correct position of the colt when the head and front feet are to be delivered first. The head should be between the front limbs.

FIGURE 63.

Illustrates how the colt should be delivered when the hind feet are first presented.

FIGURE 64.

Shows a front end presentation with the head turned to one side. With one hand, or a repressor, on the breast of the colt push its body back into the uterus far enough to permit the other hand to pull the head around between the front limbs.

FIGURE 65.

Exhibits a front end presentation with the head turned on the back. With clean and sterile ropes on the front feet so as to fix them, apply the hand to the breast and push the body back into the uterus and pull the head around between the front legs.

FIGURE 63.

Front end presentation with hind limbs raised into the outlet. Fix the front feet with clean plow line ropes and hold the front in position and push the hind feet back out of the outlet. Sometimes it may be necessary to push the colt back into the uterus before the hind feet can be removed from the outlet.

FIGURE 67.

Buttock and croup presentation. Push the colt back into the uterus and pull up the hind limbs, flexing them at the hock until the hind feet can be taken out first.

comes very dry and hard; thereafter one application per day may be sufficient.

The normal position for the birth of the colt should be the front feet and head coming first, as if the colt were slipping out, front end first, belly down and back up on its belly. The next position is hind feet first, as if it were slipping out backwards on its belly. When the colt is delivered front feet and head first, the head comes out so that when the colt must breathe before completely delivered it can secure air. If the hind feet come first, then if the colt must breathe before complete delivery it may suffocate for want of air. Hence in the second method assistance should be given to make the delivery as rapid as possible. This may be done by catching the hind feet and pulling firmly and steadily when the mare strains. In doing this much patience and careful judgment are required. In some cases neither of these positions are found, in fact, a variety of abnormal presentations may occur. If an attendant is on hand who knows how to do the right thing at the proper time, much difficulty and sometimes serious results may be prevented. For instance, if the front feet are coming and the head is turned back on one side, this can be righted quite easily in the early stages. Clean the hands thoroughly with soap and water and a disinfectant; then cover them with vaseline. Now with one hand apply pressure—say on the breast of the colt—when the mare is not straining; with the other hand feel for the nose of the colt or the head, and when found, pull it around in its correct position, between the front limbs. When this is done steady pulling on the front limbs will help the mare in delivering the colt. Other abnormal presentations may be corrected according to conditions, and this can always be done more easily in the early part of the period of delivery than after labor has been in progress some hours. In rare instances the colt cannot be delivered without first cutting it to pieces in the uterus. This cannot be done except by an expert veterinarian, and should not be attempted by the average farmer. After the birth of the colt all of the enveloping membranes or the “after birth” generally comes away in the mare without any help. Sometimes it is retained, or part of it must be removed by careful pulling with one hand and separating it from the uterus carefully with the other hand. In doing this work be sure to have the hands and arms well cleaned and thoroughly disinfected. In some cases the contractions of the uterus continue after the colt

is delivered to such an extent that the uterus becomes everted. In other words, an attempt is made to turn the uterus inside out. This is present when there is a large, dark-colored, more or less round body projecting from the vulva. It is sometimes as large as a peck or half bushel measure. This is not very common in the mare, but more frequent in the cow. If replaced at once the life of the mare may be saved. In order to replace it, it may be necessary, first, to clean it. In doing this be sure to use cotton that has been boiled in water containing some baking soda, and also use the water that has been boiled and cooled. After it is cleaned it may be necessary to produce pressure by wrapping it with broad, sterile bandages, or by large, sterilized towels. The pressure causes the blood to flow back into the vessels and reduces its size. This may require considerable time and patience. When it is gotten inside the mare may strain to throw it out again, but it should be held in place until it gets warm, and if the mare still strains, give a dose of 4 to 5 grains of morphine. This may be given per mouth or hypodermically. In some cases it may be necessary to keep an attendant watching and keeping this in for some time after it is replaced. Some advise taking 3 or 4 deep stitches through the lips of the vulva, so as to prevent the animal from throwing out the uterus. As a rule eversion of the uterus in the mare is very serious, and often leads to infection and the death of the mare. In cows it can be successfully treated in most instances.

After the naval cord has been ligated and covered with dust powder, the colt should be wiped dry and gotten up to suck. It should have the first milk, which usually acts as a purgative, but in some cases it does not; then the colt may be constipated. In that case give 1-2 to 1 ounce of castor oil and a small injection of warm water into the rectum. In other cases the colt may have diarrhoea. This may be due to laxative food the mare is eating, or to infection of the colt. It may be treated by first giving 1-2 to 1 ounce of castor oil, and then give 1 teaspoonful of tincture of opium once or twice per day, until the diarrhoea is checked. Sometimes a little lime water mixed with the mother's milk may be all that is required. At other times a little pulverized magnesia, 1 or 2 tablespoons in the mother's milk will effectually remedy this trouble.

DISEASES OF THE EYE.

DISEASES OF THE EYELIDS.

Tumors of various kinds are occasionally found on the eyelid. The upper lid is a favorite place for warts—diseased, excessive growths of the outer layers of the skin. The exciting cause of warty growths is at present thought to be a very minute plant or animal parasite. It is best to excise them with a knife; or if small, to snip them off with the scissors, being careful not to cut deeper into the eyelid than the thickness of the skin. After the bleeding has partially ceased and the blood has been wiped away with a clean, moist sponge or cloth, the raw surface may be touched or

cauterized with lunar caustic or a small pledget of cotton dipped in strong carbolic acid. Melanotic (black, pigmented) tumors are occasionally found on the eyelids of white horses. If they are small and are removed in the early stages of growth they are not so liable to return; but if they involve considerable tissue

Fig. 68.—Diagrammatic Section of the Horse's Eye (after D'Arboval) showing the relative position of the various parts. In reading the description of the anatomy of the eye frequent reference should be made to this cut.

a, Optic nerve; b, Sclerotic; c, Choroid; d, Retina; e, Cornea; f, Iris; g, h, Ciliary circle, (or ligament) and processes given off by the choroid though represented as isolated from it, in order to indicate their limits more clearly; i, insertion of the ciliary processes on the crystalline lens; j, Crystalline lens; k, Crystalline capsule; l, Vitreous body; m, n, Anterior and posterior chambers; o, Theoretical indication of the membrane of the aqueous humor; p, p, Tarsi; q, q, Fibrous membrane of eyelids; r, Elevator muscle of upper eyelid; s, s, Orbicularis muscle of the eyelids; t, t, Skin of the eyelids; u, Conjunctiva; v, Epidermic layer of this membrane covering the Cornea; x, Posterior rectus muscle; y, Superior rectus muscle; z, Inferior rectus muscle; w, Fibrous sheath of the orbit (or orbital membrane); 1, Section of orbital arch; 2, Lachrymal gland; 3, Section of small oblique muscle.

Fig. 69.—Normal Horses Eye (after Goubaux and Barrier).

or are of long existence, they are very liable to return after removal. All small tumors of the eyelids may be removed in a similar manner to that described for warts.

Pedunculated tumors may be ligated by tying a strong cord around the pedicle close to the skin; if it does not fall off in a few days another strong thread may be tied around it in the same place. Caustic medicines (Lunar Caustic or Tri-Chlor-Acetic Acid) may be applied, once every four or five days, until the tumor can be pulled away by the fingers. Care must be taken not to get these caustics into the eye; it is best not to use caustics except on tumors with large, thick bases that cannot be ligated or excised.

Wounds of the Eyelids.

These occur through bites, tearing on nails, harness, hooks of snaps, barbs of wire fences, and other projecting points, about the stable or stall. If the wound is fresh the edges may be brought together by

stitches one-third of an inch apart; ordinary white silk thread may be used.

Inflammation of the Eyelids.

Various injuries and bruises of the eyelids may occur when a horse is rolling or throwing his head during colic attacks, or other painful diseases; or neighboring tissues may be injured or bruised and the inflammation extend to the eyelids.

The writer has repeatedly observed the eyelids of cattle attacked by ringworm, a transmissible parasitic disease of the skin, causing not only inflammation of the eyelids but also of the conjunctiva, extending at times to the cornea.

Constitutional diseases (anthrax, Texas fever, purpura) may be attended by swollen and inflamed eyelids. Small wounds may admit germs into the tissues of the eyelids and produce inflammatory swellings.

Inflammation, resulting from wounds, bruises, etc., may be reduced by bathing the eye in cold water and applying antiseptic solutions. In ringworm the crusts and scales must be washed and scraped from the skin and then a one per cent. solution of corrosive sublimate may be applied once per day for three or four days. Other parts of the body and other animals with ringworm must be treated in the same way; since this parasitic skin disease is transmissible. Inflamed, swollen eyelids from constitutional diseases may be remedied by treating the disease with which they are associated.

Entropium—Folding Inward of the Lid.

The free margin of the lid is folded in against the eyeball; generally the entire margin of the lid is rolled inward, but, at times, only that half near the inner or nasal angle of the eye is thus affected.

This disease occurs most frequently in the dog but occurs also in the horse; the ox and the sheep. It has been observed in some animals at birth; and, no doubt, a tendency toward this disease is inherited—especially among dogs. Spasmodic contractions of the orbicular muscle that closes the eye, a relaxation or loose condition of the skin and an excessive development of the skin and tarsus of the lid, are said to be prominent factors in producing entropium. Scar tissue—resulting from wounds, ulcers, etc., on the inner surface of the lid—contract, or make tense, the conjunctiva to such a degree that it pulls the free

border of the lid inward; while the contraction of the orbicular muscle (in winking) would roll or fold the lid.

One or both lids of one or both eyes of the dog may be affected; but, as a rule, only the lower lid of one eye in the horse is so diseased. The constant friction occasioned by the continual rubbing of the

Fig. 70.—Entropium—Folding inward of the lower lid; the eye-lashes and hair rub over the conjunctiva and cornea, when the eye lid or eye-ball is moved, producing inflammation by constant friction.

eyelashes over the conjunctiva and the cornea, produces great irritation, which, if long continued results in inflammation. The conjunctiva becomes congested, light red and slightly swollen, the cornea may be clouded and at times ulcers form on its surface; the tears flow in excess; and the animal constantly attempts to close the eye. As soon as the lid or lids are returned to their normal position, the inflammation, cloudiness, etc., begin to disappear and the eye to retain its normal condition. Treatment consists in removing by excision a portion of the relaxed and loose skin. In the horse a strip of skin, one-fourth to one-half inch broad, is cut away parallel to, and about one-half inch from, the margin of the lid. The elliptical strip may be removed by using small, sharp shears. The free edges of the skin are then brought together by silk stitches, about one-half inch from one another. As a rule, in the course of a week the stitches may be removed. In the dog the relaxed skin may be excised much farther from the margin of the lid and the gaping wound may be left to heal without bringing the edges of the skin together with stitches. It is however, safer and better to stitch up the wound.

Ectropium—Rolling Outward of the Lid.

In this disease the eyelid is drawn away from the eyeball, the conjunctival surface turned outward, the

free border (lower lid) downward; the eyelid is rolled outward and downward, leaving the eye unprotected, subject to constant irritation from air and dust and rapid evaporation of tears. This condition produces chronic inflammation of the conjunctiva and leads to the formation of clouded spots and vascularity of the cornea. This disease also occurs most

Fig. 71.—Ectropium—Folding outward of the lower lid.

frequently in dogs, but may appear in the horse, ox and sheep. It is caused mostly, in the horse, by scar tissue in the neighborhood of the lower eyelid; this makes the skin so tense that the traction pulls the lid from the eyeball. Inflammatory swellings and new growths on the conjunctiva may also cause it. Dogs with deep set eyes and in a poorly nourished condition suffer with this disease. Ectropium is treated by cutting away a narrow strip of the conjunctiva parallel with margin of the lid. The shears may be used but no stitches are required.

Ptosis—Falling of the Upper Lid.

When the upper lid hangs abnormally downward and outward from the eyeball, without folding or rolling, it is called drooping of the lid or Ptosis. It is usually associated with paralysis of the facial nerve, and may occur on one or both sides. In paralysis of both nerves there is constant dribbling of saliva, paralysis of the lips, the nostrils and the upper eyelids. This is said to result from an injury of the facial nerve or some of its larger branches. The injury is usually produced by bruises or due to pressure of the bridle or of a yoke. In the first stages of the paralysis, it may be improved by reducing the inflammation or by removing the pressure on the nerve or its branches. But, as a rule, paralysis of one or both facial nerves is incurable. Yet the drooping of the

eyelid may be removed by a surgical operation too complicated and difficult for unskilled hands.

DISEASES OF THE HAW OR MEMBRANA NICTITANS.

The conjunctival mucous membrane which covers the haw may become inflamed when the other parts of the conjunctiva are diseased. Also the haw may be pushed out over the eye when the eyeball is drawn back into the socket, which is done in certain eye diseases for protection. In such cases uninformed persons say the horse has the "hooks" and at once proceed to cruelly cut them out. It is scarcely necessary to remark that nearly every case of so-called "hooks" is only a symptom of another disease and would certainly disappear if the real cause were removed.

In some instances the haw is injured by being torn at the upper part of its free margin or it may be torn or cut in other parts by injuries. Nearly all cases of injury recover without treatment, but should the separated or divided haw continue to irritate the other parts of the eye, it may be removed. Occasionally tumors appear on the haw or eye-washer; if small and harmless they may be left undisturbed or clipped off with the shears; but if large and harmful, the entire haw (if necessary) may be removed. In cutting away the torn haw, or the tumor and haw, the animal should be securely and safely confined (by casting or otherwise) and a few drops of a ten per cent. solution of cocaine may be put into the eye; after waiting a few minutes for the cocaine to take effect, the haw or tumor may be grasped with small forceps and completely excised with the shears; during the next few days cleanse the eye, two times per day, with warm water, and a one per cent solu-

Fig. 72.—Abnormal extension of the haw or "eye-washer" as observed in tetanus (lockjaw) inflammation of the haw etc. This continued projection of the haw, is many times called "hooks."

tion of carbolic acid. After repeated or severe attacks of inflammation of the conjunctiva, or repeated attacks of moonblindness, the haw remains more prominent and farther projected over the eyeball than normal. In tetanus or lock-jaw in horses the haws are partially or completely extended over the eyeball—especially on exposure to strong light or when the head is elevated.

DISEASES OF THE TEAR APPARATUS.

In all cases where the tears are running down over the side of the cheek and there is no swelling or redness of the lids in their normal position, it is wise to examine carefully the lachrymal or tear apparatus. Most frequently the lachrymal canal is obstructed at its opening into the nostril; this may be relieved as a rule, by removing the dirt and pus-like matter which clogs the opening.

Sometimes the canal is obstructed in its superior part near the tear sack, then it is best to inject by means of a small syringe, carbolized water or a two-per cent solution of boracic acid, into the canal at its lower or nasal opening. If the tear canal, tear sac and tear ducts are open or pervious, the water will pass out at the tear points near the inner angle of the eye on the margin of each lid. Occasionally the canal or the tear ducts are obliterated, resulting from catarrhal or infectious inflammation and from fractures of bones along the course of the canal. In such cases it may be made pervious by forcing a small silver probe into the canal; but sometimes the canal is so completely obliterated that it is impossible to open the old passage-way for the tears. When the conjunctiva or the eyelids are inflamed and when the under lid is everted in ectropium, the openings of the tear ducts are closed or are so displaced as to prevent the passing of the tears into the ducts. After recovery from these diseases, the tears cease to flow over the cheek.

DISEASES OF THE TISSUES SURROUNDING THE EYE AND IN THE ORBITAL CAVITY.

Fractures, bruises and wounds may take place in the bones and tissues surrounding the eye, and must be treated according to the conditions presented. Generally speaking, continual application of cold water baths or fomentations to the injured parts will

materially reduce and prevent inflammation. Tumors or new growths of various kinds may appear in the orbital cavity outside of the eyeball. As a rule, they are very serious and eventually necessitate the removal of the eyeball with its surrounding tissues and sometimes requires the excision of the eyelids and the skin with other tissues in the neighborhood of the eye. Whenever cancerous growths begin to spread or extend to the parts around the eye it is well to cut away all the parts involved. Such malignant growths are liable to return, even after several removals. Deep-seated spreading tumors of the orbital region should always be considered as very serious and as nearly always incurable without complete excision.

DISEASES OF THE CONJUNCTIVA.

Conjunctivitis.—Inflammation of the mucous membrane lining the eyelids and reflected over the eyeball around the cornea.

Causes.—1. Mechanical and chemical irritants.—Small seeds, pieces of hay, straw, glumes, wheat or barley beards, small insects, coal dust and other kinds of dust, sand, hair, smoke, entropium, parasites—all foreign bodies that act as mechanical or chemical irritants may produce conjunctivitis. Not infrequently has the writer observed this disease in a very severe form, resulting from injudicious and ignorant application of caustic and blistering salves, liniments or quack eye washes. Striking the animal in the eye with a whip, or stick, bruising or wounding the eyelid or parts near the eye may excite inflammation in the conjunctiva. Cold, sharp or excessively dry winds may cause it.

2. It is associated with other diseases, as—ulceration of the cornea, periodic opthalmia, occasionally with Texas fever and anthrax, influenza, strangles (distemper in horse), rinderpest, and, now and then, in the course of other infectious diseases; often it is associated with catarrhal inflammation of the mucous membrane of the nasal passages, sinuses of the head and of the lachrymal canal and ducts. Inflammation of the conjunctiva and the cornea is quite often observed in sheep when they are affected with "head scab," or parasitic skin disease, confined to the short wool regions of the sheep. Conjunctivitis is also associated with sheep pox. Cattle are at-

tacked by an enzootic inflammation of the conjunctiva and cornea, which is considered in detail under diseases of the cornea. Diphtheritic conjunctivitis appears in fowls.

Symptoms.—On the irritated and inflamed spot of the conjunctiva there will be red streaks of strongly congested blood vessels, the mucous membrane will be slightly swollen; this inflammation may in a short time extend to all parts of the conjunctiva and involve the circumference of the cornea; the eye is very sensitive to light, and is kept closed continually. During the early stages the secretion of tears is greatly increased and they flow in profusion over the cheek, but during the more intensive or severe inflammation a mucus exudate appears, which is of light gray color and contains semi-transparent flaky particles. If the inflammation is still more severe the exudate or secretion appears as a grayish yellow or a green fluid which consists of pus cells and tears. At one time, in severe cases, the secretion may be pus mixed with serum, and at another it may be pus-mixed with mucous. An organized membranous exudate is present in diphtheretic conjunctivitis and to a limited extent in follicular conjunctivitis. The superficial layer may be involved in severe cases, while in other instances all the layers and the submucous tissue may be involved in the inflammation; these distinctions are not always well defined; but as a rule, great intensity and long duration of the inflammation indicate that the entire conjunctiva and submucous tissues are affected.

Treatment.—The first thing to do is to remove the cause if it can be discovered. If the animal is very sensitive about having the eye examined, it is best to put a twitch on his nose. Place the thumb on the lower lid and the end of the index finger on the upper; by gradual and firm pressure, open the eye and look carefully for a hay seed or any foreign body or irritating particles that may be in view. After completely cleansing the index finger and removing the long, rough or sharp margin of the finger nail, it may be pushed around under the lids and under the haw in search of the irritant; this must be done with great care, and it is always best to put a few drops of a three per cent. solution of cocaine into the eye before introducing the finger. Following this search and the removal of the irritant, the eye may be washed with pure cold water or with a solution of

corrosive sublimate 1 part and pure water 5,000 parts. Bathing the eye in very warm water will relieve the pain and sensitiveness; while cold water fomentations will remove the fever. A great many cases of conjunctivitis readily yield to the simple method of adjusting a large, clean wet cloth over the eye, keeping it moist by pouring cold water on it every hour. It is generally best to put the animal in a dark stall, but unless such a place is well ventilated I prefer the open and well ventilated box stall. The following prescription has met with great favor in Germany:

Borax, 6 grains; Aqua Amygdalae Amarae, 2 drachms; Gum Arabic, 2 drachms; Pure Water, 2 ounces. Apply to the conjunctiva by putting several drops into the eye twice per day.

In purulent conjunctivitis, when pus is present in the eye secretion, one may employ corrosive sublimate 1 part, water 1,000; or nitrate of silver 4 grains and water 1 ounce. In a few seconds after applying the nitrate of silver solution, the eye may be washed with a weak watery solution of common salt; this checks the burning irritation of the silver nitrate. It is safer to use the solution of corrosive sublimate. Diphtheritic conjunctivitis develops in chickens, doves and other fowls that are affected with diphtheria of the mouth, the throat and the nose. The healthy should be separated from the diseased fowls; the diphtheritic membranes should be removed from the mouth and eye; and the mucous membranes should be covered or penciled over (by means of a feather or small brush) with a 1 to 2 per cent. solution of corrosive sublimate or with 1 to 2 per cent. solution of silver nitrate. In 20 to 30 seconds after applying the nitrate of silver solution, bathe the eye and other affected parts with a weak solution of salt water. When chronic inflammation of the follicles of the inner surface of the haw is present, it may be relieved by using a 1 per cent solution of corrosive sublimate; this should be applied as previously directed, being very careful that the fluid does not come in contact with other parts of the eye. As a rule, follicular conjunctivitis occurs only in dogs. When it will not yield to medical treatment, the inflamed follicular spots are clipped off; or part or all of the haw may be removed. Nitrate of silver solutions should be discarded in all cases where the cornea is also involved, since it is liable to leave permanent opacities of the cornea.

Hilda and Hildagarde. Owned by Oscar Ray, Atlanta, Georgia.

DISEASES OF THE CORNEA.

Wounds.

The transparent cornea may be injured by a stroke of the whip, by hard straw or hay stems, by thistles, and occasionally by sharp objects—glass, nails, splinters, hedge thorns, and wire barbs. Small, rough or sharp objects that get into the eye not only injure the conjunctiva but also may scratch or even penetrate the cornea. In fact, many of the chemical and physical causes of injuries to the conjunctiva in like manner affect the cornea.

The shunning of light by closing the eye and an extra secretion of tears are always present during the active stages of the inflammation. The seriousness or severity of an injury depends upon the extent of surface affected and whether the outer or middle layers are separately or conjointly injured; or whether the entire thickness of the cornea is perforated. If there be but a small spot of the outer layer injured, recovery takes place in a few days, by keeping the eye covered with a clean cotton or linen cloth saturated in a solution of 1 part carbolic acid to 100 parts of water. If the deeper or middle layer of the cornea be injured, it will require quite more time for healing and is liable, in the horse, to leave a scar—a whitish opaque spot. Treatment may consist in the continued application of the 1 per cent carbolic acid solution, or in applying continually a cloth saturated with a solution of 5 to 10 parts antipyrine and 100 parts of water. After the painful and feverish stage is past a few drops of a solution of 2 parts of potassium iodide and 100 parts of water may be used two times per day. If the cornea be perforated the aqueous humor escapes, and this leads, in most cases, to inflammation of the entire eye, resulting in loss of sight and generally in the destruction of the eyeball.

Occasionally a perforating wound heals by granulation, the iris becomes free and sight is restored. But most frequently in such cases the iris remains attached to the wound or scar tissue of the cornea and prohibits the light from passing into the eye. If the perforation is near the margin of the cornea, a few drops of a solution of 1 gr. of eserine to 1 ounce of water may be applied, two times per day. But if the perforation is near the centre of the cornea a few drops of a solution of atropine 1 gr. to water 1 oz. may be used, night and morning. By the use of eserine the

pupil is contracted and the free borders of the iris are taken away from the marginal wound in the cornea. By the use of atropine the pupil is expanded and the borders of the iris are removed from the edges of the central corneal wound. Infectious and general inflammation of the eye may be obviated by adjusting over the eye a cotton or linen cloth moistened every half hour with a solution of carbolic acid 1 part to water 100 parts; or corrosive sublimate 1 part to water 1,000 parts.

KERATITIS OR CORNEITIS.

Inflammation of the Cornea may involve the superficial layer, or the middle layer of the cornea; it may embrace only part of the cornea or may be diffuse—extend over the entire cornea. The partial or limited form is generally the result of injuries of the cornea. The friction of the eyelashes in entropium, small, sharp substances, and irritating salves, are common causes of local inflammation of the cornea. Diffuse inflammation is associated, as a rule, with infectious conjunctivitis in cattle or sheep; and, at times, appears in the course of cow-pox and sheep pox, and of diphtheria in fowls; and in the course of influenza and the acute attacks of moon-blindness, in the horse.

Symptoms.—When the outer layer alone is affected: As soon as the cornea becomes inflamed the animal avoids the irritating light by partially or entirely closing the eye, and tears flow down over the cheek. The cornea becomes opaque at a not sharply limited spot or over its entire surface; this opacity may be grayish blue, gray or light gray in color. One may see this opacity best by viewing it, not from directly in front of the eye, but from one side. If the inflammation is of long duration blood vessels will be found in the cornea, which may be seen in their congested condition near its border. When the opacity and the other symptoms appear suddenly (without blood vessels forming in the cornea), recovery is quite certain to occur in a few days. The darker the opacity or cloudiness the weaker the infiltration or the less damage in the cornea to be required. Light gray and white colored opacities denote intensive changes which require eight to ten days for their complete removal. If blood vessels form in the cornea of the horse, a permanent opaque spot may remain, but in the dog the complete removal of the opacity will usually occur.

If the middle layer or principal part of the cornea be injured, the opacity develops slowly, is grayish blue, gray or light gray in color. The opacity is generally irregular in form—cloudy, striped or ray shaped; these points or spots extend over the entire cornea. When inflammation produces such spotted or irregular dotted opacity, it is designated *keratitis punctata* (see Fig. 6). This spotted appearance of the cornea is due to the dotted opacities in the outer layer while the inner layer may be evenly clouded in all its parts. The deeper seated opacity may be observed by viewing the cornea from one side; this is

Fig. 73.—*Keratitis Punctata*—Inflammation of the internal or posterior layer of the cornea produces a spotted opacity; the dots or opaque white spots may be larger or smaller than those in the cut and may extend over the entire surface of the cornea. Another form of *keratitis punctata* is developed as mentioned in the text.

perceived best by illuminating the eye in a dark stall or room. A yellow colored, sharply limited opacity, announces the formation of a corneal abscess.

Shunning the light and an excessive flow of tears are always present during inflammation of the outer surface of the cornea or the formation of an abscess. In acute cases the opacity may entirely or partially disappear in three to six weeks. Should the opacity continue longer, from improper treatment or non-disappearance of the cause, vascularization (formation of blood vessels) with abscess formation or ulceration of the cornea appears; thus the prospects of recovery are decreased, while the danger of a pus-like exudate appearing in the aqueous humor or the perforation of the cornea increases. Not infrequently do these bad results appear in cow-pox, sheep-pox or infectious conjunctivitis and keritis among cattle and sheep.

Treatment.—Examine the eye critically, being especially careful to discover and remove any irritating foreign body or particles. Bathing the eye in very warm water twice per day and then adjusting over it

a clean cloth, saturated with a 1 per cent. solution of carbolic acid, will, in most cases, be sufficient. But, should there be an abscess or an ulcer present, the cloth might be saturated with a solution of corrosive sublimate 1 part and water 1,000 parts; and during the reparative stages warm water baths night and morning, and the application of the following salve, will aid in the removal of the opacity: Calomel, 30 gr., iodoform, 30 gr.; vaseline, 5 drachms. Instead of this salve one may apply with a feather a small quantity of equal parts of pulverized calomel and iodoform.

INFECTIOUS CONJUNCTIVITIS AND KERATITIS, OR INFECTIOUS INFLAMMATION OF THE CONJUNCTIVA AND CORNEA.

This eye disease is most frequently found in cattle, but may appear in sheep, horses and goats. It is said to occur only during the summer months, but the writer saw it in a herd of cattle in February and March in South-eastern Iowa. That winter was exceptionally warm. It attacked cattle of all ages; but calves and young cattle seemed to be predisposed to it. A number of young colts, running in the same field with the cattle were similarly affected. Several outbreaks of this eye disease have been reported to me as occurring during the spring and summer months of 1892, in Alabama.

The disease announces its presence by an increased flow of tears; the eyelids are closed and slightly swollen. The conjunctiva becomes swollen, its blood vessels congested and, in severe cases, a purulent discharge appears.

Fig. 74.—An illustration of an abscess and the attending vascularization of the cornea as observed in infectious keratitis and conjunctivitis in cattle. The black spot in the cut represents the yellow abscess and the radiating lines the blood vessels in the cornea.

Young animals seem to have a general fever, hanging of head, loss of appetite, and consequent emaciation; loss of appetite, etc., is most probably the result of pain instead of fever. These symptoms continue to increase for the first 8 or 10 days. About the third day from the first appearance of the disease, the cornea will exhibit a small delicately clouded spot, near its center, which will gradually extend over the entire cornea, giving it a milk white appearance. The centre of the opaque cornea is at first pearly white in color, but in a short time a straw colored or yellow spot appears; this spot signals the formation of an abscess. The cornea at the yellow spot is rough and surrounded by a wall of thick, swollen, pearly white tissue. From this yellow centre (see Fig. 7) numerous blood vessels take their course toward the sclerotic border of the cornea. The yellow centre is generally longer from side to side, shorter from above to below, and it is said to be occasionally mistaken for "an oat grain in the eye" by unformed laymen. The abscess generally erupts or breaks open on the outer corneal surface leaving an ulcer to heal by granulations forming over its sides and bottom. In cattle, as a rule, the scar tissue is entirely removed and the cornea becomes clear and completely normal. However, in horses and occasionally in cattle a permanent pearly white opacity remains, causing partial or complete blindness. Some cases do not advance to the stage of abscess formation; in others the abscess may not erupt, while in still others the abscess may be so large that when it breaks open, the pressure of the aqueous humor against the remaining thin portion of the cornea will perforate it; this sudden removal of pressure on the lens may rupture the capsule of the lens and permit it to escape; the entire eye is thus involved, resulting in total loss of sight and of the eyeball.

The cause of this spreading eye disease is unknown, yet there are indications that point towards a germ or a micro-organism as an exciting cause. Billings claims that it slowly extends over a herd from one animal to another; one eye may be at first affected, but in a short time the other eye is attacked. According to some of the German authorities the disease spreads quite rapidly—in a few days attacking 50 in a herd of 300; in 7 days attacking 20 in a herd of 40.

Treatment.—Separate the sick from the healthy; apply a solution of corrosive sublimate 1 part, water 2,000 parts; saturate a clean cotton cloth with the

above solution and adjust the cloth over the eye; keep the cloth moist with the solution. During the purulent discharge from the conjunctival sack, the eye may be washed night and morning with warm water.

ULCER OF THE CORNEA.

Loss of substance or destruction of a limited portion of the cornea may result from the erupting of a corneal abscess, as in infectious keratitis; it may also appear in suppurative inflammation of the conjunctiva or cornea, and it is occasionally found associated with influenza in the horse; very often it is observed in the course of influenza (distemper) in the dog.

Ulceration of the cornea appears to be caused by an infectious or contagious microbe, since the disease is transmitted from one eye to the other, and occasionally appears as a disease that may extend to a number of animals in a locality.

An ulcer may appear near the center of the cornea or near its border; the cornea surrounding it is generally opaque; the bottom of the ulcer may be greenish yellow or gray white in color; the borders of the ulcer are, in the early stage, so abrupt that it appears as if it had been cut out with an iron punch. It may extend in depth to the internal layer of the cornea, then the reparative process may begin. Shortly after the formation of the ulcer, the cornea becomes vascular; the blood vessels give the opaque cornea around the ulcer a reddish tinge. As soon as the developing blood vessels reach the advancing borders of the ulcer the process of repair begins and continues slowly until the ulcer completely disappears, leaving behind a pearly white scar in the horse, but in the ox and the dog this opacity is, as a rule, removed.

If the ulcer is located near the border, the healing process progresses more rapidly than when it is in the center of the cornea, because the developing blood vessels can reach the ulcer sooner and thus check its advancement. If the internal layer of the cornea is destroyed by the penetrating ulcer, the inflammation extends to all parts of the eyeball, and generally results in the loss of the entire organ.

Treatment.—Prof. Moeller very highly recommends aqua chlorata diluted with 2 or 3 parts of water. A solution of corrosive sublimate 1 part and water 1,000 parts may be employed; or a 2 to 4 per cent. solution of boracic acid. It is not advisable to use silver ni-

trate as it generally leaves a permanent opacity in the cornea. In examining the eye care should be exercised to prevent transmitting the purulent irritating discharge with its microbes, from the diseased eye to the healthy one. It is also best to separate the diseased animal from all others. If the cornea is perforated, a 1 per cent. solution of eserine or atropine may be used as advised in perforations of the cornea under the head of corneal wounds.

OPACITIES OF THE CORNEA.

Scar tissue, infiltrations and organized exudates that supervene or result from injuries, inflammation, ulcerations and abscesses are termed opacities. These opacities remain after the inflammation has subsided or after the wound or ulcer has healed, and are not to be confounded with the opacities attending active inflammation. Slightly foggy, weakly clouded, translucent, grayish blue or gray spots, not sharply limited are mostly found in the outer layer of the cornea and are sometimes called *nebulæ*. If the opacity is semi-transparent, sharply limited, gray or milk white, it is designated *aculæ*. If the opacity is a dense, completely opaque, pearl white, gray or white, regularly distributed or in large spots or stripes, it is called a *leucoma*. There are also chalk-like, well defined opaque spots which are formed by using acetate of lead or silver nitrate with common salt, calomel or corrosive sublimate; insoluble precipitates are thus deposited in the corneal tissue. Black colored opacities may be spotted or cloudy and are due to bleeding from the vessels in the vascular cornea, or to adhesions of detachments of the pigmented iris; the latter may occur as a result of the attachment of the iris with the inner surface of the cornea.

The harm produced by opacities depend upon their location; an opaque spot in the center of the cornea cuts off more light than one located near the border. Total blindness is better (more safe) than partial blindness; hence large and dense opacities are preferable to weak and diffuse opacities, unless the latter can be removed. Scar tissue, from ulcers, wounds or abscesses, can not be removed in the horse; it may in some instances disappear in the ox, but in the dog, it is, as a rule, entirely removed. Chalk spots, streaks or stripes, as a rule, are permanent—not amenable to treatment. Weak and superficial opacities may be improved and many times can be removed by judicious treatment.

The following ointment may be employed: Yellow oxide of mercury, 4 grains; atropine, 1 grain; vaseline 4 drachms. Put a small quantity under the eye lid; then with fingers on the outer surface of the lids work or move them around over the cornea in radial and circular directions. Finely pulverized calomel may be thrown into the eye by placing a small quantity in a quill and blowing it into the eye. This should not be repeated oftener than once per week. In case the horse will not permit the blowing of the calomel into the eye, it may be used in the form of a salve, by mixing it with vaseline. A salve of potassium iodide 10 grains and vaseline 1 ounce may be employed. Some authorities recommend massage treatment—placing two fingers upon the upper eye lid and with slight pressure moving it in a circular direction over the opacity. This massage treatment may be repeated daily unless signs of inflammation should appear.

STAPHYLOMA OF THE CORNEA.

The bulging forward and outward of the cornea is designated *staphyloma*. It may be partial or complete, depending upon whether a part or all of the cornea is involved. Thinning of the cornea by ulceration and eruption of large abscesses, so reduce the resisting power of the cornea that the intra ocular pressure (pressure of the aqueous humor, etc.) distends, projects or pushes the cornea outward. The scar tissue resulting from ulceration is also unable to withstand the intra ocular pressure and the cornea

Fig. 75.—Total Corneal Staphyloma (after Armatage).

bulges forward, forming a partial staphyloma. A staphyloma from either of the foregoing causes is generally opaque, gray or white colored. In the healing of perforating wounds, the iris may adhere to the scar tissue, should the corneal scar then become distended it would carry with it the iris and the result would be called an *Iris-staphyloma*.

Occasionally intra ocular pressure pushes forward the entire transparent cornea.

The treatment of staphyloma is mainly preventive. In impending perforations of the cornea from ulceration, wounds or abscesses, a compress bandage and a 1 per cent. solution of eserine may be employed. In cases of established perforation the eserine or atropine may be used as before directed for perforating wounds of the cornea. Proper treatment of abscesses, ulcerations and wounds of the cornea will also prevent the formation of a staphyloma.

NEW GROWTHS ON THE CORNEA.

Pterygium (see fig. 76) is a peculiar fleshy growth consisting of an abnormal development from the conjunctiva. It has been observed in horses, dogs and

Fig. 76.—PTERYGIUM.—Fleshy growth on the conjunctiva and cornea (after DeSchweinitz.)

cattle. Its usual situation is at the inner side of the eye ball; it is triangular, or fan-shaped, with the apex extending almost to the center of the cornea; generally it is loosely attached to the cornea and the conjunctiva. Sometimes it is present at birth and at times it results from the repairing of an ulcer near the border of the cornea. It is believed that animals exposed to smoke, dust, heat and slight injuries to the cornea are predisposed to its development. Treatment consists in removing the loose pterygium with the knife or shears; this should be done by a surgeon after the animal is cast or confined and a solution of cocaine is applied to the eye. The cornea usually remains opaque at the spot from which the tissue is removed. When a pterygium results from the contracting scar tissue pulling the conjunctiva over a part of the cornea, it should be left undisturbed.

A Dermoid is a small, skin-like growth, which usually appears on the nasal side of the eye ball, partly on the cornea and partly on the conjunctiva. The outer surface is generally covered with long hair that

project outward between the lids. (See fig. 77.)

It occurs in calves, pups, colts and lambs and is most frequently present at birth; but, according to some authors, it may be acquired after birth. The hairs interfere with the rays of light and the dermoid, as a whole, irritates the cornea and conjunctiva. Treatment consists in removing the dermoid by

Fig. 77.—DERMOID.—Left eye of dog (after Gurlt).

means of the knife or shears. The animal is cast and the eye is anesthized with cocaine; then the loosely attached skin-like growth is carefully dissected from the cornea and conjunctiva; a permanent opaque spot remains, but the constant irritating action is removed.

DISEASES OF THE IRIS.

Iritis or inflammation of the iris is generally associated with diseased conditions of the ciliary bodies, or the choroid coat; because, a close connection exists between these parts of the eye, in location, attachments and blood supply.

Iritis also appears in the course of inflammation of the entire eye ball, in periodic ophthalmia (moon-blindness); it occurs also, in some instances, in connection with influenza, strangles (distemper), infectious inflammation of the lungs and pleura, in acute muscular rheumatism, in inflammation of the navel in young animals and occasionally in connection with catarrhal inflammation of the conjunctiva or ulceration of the cornea. Penetrating wounds or injuries near the margin of the cornea excite inflammation in the iris. Very rarely does iritis appear alone—without other parts being involved at the same time.

Owing to the fact that the iris is richly supplied with blood vessels, it is disposed to produce exudates, or to bleeding from its surfaces. The exudate may be flaky and gray, floating in the aqueous humor; or it may be pus-like and form a yellowish sediment at the bottom of the aqueous chamber.

These exudates may be tinged with blood or the entire aqueous humor may be colored by blood from the vessels of the iris. The exudates from the posterior surface of the iris falls between the iris and anterior or front surface of the lens; this pushes the iris forward; unless the iris is moved by the expansion of the pupil, the back or posterior surface of the iris becomes firmly attached to the capsule of the lens. The iris may, also, become attached to the posterior surface of the cornea; this frequently results from perforating wounds or ulcers of the cornea. The discoloration, swollen condition of the iris, and the flaky, purulent or bloody exudates can not be observed in many cases, because the cornea is so clouded or opaque. However, in the first or the last stage of such cases, one may be able to view the iris. During the "clearing up" period in moon-blindness one may observe the iris, faded somewhat in color, with its pupillary margin more or less ragged and irregular. Generally the tears flow in excess, dread of light and extreme sensitiveness are present during the active stage of iritis.

In the treatment of iritis the chief aim is to prevent the pupillary or free margin of the iris from forming attachments to the capsule of the lens or the posterior surface of the cornea. For perforations of the cornea directions for treatment have been given. To prevent adhesions to the capsule of the lens, the pupil may be kept expanded, during the active stage of the inflammation, by the use of atropine. The following has proven very beneficial in the hands of the writer: atropine 1 grain; potassium iodide 5 grains; pure water 1 ounce. A few drops may be put between the lids two times per day. The application of hot water will stimulate the absorbents and hasten the removal of the exudates and, at the same time, reduce the pain; while cold water fomentations will best reduce fever and inflammation.

CLOSURE OF THE PUPIL.

If the iris, during the extreme contraction of the pupil, becomes bound down to the capsule of the lens throughout its entire pupillary margin, it may leave a small, clear pupillary opening; this condition is designated exclusion of the pupil. But if the pupil be completely obliterated during extreme contraction of the pupil when the iris is attached to the capsule of the lens, or the small pupil becomes filled in with an opaque, inflammatory deposit or exudate, the condi-

tion is termed occlusion of the pupil. The destruction of the pupillary attachment of the iris to the lens capsule is soon followed by the formation of a cataract—opacity of the lens. The anterior division of the aqueous chamber is completely separated from the posterior and the iris is bulged forward at all parts except at its marginal attachments to the lens capsule.

If the attachments of the iris to the capsule are not firm and solid, the iris may be torn loose by the use of atropine. In case that does not succeed, the iris may be mechanically separated or detached by a surgical operation; or a new pupillary opening may be made by the operation known as iridectomy. These operations can only be performed by a skilled surgeon and are, many times, done after the lens has become opaque or the operation is followed by opacity of the lens, destroying the vision. The writer observed a case of occlusion of the pupil in both eyes of a three year old horse that was brought to the free clinic at the experiment station in Auburn. The cornea and aqueous humor were transparent, and the occlusion was very probably a result of acute iritis. A strong solution of atropine was dropped into the eye but the iris was so firmly fixed it could not be detached.

Excessively developed or large "soot balls" "grape-like bodies," hanging from the inner aspect of the superior part of the free margin of the iris, interfere with, or obstruct, the passage of light into the eye. The large, brown, flake-like bodies are quite frequently the cause of shying and cases have been recorded where complete blindness appeared as a result of these "soot balls" entirely closing the pupil. By a surgical operation they could be removed; this should be attempted only by a skillful operator.

Some white horses possess such a high degree of sensitiveness of the eye to light that in clear sunshine the pupil is closed by complete contraction and the animal cannot see until the sun sets.

CATARACT.

All opacities of the crystalline lens, regardless of size, origin or condition, are embraced by the general name cataract. A false or spurious cataract is produced by collections of pigment on the capsule of the lens, resulting from the tearing loose of the attachment of the iris to the capsule. It appears in dark, almost black, colored spots on the anterior surface of

the capsule. True cataract means that there must be opacity in the substance of the lens or its capsule. If the opacity is in the substance of the capsule it is known as capsular cataract, and when in the substance of the lens, it is designated lenticular cataract. Lenticular cataract may be partial or complete; the former when a small portion of the lens substance is involved and the latter when the entire lens becomes opaque. The causes of cataract are various; and in some cases are not distinctly understood. Occasionally a cataract may be present in one or both eyes at

Fig. 78.—PARTIAL CATARACT (after Armatage).—The opaque spot or spots in the lens or its capsule may be seen through the pupillary opening. Spots in the cornea should not be mistaken for the deeply located opacities in the lens.

birth. Heredity, no doubt, exercises a great influence in the production of cataracts during foetal life and also predisposes an offspring to the disease in later life. Cataract frequently manifests itself in the course of diabetes mellitis (sugar in the urine) but there is no positive proof that the sugar in the system causes the cataract. Hemorrhages (bleeding) in the aqueous chamber lead to straining of the capsule; the coloring matter of the blood is deposited in the capsule and the dark colored opacity remains after the blood is absorbed or removed from the aqueous chamber. Disturbances in the nutrition of the lens in old age is said to be the cause of senile cataract. In old age the lens substance becomes more and more solid; this leads to irregularity in its density; also prevents changes in the curvature of the lens that are necessary in the adjustment, or its accommodation, to different distances. The constant straining of the eye to bring a hardened lens to the various positions or forms for different distances, would lead to perverted nutrition and possibly to inflammation, in the capsule, the lens, the ciliary ligament or ciliary bodies. The nutrition of the lens may also be perverted by inflammation primarily in the lens itself or from extension of inflammation in the iris, the ciliary bod-

ies or the ciliary ligament, to the lens. Active inflammation in the lens or the surrounding parts, (from wounds, injuries or other diseases) generally leaves inflammatory products or deposits in the substance of the lens or its capsule, which form permanent opacities. Strokes on the head that produce sudden concussion are said to cause opacities in the lens. There are many cases of cataract, the cause of which cannot be determined; but the most prolific cause of cataract in the horse is periodic ophthalmia (moon blindness). Straining the eyes to see objects in imperfectly lighted barns or stalls, no doubt, plays an important part in producing cataracts as well as other eye diseases.

Occasionally small spurious cataracts of the capsule disappear, because of the great activity of the cells of the capsule. But opacity of the lens substance very rarely disappear; because changes in its structure take place very slowly, for it contains no blood vessels or nerves.

Sometimes small gray specks may remain unchanged; but, as a rule, the little gray star-like opacity gradually increases until total lenticular or capsular opacity appears.

In examining the eye for a cataract one may readily see a gray, a bluish gray, a greenish yellow, a brown or a pearl white reflection in the pupillary opening; the form (star-shaped, cloudy, fog-like, feathery, streaked, or scattered dots, ball-shaped, etc.) can be determined if the opacity be sufficiently de-

Fig. 78½.—TOTAL CATARACT (after Armatage).—The opaque lens gives the entire pupil a grayish white color.

veloped. The exact location and form of the small, beginning white speck may not be visible to the observer's unaided eye, especially out in the clear sunshine or when the ground is covered with snow. The animal should be placed so that the light falls upon the affected eye from a clear window or an open door in front of the animal. The observer then looks into the pupillary opening, standing in front or to one side; it is well to observe the eye from various points

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of view. If the pupil is contracted or too small to admit of sufficient examination, a few drops of a solution of atropine (1 gr. atropine to 1 ounce of water) may be put into the eye to expand the pupil. The lens may, also, be examined by placing the animal in a dark room and illuminating the eye with a candle, or a candle and a double convex lens, or with a candle and a small concave mirror (see methods of examining the eye.)

Treatment of cataracts in domestic animals consists chiefly in prevention. The reducing of all inflammations of the eye, the prevention of periodic ophthalmia, keeping the surroundings of the animal in proper condition and maintaining sufficient light for the animal to see distinctly in all parts of the stall without straining the eyes. As a rule it is best to have the light enter the stall or barn from behind the animal, or from

Fig. 79.—Luxation (dislocation) of the opaque lens into aqueous chamber; the lens lies in front of the iris, almost completely obstructing the passage of the light through the pupil.

both sides. In man the opaque lens is removed by a surgical operation, and a double convex lens is adjusted in front of the eye thereafter. But this is impracticable among domestic animals, since the double convex lens can not be adjusted to the eye, and the eye would always be hypermetropic (farsighted), permitting the animal to see close objects indistinctly and therefore inducing it to shy or become frightened. However the opaque lens is occasionally removed in horses and dogs to eliminate the unsightliness of the cataract; but there is always more or less danger of losing the entire eye ball.

AMAUROSIS.

Paralysis (palsy) of the retina or optic nerve has been technically named amaurosis. This condition may depend upon tumors in the brain, injury to the optic nerve between the brain and the eye-ball, or inflammation of the retina. Parasitic cysts often ap-

pear in the brain of sheep and the amaurotic condition of the eye is a characteristic symptom.

Abscesses sometimes implicate the roots of the optic nerve and amaurosis supervenes. Temporary amaurosis is present during the intoxication period of lead poisoning; poisoning from *Kalmia latifolia* ("ivy"); during the comatose condition of the cow in paturient apoplexy (milk fever); and in congestion of the brain. Inflammation of the retina is nearly always present in moon blindness and occasionally it terminates in paralysis of the retina—amaurosis. Detachment of the retina from the choroid, hemorrhage from the retinal blood vessels, and emboli (plugging by clotted blood) of retinal blood vessels and excessive loss of blood, cause temporary or permanent amaurosis. If, in the course of inflammation, if the retina pigment is deposited in the retina, it produces night blindness—a condition that prevents the animal seeing at night. Extreme sensitiveness of the retina as observed in Albinos and in some white horses leads to day blindness. In such cases, the pupil is so nearly or completely closed that the animal can not see in clear sunshine, or when the ground is covered with snow; but during twilight, on cloudy days, and at night vision is normal. Amaurosis sometimes results from castration.

In well established cases of amaurosis there is total blindness; yet there are no opacities in any of the tis-

Fig. 80.—AMAUROSIS.—The pupil is greatly expanded, gray-blue in color and the eye appears bright, glassy, very clear (after Armatage).

sues or humors of the eye. The eye is bright, clear and perfectly transparent. The animal steps high, stumbles over, and runs against objects in its way. If at a short distance, you noiselessly threaten to strike it, there is no winking or manifestations of fear. The ears are very sensitive to sound, and the outer ear are constantly on the alert to catch all noises. The pupil is expanded to its extreme limit; the iris is immovable and insensitive to light. Leading the animal

from the dark into the light, or from the light into the dark, does not change the size of the pupil or move the iris; while in the normal eye the pupil expands in darkness and contracts on being brought to light. The pupillary reflex (the light reflected from the retina outward through the pupil) is, as a rule, grayish-blue; but may, at times, appear more gray than blue, or present a more or less distinctly green color.

Treatment.—When amaurosis is a result of another disease, it is evident that the disease of which it is a symptom should be treated. In cases of recent standing, good nutritive food, extra care and a nerve tonic (drachm doses of *nux vomica* two times per day) may be employed with advantage. But treatment of long standing cases always proves valueless.

GLAUCOMA.

This name is applied to several varieties of a disease whose chief symptom is increased ocular tension. The increased intro-ocular pressure is a direct result of the jelly-like vitreous humor becoming thin, more watery and greater in quantity. This condition may appear independent of any other disease, but it generally appears, accompanied by, or as a sequel of, inflammation in the choroid or the ciliary bodies. However, the exact cause in many instances is unknown. The extra amount of lymph or watery secretion within the eye has been explained in various ways. Some have claimed that it was due to obstructions in the intro-ocular lymph vessels, which carry off the extra amount of lymph; others have suggested that the extra supply of water was due to excessive secretion by the choroid, and especially the ciliary bodies. The development of glaucoma is slow, its course is nearly always chronic and of a more or less intermittent form. Old animals which have far-sighted (hypermetropic) eyes are predisposed to glaucoma.

Symptoms.—Increased hardness of the eye-ball, or rise of intra-ocular tension, is the most prominent symptom. These conditions may be determined by placing the index finger of the right hand upon the upper lid of the left eye and the index finger of the left hand upon the upper lid of the right eye; then compare the tension or hardness of one eye with the other by palpating with the tips of the fingers; in increased hardness, firm pressure of the finger tip pro-

duces no impression; but the tension may be doubtful unless there is a marked difference in the impressions made upon the two eyes. The pupil is generally greatly expanded and the lens, as a rule, remains transparent, but may in rare instances be opaque. The depth of the anterior part of the aqueous chamber is diminished; the front surface of the iris is almost in contact with the internal surface of the cornea. The iris in some cases appears swollen and it is sluggish in movement or entirely inactive. The slight diffuse cloudiness of the cornea and the aqueous humor produces the sea green (glaucoma) color of the pupil. The episcleral and conjunctival vessels are more or less congested. But the excavation or sinking or depression of the optic nerve can not be seen without the aid of an ophthalmoscope; this cupping of the optic disc is due to the intra-ocular pressure; the cup is called the glaucomatous cup and the yellow halo around it is known as the glaucomatous ring.

Treatment consists in preventing inflammatory adhesions between the iris and cornea by using eserine. Also, reduce inflammation of the iris, ciliary bodies and choroid, that may lead to glaucoma; this may be accomplished by using hot or cold water fomentations. A well developed case can only be relieved by iridectomy. If eserine is used constantly it must be in a weak solution (1-10 to 1-16th grain to one ounce of water.) Iridectomy consists in removing a portion of the iris; in glaucoma one-fifth to one-fourth of the iris should be removed; or what is known as the broad peripheral iridectomy can be done only by a skilled surgeon.

HYDROPTHALMUS.

This is an enlargement of the eye-ball due mainly to an increased secretion of the aqueous humor, as in glaucoma. Sometimes the eye ball becomes twice its normal size; the cornea is generally so opaque that one cannot see the inner parts of the eye. In consequence of the enlarging of the eye-ball the attachments of the lens are partially or entirely torn loose and the lens may float in the vitreous or the aqueous humor. The enlargement of the eye may appear suddenly, in twenty-four hours; or may advance slowly. Seldom is it relieved by treatment. Occasionally the cornea is ruptured and the eye-ball lost. In the early stage, the cornea may be punctured, thus allowing the extra amount of aqueous secretion to escape; this

has, in some cases, proven beneficial; however, it cannot be done by the novice or the inexperienced.

DISLOCATION OF EYE BALL—EXOPHTHALMUS.

The eye-ball may be pushed out of its socket by tumors that originate behind the ball; sometimes by bleeding, from deep penetrating injuries, congestion of blood vessels; by horns of cattle, by biting and scratching among dogs and cats, also by dislocation of the lower jaw in the smaller animals. Occasionally an animal has its eye dislocated by having it crowded out with a blunt stick or club in the hands of a cruel boy or attendant. If the eye is not lacerated, bruised or seriously injured and the optic nerve is not torn, the ball may be returned to its cavity and a compress bandage applied over it to keep it in place. This should be done as early as possible or the swelling of the parts around the eye will prevent returning it to its proper place. However, the outer angle of the eye may be divided if necessary to admit the eye-ball to the socket. Should the eye-ball be badly injured or in case it is impossible to return it to the socket, the entire protruding parts may be cut away as deeply within the eye socket as possible; a pledget of cotton saturated with a one per cent. solution of carbolic acid or corrosive sublimate may be pressed into the cavity; a compress bandage should then be placed over the eye.

When the eye is dislocated by growing tumors in its socket, or if there are malignant or fungoid tumors within the eye, or if the eye is very badly injured, it may be necessary to extirpate the eye-ball, its muscles and the surrounding tissues. For this the animal must be cast, anaesthised with chloroform or some other anaesthetic; an assistant holds the eye lids apart; the operator grasps the cornea or the internal or external rectus muscle with the forceps in his left hand; the eye-ball, the tumor, or the entire contents of the orbital cavity, if necessary, are then removed, with the shears or knife. The bleeding is checked by applying a pledget of cotton, and a compress bandage as before described.

ANIMAL PARASITES OF THE EYE.

Filaria papilosa is a small, round, white worm that is found most frequently in the vitreous humor; but is occasionally observed in the aqueous humor and

commonly spoken of as the "snake in the eye." It is from one-half to two inches in length, and it is very probable that the young filaria reach the eye by way of the blood vessels, and develop in the humors of the eye. However, it is scarcely probable that the humors of the eye are the natural habitat or home of this parasite, since the same worm has been found in other parts of the body. One man reports that he observed a worm in the aqueous humor during a period of six years. But a few months is usually the length of time this parasite lives in the eye. A number of cases are recorded where this parasite has produced inflammation of the cornea and iris, with an extra flow of tears and opacities of the cornea and aqueous humor; these conditions may subside in a short time and leave a slight cloudiness of the cornea and aqueous humor. In certain districts in India this parasite is found very frequently in the eye of the horse and if not removed the eye goes blind. This worm has also been observed in the eyes of cattle. The worm may be removed from the aqueous chamber by cutting a small opening in the cornea at its upper border near the sclerotic margin; then remove the worm with small forceps. Before operating it is necessary to cast the horse or ox; anaesthise it with chloroform or ether and apply a ten per cent. solution of cocaine to the eye. After operation keep the eye moist and cool by frequent or constant cold water applications, and occasionally put into the eye a few drops of a one per cent. solution of carbolic acid or boracic acid, or a weak solution of corrosive sublimate.

Filaria lachrymalis is a small, white, round worm one-half to one inch long; it lives in the lachrymal ducts, under the hawk or eye washer and sometimes under the eyelids; it causes inflammation of the conjunctiva and lachrymal ducts and may close the tear ducts. Remove the worms from the tear ducts and the conjunctival surfaces by using small forceps; then apply, two or three times per day, a few drops of a corrosive sublimate solution (1 part c. s. to 1000 parts of pure water).

As elsewhere mentioned, Willach has discovered in the eye the young forms of various round and flat worms, and he claims that these animal parasites play an important part in producing periodic ophthalmia.

Since nearly all parasites gain admission into the system by way of the alimentary canal, infection may be prevented by observing a few precautions. Impure drinking water is probably the most common carrier of the various animal parasites. Hence always

give animals water from deep wells or pure springs, and never from ponds, rivers, or stagnant lakes. The digestive tract may become infected with these parasites by ingesting infected food. In all cases where parasites are found in the alimentary canal (manifested by the occasional passing of parasites with the feces), it is advisable to give one-half to one drachm doses of sulphate of iron or sulphate of copper in the ground food two times per day for one week; then give a purgative, consisting of one pint of raw linseed oil or one ounce of Barbadoes aloes.

STRABISMUS, SQUINTING OR CROSSEYE.

In this defect the visual axis or line of one or both eyes deviates from the normal. In other words, the eye-ball is turned inward, outward, upward or downward by the excessive contraction of a muscle or as a result of the paralysis of one of the muscles of the eye. In converging (inward) strabismus, the external rectus muscle may be paralysed and thus be unable to counteract the contractions of the internal rectus, its antagonist. This weakness, partial or complete paralysis of one or more muscles of the eye may be due to the pressure of tumors on the nerve of the muscle, rheumatism, tumors at the base of the brain or injuries of the muscle. Squinting or crosseye may be treated by section of the antagonistic muscle, but this can be done only by a skilled veterinarian. However, this defect is rare in domestic animals and may be detected by noting the squinting appearance and carefully comparing one eye with the other. When strabismus is present it causes considerable shying, which is especially annoying in nervous animals.

SOME OF THE CAUSES OF INDISTINCT VISION AND SHYING.

Hypermetropia or farsightedness is that defective condition of the eye which causes the principal focus to fall behind the retina, as illustrated in figure 81—H. In other words, the parallel rays which enter the eye come to a focus behind the retina. As a rule, the axis of the eye or the diameter from before to behind is too short and the cornea may appear less convex or flatter than normal. Convex glasses are used in hypermetropia in man, but are impractical with animals. Distant objects may be seen distinctly but the images of objects at a short distance are blurred and sometimes distorted into frightful forms. Hence farsighted horses are frequently frightened, or are caused to shy as a result of indistinct vision.

Myopia or shortsightedness is a condition in which the refractive index of the eye is too great or the axis of the eye is too long; the parallel rays come to a focus in front of the retina (as in fig. 81—M.); or the principal focus falls in front of the retina. In shortsightedness the cornea may appear very convex or conical as it frequently appears in cattle. Close or near objects can be seen distinctly but distant objects may be distorted or become very indistinct. Concave

Fig. 81.

Diagrammatic section of an eye (after Møller) to show:
 That the parallel rays of light, which enter the normal eye, converge or focus on the retina, E, making a distinct image.
 That, in the farsighted eye, the parallel rays focus at H behind the retina, forming a blurred image on the retina.
 That, in the shortsighted eye, the parallel rays converge at M in front of the retina, forming a very indistinct image on the retina.

glasse, are used by farsighted persons; but since the use of glasses is impractical for animals, shortsightedness, therefore, becomes a permanent cause of shying and fright.

In the Normal or Emmetropic eye, the principal focus falls on the retina, and distinct images of all objects, at near or far distances, form on the retina (fig. 81—E.) The cornea, the aqueous humor, the lens and the vitreous humor take part in the formation of the image. The cornea is the principal refracting medium when the eye is at rest; but the changes in the convexity of the lens (caused by the contractions of the ciliary muscle) are the means by which the eye is adjusted, or accommodates itself, to different distances.

In the far-sighted, short-sighted and normal eye the curvature of the cornea and of the lens is regular; but sometimes the curvature of the cornea may be so irregular that one part or meridian may produce short-sightedness while still another meridian may be normal. This condition produces a very much distort-

ed image and is a fruitful source of shying or the cause of fear and fright. Irregularities in the meridians of the cornea produce the condition known as astigmatism. This defective vision may also be caused by an oblique position of the lens. There are several kinds and degrees of astigmatism, all of which are very difficult to distinguish and can only be relieved by the use of proper glasses which are inapplicable to animals.

Slight cloudiness or opaque spots in the cornea, weak cloudiness of the aqueous humor, beginning cataract, beginning amaurosis or beginning glaucoma are accompanied by indistinct vision, and consequently produce frequent shying. In fact, partial blindness from any cause is always attended by indistinct vision and shying, fear or fright.

PERIODIC OPHTHALMIA—MOON-BLINDNESS.

This is an eye disease peculiar to horses and mules. Before the development of veterinary science the belief was prevalent that the moon exerted a direct or indirect influence upon the eyes; because the inflammatory attacks recurred at monthly or somewhat regular periods. Thus the names "moon blindness" and "mooneyed horses" originated. But as veterinary science progressed, extensive clinical and anatomical investigations made known the fact that moonblindness was a periodic or recurring inflammatory disease of the entire eye, involving primarily the iris, the choroid coat and the ciliary bodies.

Symptoms.—This disease makes its appearance very suddenly—generally beginning in the night; in the morning the eye is found closed, extremely sensitive to light with a very great flow of tears down over the cheek. In some instances there is systematic fever, while in other milder cases, it is not manifest; but, as a rule, the horse or mule is dull, wanting in vigor, and energy, indicating constitutional disturbance. The eye-ball is drawn backward into the orbital cavity, by the retractor muscle; this makes it appear smaller than the healthy eye; after several attacks the eye-ball is said to shrink in size—decrease in actual volume. The conjunctiva exhibits slight swelling and diffuse reddening; the surface blood vessels of the sclerotic are congested; this produces a light red ring, or seam around the cornea (pericorneal injection.) The cornea near its outer border exhibits a weak, diffuse cloudiness, which soon extends over the entire cornea; in the beginning this cloudiness is weakly

marked and the cornea appears as if it were glass with a thin layer of fat spread over it. In the advancement of the disease the middle or principal layer of the cornea becomes affected, which leads to intense, diffuse cloudiness and occasionally to vascularization of the cornea; the latter is distinctly visible at its border in a few days after the beginning of the attack. Sometimes a pearl white opacity may appear at some spot on the outer surface of the cornea. In the beginning the slight cloudiness of the cornea does not prevent one from viewing the iris, the lens and sometimes the vitreous humor and the retina. The purulent or flakey exudate in the aqueous humor and the excessive contraction (almost entire obliteration) of the pupil hide from view all the internal parts of the eye. The iris appears rough on its outer surface, slight-

Fig. 82.—Diffuse cloudiness of the cornea as observed in moon blindness and in inflammation of the cornea. The internal structures of the eye are cut off from view by the total opacity of the cornea (after Armatage).

ly glazed, lighter colored than normal; at times it is covered with a grey exudate. The ciliary portion of the iris is bulged forward and outward; the movements of the iris are slow and weak; it is quite insensible to variations in light, and the pupil does not expand in the dark. The color of the pupil when visible during its contraction is greyish green. Atropine causes the iris to expand slowly, weakly and irregularly; at points the pupillary border of the iris adheres to the capsule of the lens; the remaining parts are free; expansion of the pupil under such conditions produce irregularities in the iris and in the outline of the pupil (see fig. 83). At the lower part of the aqueous humor, in the anterior chamber, there is a gray-yellow, partly sedimentary, partly flocculent exudate, which sometimes is colored with blood. The quantity of the exudate varies; in the early stage of the attack—especially in the later attacks—it is visible by focal illumination as a slight cloudiness; at the height, or severest stage, of the attack the aqueous chamber

is almost entirely filled; the exudate settles to the lower part of the aqueous humor, and is gradually absorbed and entirely disappears in the course of ten to fifteen days.

No prominent changes are exhibited in the conjunctiva; however, the pigmentation of the conjunctiva of the eye-ball makes it difficult to observe variations in its blood vessels. Occasionally the conjunctiva becomes swollen and produces a slimy, serous secretion. In cases where the vitreous humor can be observed in the early stage of the attack it is found to be clouded. In the active, inflammatory stage, the eye-ball is found, by palpation, to be sensitive and hard. Opacity of the lens appears during the later attacks, and,

Fig. 83.—This cut represents the free border of the iris attached at points to the capsule of the lens, producing an irregular, ragged outline of the pupil and wrinkling of the iris. This may be observed after several attacks in periodic ophthalmia (modified from Armatage).

as a rule, when the lens become entirely opaque (total cataract) the periodic attacks cease in that eye. In six to eight days after the beginning of the attack the inflammatory appearances begin to subside; the sensitiveness to light and extra flow of tears abate; the exudate in the anterior eye-chamber begins to disappear; the pupil begins to expand and the iris may re-act with regularity. After about fourteen days from the beginning of one of the early attacks the inflammatory changes will have so completely disappeared that casual observation fails to discover anything abnormal in the recently diseased eye. However, a careful and critical examination discovers that the iris is still attached to the capsule of the lens; or one may find on the capsule pigment masses which were left here in the breaking away of the iris from the capsule; the iris is lighter in color—lighter brown, very like the color of dead leaves. Occasionally the iris is so pressed forward that it come in contact with the cornea and the anterior division of the aqueous chamber appears obliterated. The pale green appearance of the pupil indicates more or less cloudiness of the vitreous humor. In most cases, especially af-

ter the later attacks, there remains a bluish ring around the margin of the cornea—a diffuse cloudiness—the upper eyelid, instead of presenting a continuous arch, exhibits an abrupt bend a short distance from the inner angle; the upper lid and the eyebrow are also more wrinkled than usual; after a few attacks the eye-ball shrinks in volume, is smaller than normal, and in the interval between attacks the eye-ball, by palpation, exhibits uncommon softness. In most instances cloudiness of the vitreous humor and detachment of the retina can only be discovered by first expanding the pupil with atropine and then examining the eye with the ophthalmoscope. After the disappearance of the acute inflammatory symptoms, or after the inflammation has subsided and all damages are partially repaired, or the eye has “cleared up,” it may remain free from another attack for a month, for two or three months or even for a year. However, as a rule, the attacks occur somewhat regularly every four or six weeks until the eye becomes entirely blind. This disease generally results in the formation of a total cataract and occasionally in paralysis of the retina or optic nerve—amaurosis. The attacks may vary in severity in the different cases, but the successive attacks in each case grow more severe and leave behind more distinct and prominent signs of approaching total blindness. Five to seven attacks, as a rule, completely destroys the sight; thereafter that eye remains free from periodic inflammatory attacks; the other eye is then liable to become similarly affected until it goes blind. Rarely are both eyes thus diseased at the same time, but they may be attacked alternately until each one becomes blind.

The diagnosis of periodic ophthalmia is not difficult. The previously mentioned symptoms and course of the disease are generally quite distinct. There are exceptional conditions and times when the owner or observer will be in doubt. During the first attack, when the cornea and the aqueous humor are so badly clouded that the pupil, the iris and all internal parts of the eye are invisible, one can not determine beyond question whether it is a case of simple iritis or iritis associated with some form of influenza. In some attacks the cornea may be so opaque for a time that one is unable to discover whether the aqueous humor is clouded or not; in such a case the owner may believe that the cornea is injured in some way. Time alone will bring forth or make clear the other symptoms. Again, during the interval between the first and second or between the second and third attacks,

the before mentioned symptoms may be indistinctly marked; it will then be necessary to wait for the appearance of another attack. But in all the doubtful, indistinct cases, the characteristic fact of its recurrence in the same eye will remove all doubts in the mind of the owner if not in the mind of the buyer.

Causes.—A number of different microbes have been found in the tissues and humors of eyes affected with moon-blindness. Vigezzi has found a micrococcus, which he believes to be the direct cause of the disease; Trinchera discovered an immovable, curved bacillus; R. Koch found a short bacillus, rounded at its ends; Richter found a diplococcus and a triplococcus. However, no positive proofs have as yet been discovered, by experimentation or otherwise, that would justify a positive declaration in favor of any microbe. In fact the investigators have found a germ associated with the disease; but, if the microbe has been cultivated on artificial media the eye disease has never been artificially transmitted or produced by means of the germ.

Willach examined 37 eyes from 24 horses and has discovered a variety of forms and kinds of round and flat worms; most of them were found in the humors and represented the young stage in their development. Similar parasites were also discovered in the alimentary canal, the liver and the lungs. Willach believes that these worm-like parasites migrate from the alimentary canal during their early life—chiefly by way of the blood vessels—and thus reach the eye; these migrations take place periodically or at such times as the egg or young forms of the parasites reach the alimentary canal in the food or water. This theory would, of course, explain the periodic nature of the disease and many other phenomena connected with it. But the worm-like forms were found only in the examination of dead eyes, whereas the limited number of cases and want of transmission or actual production of the disease by experiment will not justify, beyond question, the 'far-fetched' conclusions.

On river bottoms, on moist clay soils, on marshy grounds, on moist coast lands of seas and lakes, in malarial districts, this disease is said to be most prevalent. In 1875, a regiment was moved from Frankfurt on the Main to Hofgeismar; at the former place moon-blindness never appeared; during the first year; at the latter place, 5 cases appeared among the horses of the regiment; the second year 12; the third year 11; the fourth year 14, and the fifth year 42. The

regiment that was stationed at Hofgeismar was moved to Frankfurt; during the last five years of this regiment at Hofgeismar there were 130 cases of periodic ophthalmia, and during the first five years at Frankfurt not a single case appeared. Hofgeismar, Saarbuck, St. Aveland and other places in Germany seem to be peculiarly adapted, by their moist clay soils, to the development of the microbe, the parasite, the gas or miasmatic factor that causes this disease. Records also show that on certain low lands of Belgium, France, Spain, Italy, Austria and England, this eye disease prevails extensively. Likewise in our own country certain localities have more cases of moon-blindness than others.

The writer has observed that this disease is more prevalent in the Southern States, than in the Central or North-western States. Compare the number of cases in the dry, cool climate of South Dakota with the moist, warm climate of Alabama and the result shows the extremes—the almost complete absence in the former State and the unpleasant prevalence in the latter. It is said to occur less frequently on lime soils. Clay soils will retain moisture longer and as a rule are richer in organic materials than sandy soils; consequently germs, malarial parasites, etc., will grow abundantly on the moist clay soil.

The disease appears on sandy soil if there is sufficient moisture; it will also appear on moderately high rolling land irrespective of the kind of soil if there be sufficient moisture—as a rainy season followed by a warm season with occasional heavy rains. A number of cases have been observed at Auburn, 800 feet above the sea level, with a gray sandy soil; however, there are red clay districts not far from Auburn. I, also, have reports of its appearance on sandy soils in other parts of this State.

In the period from 1879 to 1890, appeared 2183 cases of periodic ophthalmia among the horses of the Prussian army. Of this number 585 were in the 15th army corps; 358 in the 1st; 339 in the 11th; 145 in the 10th; 135 in the 5th; about 80 in the 2nd, the 3rd, and the 8th; about 70 in the 7th; about 60 in the 4th, the 6th, the 9th and the 14th; 49 in the guard corps. It will be observed from the above records that the disease prevailed quite extensively in the respective localities of the first five of the army corps above mentioned; while in the districts of those last mentioned the disease was comparatively rare.

Cloudy weather, or moist air, so common and constant on wet lands, is said to be a factor in causing

Mr. Lee Douglas, of Atlanta, Ga., on his blue ribbon horse.

this disease. Rank, succulent fodders, grown on wet lands, associated with a damp, sultry atmosphere, is conducive to the production of a lymphatic temperament or constitution—a horse with a coarse open texture of bones and muscles, with an excess of connective tissue, with thick skin, legs covered with an abundance of long hair and with labored, sluggish movements. No doubt, such animals are predisposed to moon-blindness. Fodder, hay or grass, from low, swampy or wet soils may also contain the germs or malarial parasites which are believed by some to cause this disease. In some localities of Europe the hay and fodders, grown upon certain soils, are said to be the cause, or the carriers of the cause from the soil to the animal.

A constant stimulating diet of corn, rye or barley grain—especially in summer or when given to the growing colt—contain too much of the fat and heat producing food and not sufficient proportion of the muscle and bone forming food; the horse so fed may be very fat but less able to resist the germs of disease, more liable not only to moon-blindness but also to "big head" and other constitutional diseases. Constant feeding of corn will certainly make the periodic attacks occur more frequently and also augment their intensity. This has been proven by a number of trials. A reliable farmer living near Auburn had a fine young mare that had been attacked two or three times; he believed the corn was making the disease worse; hence he withheld the corn and thereafter fed her upon oats; the eyes were not again attacked, and they recovered so completely that her owner could never observe anything wrong with them. Certainly the feeding of corn alone did not produce the disease, but after the real exciting cause had established it, the corn either maintained a supply of food for the microbe or diminished the general vigor of the animal or the resisting power of the leucocytes—germ destroying cells of the body. High feeding associated with irregular exercise, feeding irregularly and using unwholesome, decayed or partially rotten hay, fodder or grain; also the surface water of runs, ditches, ponds and shallow wells receiving the impurities from barns, barn yards or outhouses—all these are contributing causes and many times the impure water may convey the microbe, the originating cause, into the system.

Overworking an animal, no doubt, depresses the vigor and resisting power of the animal, thus attacks are more liable to begin or recur during the severe, exhausting spring plowing and summer work. Dur-

ing the time of breaking the colt and of the eruption of permanent teeth the attacks are excited to greater severity and are called forth more frequently. The eruption of nearly all the permanent teeth occur during the last half of the third, fourth and fifth years of age. The small teeth that usually appear just in front of the first molar on either side of the upper jaw, very rarely in lower jaw, are commonly called wolf teeth or "blind teeth." Many people believe that this little tooth in some mysterious way affects the eye, causes it to go blind "by pressing on the nerve of the eye." This is, to say the least, very unreasonable if not nonsensical. Those little teeth never affect the eye. No doubt they are broken off many times when a horse has an attack of periodic ophthalmia and the eye "clears up" in ten to fifteen days—not because the little tooth was pulled or broken off with a punch—but because that eye disease appears and disappears periodically. Heredity is certainly a strong predisposing cause of the disease. (It does not originate the disease, the offspring inherits the tendency or weakness of the eyes, that permits the originating excitant to call forth the disease with little resistance. This transmission, from sire or dam to the offspring, of defective tendencies is, no doubt, responsible for the appearance of periodic ophthalmia in certain families when the original blood was so contaminated. In France the government discourages, and prohibits when possible, the use of blind stallions or mares for breeding purposes. The farmers and stockmen of the country have observed and noted the influence of heredity in the production of moon-blindness. From the replies to a circular letter which I sent to farmers and stockmen in all the counties of Alabama, twenty-one stated that heredity was a primary or secondary factor in the cause of periodic ophthalmia.

Poor or badly ventilated and improperly lighted stalls or barns are also casual factors. Prof. Williams of Edinburgh says: "Fifty years ago thousands of horses became annually blind from ophthalmia; now-a-days one seldom sees a case of blindness from this cause. This happy result is due to the enlightened writings of Coleman on ventilation and the advance of veterinary science—facts which the public seem to ignore." In improperly lighted stalls or barns the light is so weak, or small in quantity, that the eyes are continually strained in order to see distinctly; or the light enters from a small window directly in front of the horse, placing the horse on the shady side of the objects in front of him, and this in combination,

or contrast, with the constant glare of the window, is certainly as trying on the eyes as insufficient light. The light should come from behind or from either side of the animal in quantity sufficient to make all objects in the stall distinctly visible. It has been suggested that exposure to cold, or to any of the atmospheric influences which ordinarily produce acute catarrh or cold in the head, will cause an attack of moon-blindness. The records of the disease in the Germany army show that more cases occur in winter than during any other season. But in this State the majority of cases appear in the spring and summer.

A rheumatic condition of the system is said to play an important part among the long list of causes of moon-blindness. It, however, like many other depressing diseases and influences, is only a preparing or predisposing cause or condition which can not originate the disease but may excite frequent attacks and increase its severity. Smoke, pungent vapors, hayseeds, dust or any local irritants or injuries may awake the latent tendency or augment the intensity of an attack. In short, whatever depresses the vigor or debilitates the system will aid in originating the disease and will also increase the intensity and frequency of the attacks; anything that strengthens the constitution or improves the animal vigor will be a protective or assist in preventing periodic ophthalmia.

The essential and originating cause is very probably a microbe, a miasmatic germ, an animal, worm-like parasite or the poisonous product of a germ. The natural habitat or its native place of propagation and development seems to be on moist lands that are, during one season, extremely wet and at other times dry enough to bring forth crops. The surface water of such districts, and the fodders, grasses and hays grown on such lands, transmit or carry the germs into the system of the animal.

During January, 1893, the veterinary department of the Alabama Agricultural College issued about two hundred circular letters containing questions relative to eye diseases among domestic animals; these were mailed to farmers and stockmen in all the counties of Alabama, and they were also published in many of the daily and weekly papers of the State. The principal question in the circular letter read as follows:

"Are horses and mules in your beat or county affected with what is commonly called moon-blindness? If you have such an eye disease please state how frequently it occurs, and what is your view of the cause of it."

I received in all nearly 125 replies. From these replies I have obtained the following records on periodic ophthalmia or moon-blindness:

Eighty (80) cases were reported in such a manner as to leave in doubt just when they occurred; 33 cases were reported as being in existence at the time (January and February) of replying; 7 parties report that the disease was prevalent in their respective beats ten to twenty years ago, but not of late years. During the first three months of 1892 and during the same time in 1893, 21 cases have come under my observation at the free Saturday clinic; these cases were from the country and towns surrounding Auburn, and represent fully ten per cent. of all the diseased cases that appeared at the free clinic during the same time. The above records certainly indicate that periodic ophthalmia is a common disease among horses and mules of Alabama; and according to the reports on other eye diseases it is the most prevalent and frequent cause of blindness.

The reports do not give data sufficient for one to state in just what beats it occurs, but they do show that moon-blindness has been, or is at present, in nearly every county in the State; that annually a great many valuable horses go blind as a result of it. Generally speaking, the reports seem to indicate that the disease is most prevalent in the low lands or malarial districts of the State; yet the knowledge given of the local geography of the places from which the reports come, is not sufficient for one to make an accurate comparison.

From the replies I find that a variety of opinions were expressed as to the cause, and a great many failed to express their views, while others said they did not know. Let me now give a consensus of the opinions expressed. Six parties believed that improper and irregular feeding are important factors in the cause of moon-blindness; 3 say "not enough variety in diet;" 4 believe "too much fodder and grain and not enough hay" is the cause; 1 says "feeding corn to colts;" 9 claim "feeding corn as an exclusive grain diet" is the direct cause; 3 give "exposure to cold" the credit; 1 says the "eruption of permanent teeth and the shedding of colt teeth;" 1 says "blind teeth;" 1 makes "high feeding and irregular exercise" responsible; 11 claim that "overwork" in various ways is a potent casual factor; and 21 say heredity, especially in blind or "weak-eyed" breeds, is the chief cause; six (6) parties traced the history directly to a blind sire or dam. Surely the above ideas, relative to the

cause of periodic ophthalmia, show that the stock owners of Alabama have been searching for the cause; and if they have not discovered the actual originating cause, they have found factors that intensify or conditions that make the disease worse. Some have suggested that homebred horses are more disposed to this disease than horses or mules brought here from other States; yet others claim that the opposite is true. I am of the opinion that the animals freighted here from Kentucky, Missouri, Illinois, etc., are far more liable to contract periodic ophthalmia than home-bred horses, because the diet of the Northern horse is very greatly changed and he must also become acclimated—his system must be adjusted to new climatic conditions.

The susceptibility of an animal is determined to some extent by age. From the reports of cases where age was mentioned, and also from the records of European authorities, the period of greatest frequency is from 3 to 9 years of age. Some have placed this danger period from 2 to 7. Yet it should be remembered that periodic ophthalmia does occur outside of the above age limits, for I have reports of cases 12, 13 and 15 years old.

Treatment.—Taking into consideration our indefinite knowledge of the originating cause and the numerous attending, exciting and predisposing causes, and the fact that the disease generally results in total blindness in one or both eyes, it is evident that preventative treatment is the most profitable and reasonable. The drainage, ventilation and light in most barns are sadly neglected and generally very defective. The barn is usually resting on the ground and the stalls are filled with clay which becomes saturated with urine. The clay allows very little moisture to pass through it; the urine, which falls upon it and with which it becomes saturated, passes off mainly by evaporation. With little ventilation or drainage below it, the clay rarely becomes dry and the atmosphere of the stall is constantly saturated with unhealthy gases (ammonia, etc.,) from the fermenting urine and decomposing organic matter of the feces. Such unhealthy conditions can be greatly improved by following the methods usually adopted in building houses in this climate. The floor of the barn should be two to three feet above the ground; this may be accomplished by making the brick or stone pillars for underpinning the required height and using strong plank two inches thick for flooring.

Lattice work between the outside pillars will permit free circulation of air under the barn and prevent the use of the basement for a dog house, pig pen or as a place for fowls. This will give good, cheap drainage below with excellent under ventilation. The ventilation of the box stall (the best and healthiest kind of stall) should be so arranged that the hot and light air may escape through an opening or series of openings in the upper part of the outer wall, permitting it to pass directly out of the barn. Similar openings should be located in the outer wall near the floor to allow the heavy gases (carbonic acid gas exhaled by the lungs, etc.) to escape. Besides these openings lattice box stall doors and lattice outer hall doors and windows should always be in use for summer ventilation. There may be objections (its hardness and the drying out of the feet) to standing a horse on a plank floor; but these may be overcome by bedding or littering the box stall; by occasionally soaking the feet in water, and, when nearly dry, oiling them with an ointment made of one part of pine tar to eight or ten parts of lard or cotton-seed oil. The light should, as before mentioned, enter from behind or from both sides of the animal; in the box stall the light should thus enter when the horse is standing at the manger. Furthermore, the light should be so arranged and of sufficient quantity to enable the horse to see distinctly in all parts of the stall.

The water supply and time of giving water to horses should be carefully considered. All surface water, from ponds, brooks, rivers and shallow wells should be avoided. Spring water, taken directly from the spring, filtered rain water or other kinds of filtered water, or water from deep wells are best, and less liable to contain disease-producing germs. The horse and the mule should always be given water before feeding grain—never after, unless it be given two hours after feeding.

A constant corn diet is to be avoided, especially as a food for colts. It is extremely doubtful if corn for colts is ever advisable. Furthermore, it is injudicious to feed horses or mules upon corn as the only grain food at any other time except in the cold period of winter. In fact, there is no time in this climate when corn alone is really needed or demanded by the system. Far better results will be obtained by using oats as the staple or chief grain food; and, at times, equal ground corn, cow peas and oats, or equal parts of ground corn and wheat bran, may be substituted for

oats alone. Corn should never be fed to horses with weak eyes or with diseased eyes. Corn and fodder (leaves) form the staple articles of food, for horses and mules, in some parts of the South with a climate that will produce green rye for soiling during the entire winter and green sorghum and green millet for summer. Corn is too stimulating and contains too much heat-producing material; the corn fodder is a dry, rough food, which in combination with corn is liable to lead to attacks of constipation, producing passive congestion of the blood vessels of the brain and the eyes. To be sure this does not always occur, but many times an attack of periodic ophthalmia may thus be called forth. Variety in rations should always be considered, and extended according to local food supply; watch the effects of the quality and the quantity of the various foods, and many times you will be able to regulate the diet of the animal according to your experience in feeding it. No fixed or absolute laws can be made to fit all cases; horses have their individual peculiarities as well as persons.

High feeding, with irregular exercise; excessive and exhausting work; exposure to cold (rheumatic influences) are to be avoided as far as possible, especially with animals affected with periodic ophthalmia or predisposed to it.

The indiscriminate use of blind animals for breeding purposes can not be too strongly condemned. Heredity is certainly the most potent predisposing cause of periodic ophthalmia. Mares with weak eyes and with a lymphatic temperament and structure should not be bred to stallions of similar temperament and form.

Proper curative treatment will sometimes check the progress of the disease, and may, in rare instances, result in permanent relief. During the active inflammatory stage bathe the eye in cold or hot water for 2 to 2 hours morning and evening; after each bathing put into the eye a few drops of the following solution: Potassium Iodide, 10 grains; Atropia Sulphate, 5 grains; Boracic Acid, 10 grains; Pure Water, 2 ounces. This medicine may be used for 6 to 15 days until the eye begins to clear up; then use the same prescription, omitting the Atropia Sulphate. When possible adjust over the eye a cotton cloth or small bag of cotton, kept constantly wet with cold or hot water. It is well to keep the horse, during the inflammatory stage, in a dark box stall if the ventilation, cleanliness and drainage of the stall is healthful and good. If the horse is constipated a mild purga-

tive (one-half pound of Glauber's salts or one-half pint of raw linseed oil) may be given. Constipation may be thereafter avoided by giving a bran mash once or twice per week. Moderate and regular exercise or easy work is beneficial, but keeping the affected horse or mule at hard work is decidedly injurious. In every instance it is wise to remove, when possible, all predisposing or attending causes.

Recently a new treatment has been used in treating periodic ophthalmia. Harrison originated the plan of opening the anterior chamber of the eye (the cavity containing the aqueous humor) and allowing the aqueous humor and the pus-like material with its germs or parasites to escape. This should be done with great care and the eye washed or bathed, regularly every day with water that has been boiled and cooled. It is well to add a little soda, carbolic acid or creolin to the water. The puncture is made in the cornea near its lower border and from below upward. Unless the operator has had experience it is best to employ some veterinarian who is an experienced operator.

As indicated in several reports from different parts of the State, periodic ophthalmia seems to be disappearing in certain localities. It will certainly decrease in frequency, or entirely disappear, when the stock raisers comply with the hygienic laws governing the health of horses and mules. The principles of feeding, ventilation, drainage, breeding and sanitation in general must be studied and practiced, from a scientific stand-point. Besides, the South can and should raise her own mules and horses. Healthier, better and cheaper animals can be bred and raised in the South than the majority of those that are annually shipped here from the North.

METHODS OF EXAMINING THE EYES.

Remove the blind bridle or any harness obstructions to free vision. Tie a cloth over one eye and then lead the animal over obstructions that will cause stumbling or high stepping. Repeat this test with the other eye blindfolded. If the animal with one eye blindfolded stumbles over low objects the vision of the other eye is defective. Note the attentive and erect position of the ears indicating that they are attempting to compensate for the defective sight. Carefully compare the fullness or prominence of one orbital region with the other; note that in fat or young animals the orbital cavity is full and that in poor or old animals the eye

socket is not completely filled and the orbital rim or bony border is prominent. Excessive fullness of one orbital region would indicate that the eye-lids or the tissues, surrounding the eye-ball, are swollen, or it would indicate the presence of a tumor in the orbital cavity. Closely observe the form, position and condition of the eye-lids: the presence and position of the eye-lashes; also, compare the curve of the free border of one upper lid with the same lid of the other eye. Examine carefully the secretion at the inner angle of the eye. The tears are like water; mucus appears gray and flocculent; pus mixes with the tears and appears yellow and cloudy; in the dog pus sometimes is colored green. If the mucus and pus are mixed, the mucus flakes are colored yellow. An excessive quantity of tears, mucus or pus is manifest by the flowing of the secretions down over the cheek. The presence of the mucus, pus or an extra quantity of tears flowing over the cheek should induce the observer to look closely for foreign particles in the eye, inflammation of the conjunctiva, abscess or ulceration of the cornea and closure of the lachrymal ducts. For further examination the animal should be taken to a barn or stall. It is best to use a stall with one window or one door; the animal's head should be turned to the open door or to the window, allowing the light to fall on the eye from directly in front or from an angle to the right or left of the front. The eye may be opened by gently and firmly pressing the lids apart with the thumb and index finger, using the right hand with the left eye, and the left hand with the right eye. To see the conjunctiva of the upper lid, it may be everted by grasping the eye-lashes with one hand and everting the lid over the forefinger of the other hand. Examine closely the haw or "eyewasher" and all parts of the conjunctiva for signs of injury, inflammation and irritating particles. Examine also the opening of the tear ducts.

The observer's attention is next directed to the size, form and position of the eye-ball. It is always advisable to compare one eye with the other that the abnormal may be judged by its deviation from the normal. If the eye-ball projects outward and forward excessively, dislocation of the eye-ball, hydrophthalmus (excess of water in the aqueous humor) or a tumor in or behind the eye may be suspected. If the eye-ball is drawn backward into the eye socket, severe inflammation is present, attended by extreme sensitiveness to light, as in the beginning of an attack of moon-blindness. A decrease in volume or size of the eye-ball,

(after repeated attacks of periodic ophthalmia and in tuberculosis of the eye-ball) is manifest by apparent drawing of the eye into the socket and the more or less infolding of the upper lid near the inner angle of the eye. The tension and hardness of the eye-ball may be tested by palpation upon the upper eye lid, with the index finger; both eyes should be tested at the same time that one may be compared with the other. Note the presence or absence of the congestion of the pericorneal blood vessels; its presence indicates inflammation of the ciliary bodies, the iris and sometime the choroid coat.

The cornea may be next viewed from various positions, noting carefully its curvature, its opacities, the presence or absence of ulcers, vascularization, swellings or new growths. The location, color and limitations of the opacities should first be determined. The weaker the opacity or cloudiness the more blue the color; intense opacities are white. Black opacities of the cornea signify pigmentation from iris adhesion or from blood stains. Striped and pearl like opacities with sharp limitations, point to scars or chronic changes in the cornea; chalk spots result from the employment of silver and lead salts in wounds and ulcers of the cornea. Viewing the cornea in profile, or from one side, will enable one to locate the opacity, revealing in a degree what layers of the cornea are involved and to a certain extent enables one to determine the curvature of the cornea, especially in partial or total staphyloma and extremely flat or very conical form of the cornea. If the transparency of the cornea will permit, investigate the aqueous humor, searching for the gray, flocculent exudate or the yellow, sedimentary pus exudate in blood effusions; these may be present in penetrating wounds of the cornea, iritis and moon blindness.

The color, condition of the outer surface, movements and attachments of the iris should next be examined. The iris may become grayish brown by the deposition of inflammatory products in its substance, or become gray from the deposit of an exudate on its surface. The bluish-green color of the iris, manifest after one or two attacks of periodic ophthalmia, is due to an atrophied (shrinking) condition of the iris. Occasionally in cattle a tubercular growth develops from the iris and completely fills the aqueous chamber of the eye. The iris may be attached by inflammatory adhesions to the capsule of the lens (as in iritis or moon-blindness); or it may thus adhere to the posterior surface of the cornea (a result of penetrating

wounds and ulcers.) By the use of atropine, if the pupil is small or contracted, or eserine if the pupil is large or expanded, these adhesions may be destroyed or their permanent presence made known by the immovable iris and unchangeable form of the pupil. The iris, when attached to the capsule of the lens or to the cornea, may appear rough on its outer surface and its pupillary border is more or less irregular. The ragged, irregular border of the pupil should not be mistaken for the large brown "soot balls" that appear so frequently along the upper and lower parts of the pupillary border of the iris. The movements of the iris should also be watched when the animal is taken from the sunlight into the barn, or from the dark stall into the sunshine. If the pupil contracts regularly in bright light and expands regularly in partial darkness, the action of the iris is normal. But should the pupil remain greatly expanded under all conditions of light and darkness, one would suspect partial or total amaurosis. If the pupil remains partially or greatly contracted under all conditions of light and darkness, one should suspect adhesion of the iris to the capsule of the lens.

The pupillary reflex or color of the pupil is the reflection of light from the retina and the choroid. The normal color of the pupil varies with the variations in its size or in its degrees of expansion or contraction; its color also changes with the variations in the light. By great expansion of the pupil it appears blue-green; by medium expansion it appears blue-black; by great contraction it appears black. The color of the pupil in amaurosis is generally lighter, more clear and glassy than in the normal eye. When the pupil is small atropine should be used to produce maximum expansion. Or, the animal may be taken into a moderately dark stall where the color of the light reflected from the upper part of the retina and choroid will be green, and that reflected from the optic papilla (spot where the optic nerve enters the eye ball) will appear light red. This light red color is very distinct in carnivorous animals.

Cloudiness of the lens or the vitreous humor changes the color of the pupil according to the intensity of the cloudiness. Total cataract gives the pupil a gray, a white or whitish yellow color; while by a partial cataract the normal color of the pupil is cut off at the points or places of local opacities of the lens or its capsule. In cloudiness of the vitreous humor the pupil becomes more or less distinctly green. A liquid condition of the vitreous humor combined with

cloudiness of the same also produces a distinct green pupil. Sudden or great movement of the cloudy vitreous humor, is a certain proof of its fluidity. The observer should view the pupil from various positions; by the use of the hand or a black hat the superfluous rays of light, or those coming from certain directions, may be cut off. The observer should not mistake the images of white objects (white shirt fronts, windows, holes in the building), for white or gray opacities in the lens or other parts of the eye.

Dislocation of the lens, falling of the opaque lens into the anterior or aqueous chamber of the eye has its appearance suggested by figure 79. But if the opaque lens should fall into the vitreous humor, the upper part of the pupil may remain transparent, and the small appearing optic papilla might be visible; yet a portion of the white or gray opaque lens could be seen through the lower part of the pupil; as a rule, the iris remains passively inactive and its pupillary border floats in the aqueous humor. Sometimes the lens may be partially dislocated or may have some shred-like, or hanging thread-like, attachments to its old location; these conditions would present different views in the pupil.

In order to be more accurate in locating and discovering opacities, the animal should be placed in a dark room where the eye may be illuminated by the use of a lamp or candle. The lamp may be placed in different locations, in front of, and outward from, the eye to be inspected; opacities will then be made more distinct. Three images of the flame may be seen as illustrated in figure 84. In the normal eye the first image is the largest, upright, the most distinct and reflected from the front surface of the cornea; the second image is smaller, upright and reflected from the

Fig. 84.—This cut (after Schlampp) shows the images of the candle's flame. The animal should be placed in a dark room or stall, or the test may be made at night in an ordinary stall; the candle is held a short distance in front of the eye to be examined and the following images, as above illustrated, will be seen. The first upright image is reflected from the cornea; the second upright image of the flame is reflected from the capsule on the anterior surface of the lens; the third or inverted and small image of the flame is reflected from the capsule on the posterior surface of the lens. The dark back-ground of the cut represents the pupil.

anterior surface of the lens; the third one is the smallest, inverted and reflected from the posterior surface of the lens. In the normal eye it will be noticed that these images are more or less distinct and that, as the lamp or candle is moved, the first two images of the flame will move in the same direction that the candle moves, but the third or inverted image moves in an opposite direction to that of the candle. As the candle is moved about in front of the eye, it may reach a place where the first two upright images remain clear and distinct, but the smallest and inverted image becomes cloudy and indistinct; this would indicate that the substance of the lens or the posterior part of the capsule is opaque at the point or spot where the candle's rays attempt to pass through. If the second image becomes indistinct the opacity lies in the anterior part of the capsule; if the first image becomes hazy and diffuse the cloudiness is in the cornea. Total cloudiness of the cornea would obliterate all three images, and the diffuse cloudiness of the aqueous humor obliterates the second and the third image.

A small double convex lens may be used, as illustrated in figure 85, to focus or collect the rays from a candle or lamp in a dark room or stall. Or, a con-

cave mirror (with a small, round opening in its center for the observer to look through) can be used to collect and reflect the rays from a candle or from an open door or window; in using the mirror the candle or window should be backward from the head and outward from the shoulder or body. By employing the double convex lens or concave mirror, the transparent or opaque condition of the cornea and the aqueous humor may be distinctly observed and many opacities can thus be seen that are invisible in ordinary daylight. By employing atropine to expand the pupil, slight opacities of the lens may be made distinct and cloudiness of the vitreous humor may be observed. These methods of illuminating the eye also enables one to carefully examine the condition of the iris.

The ophthalmoscope is an instrument that is used by oculists to look at the retina, its blood vessels, the papilla optica, and to determine the degree of farsightedness, shortsightedness, astigmatism, etc. Its use, however, requires great skill and much practice; hence, direction for using it will be omitted, since they would be of little value to the average man.

Fig. 85.—This cut (after Schlampp) illustrates the double convex lens is employed in illuminating the eye or parts of the eye for the purpose of examination. The examination is made in a dark room or at night; the glass lens is moved forward and backward until the candle's rays are focussed upon the desired part or various parts, as it is up on the cornea and lens in the above cut.

CONTROLLING THE HORSE.

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DEVICES FOR CONTROLLING SOME OF THE BAD HABITS OF OUR HORSES, ETC.

For the want of a proper education when young, together with the careless handling and abuse of our horses, they contract habits that are both dangerous to themselves, their companions and those who handle them.

It has been our purpose all through life to carefully study horses' habits and the laws of their control with the least possible inconvenience and punishment and we are thoroughly convinced that the simplest and most effective means of control is through devices that harmonize with the laws of his organization.

His strength being superior to that of man, precludes, at once, the idea that we should ever go to battle with him on anything like equal grounds; in fact, we would discourage the idea of ever getting into a fight with our horses, for this reason, since they are endowed with the same passions as ourselves, such as, resentment, courage, revenge, etc., etc. We must banish the idea that our horses are "mere brutes" to be yanked, kicked and pounded at will, without the remembrance of the event being stored up by them, for some opportunity when they will have the best of us. They are not only endowed with passions, but intellect as well, and just in proportion to this latter endowment, and their educational advantages, is the true value of the horse. We estimate men by their natural ability and education, then why not apply the same rule to our horses? We have good and bad citizens, and for the bad we have made laws and prisons for their control, and if we would correct the bad habits of our horses we must use the means with which to overcome their muscular power without injury, or arousing their passion toward us, as is naturally engendered by whipping, "yanking" and kicking. Let us so confine them that they have to operate against themselves rather than us, and, our word for it, the results will be much more satisfactory than the usual methods of either indulgence or punishment.

The usefulness of our horses is, to a marked degree, just what we make it. We do not advise letting our horses control us by their superior strength, neither do we encourage the idea of conquering our horses by punishment and abuse. The true principle of control of horses for the best results, is by such means as would deprive them of their power to oppose us, and our kind and humane treatment of them whenever we are in close contact with them. Whenever we get our horses into trouble, confinement or entangle, it is far better to be away from them during their efforts to liberate themselves, and, when they find all efforts fruitless, then is the proper time to go to their assistance and relieve them of any entanglement or uncomfortable position they may have got into in the struggle, bearing this one principle in mind strictly, we become masters of the situation, if our means and methods are practically applied.

One point of great importance in the management of horses is to be sure we have the absolute means of control, without failure either of principle or appli-

ance and when these are properly applied, any except insane horses will readily be made subservient to the reasonable requests of man.

EDUCATION OF THE HORSE IN THE STALL

It is a great satisfaction to any owner of a good horse to have him understand and promptly comply with all requests while in the stall, without excitement, irritation or annoyance. One of our first duties is to show the horse what we want of him in the stall and how he should comply. After tying him to the manger and getting out of the stall, the next thing is to get back into the stall on either side without his resenting or crowding us in the stall—with perfect indifference to being pushed about from side to side.

(No. 1.)

Many a colt has been forever spoiled the first day he was in the stable, by the treatment he has received in trying to get him to stand over in the stall. It is usually commenced by trying to push him over from side to side; if we have not strength enough to overcome his, then we are too apt to resort to the whip, fork-handle or club to accomplish the desired result, and by this last means frequently make a bad actor in the stall forever.

Our first illustration (Fig. 1) is designed to show not only the position frequently taken by the horse in the stall, but the expression and dangerous action towards any one who may desire to enter. He not only refuses to stand over, but indicates that he will kick if he is interfered with.

What is to be done? Shall we go at him with a

club, so show him what we want him to do? Or shall we anticipate the difficulty, and before placing him in the stall provide the means of easy control, as shown in our illustration (Fig. 2). This consists of a staple and ring just over the manger (to which his halter should be tied) about as high up on the side of the stall as his back. Another ring and staple at the rear of the stall partition (see letters A and B), then tie a

(No. 2.)

rope or strap into the ring of the nose band of the halter, pass it through the ring A and back to the ring B, to which tie sufficiently long to enable the horse to eat the entire length of the manger. When we go to enter the stall, we place our hand on him, as represented in Fig. 1, and if he refuses to stand over, we reach forward as far as possible in the stall and grasp this side-rope or strap and at the very instant we say "stand over" we pull on the rope, which brings

stands over in the stall to the right whenever requested, without fear, excitement or resentment. When he has fully learned what we want from that side of the stall, then we change the rope to the other side of the stall and proceed as before, and we are soon well paid for our trouble, in having a horse that promptly responds to our every wish in standing over in the stall.

This remedy for crowding in the stall is so simple and practical that we are surprised that any horse is permitted to continue the habit. The principle is that when we pull the head to one side of the stall it is perfectly natural that the rear end must go to the opposite side which gives room and safety to enter. Do not try to whip to submission, but use the means that control the actions, treat kindly, and success will crown our efforts, in the management of our horses in the stable.

THE HALTER-PULLER.

This habit when once confirmed is quite difficult to entirely eradicate. The first way to avoid this bad habit is proper education to the halter when young.

When we have a confirmed halter-puller, in the stable or out of doors, the best method we have tried is to take a rope ten or twelve feet long and say 3-8 to 1-2 inch in diameter, tie a knot in one end, then a loop that will not slip, or a ring tied in the end will do as well. Place this rope around the body of the horse just in front of the hips, with the slip immediately under the body at the flank; then pass the rope along under the body, between the fore legs, under the noseband of the halter, then through the ring or

(No. 3.)

his nose to the side of the stall to which the rope is attached, and, by a slight push at the hind quarter he is forced in the opposite position in the stall, and we step in by his side with perfect safety from kicking, fighting or crowding (see Fig. 2), and this followed up for a few days (often repeated) the horse readily

hole of the manger or post to which we want to hitch him and back to the ring of the head-stall, and tie so as to give him about three feet between his head and the place to where he is hitched—all as shown in figures 3 and 4. Whatever he is afraid of may now be brought in front of him, and instead of waiting to see

whether he will pull, we start for him and don't stop until we reach the point to where he is hitched, at which time, nine times in ten he will be there to meet us; as he will only pull while one breath lasts him, when he must come forward for relief. Illustration Fig. 3 shows him doing his utmost to break loose, but being hitched at both ends of his body and the pull equal at front and rear, he suddenly leaps forward to relieve the pressure at the rear end and appears as shown in Fig 4, with an entire change of expression and demeanor. He may try it two or three times always with the same results. We should not hurt him,

(No. 4.)

nor should we give way for him when he pulls; but rather follow him up to show him that he cannot get away from his object of fright, which soon convinces him that his efforts are fruitless. He may now be tied with a halter-strap that will break at only a moderate pull, with the rope from his body secured to the hitching post or manger so that the pull on his head comes first, and when it breaks he comes suddenly into the hitch around his body which so surprises him that, in a few days, by hitching with a still weaker and weaker tie-strap, he cannot be induced to pull enough to break a mere string. The hitch around his body should not be neglected for quite a time, so that should he pull back and break loose, and get away, he has intelligence enough to know when the rope is around his body and when it is not.

Right here we want to say to our readers that there is a principle with horses, that whatever happens at the front part of their bodies impels them backward, and at the rear part induces them to move forward, and with this ever in mind it will greatly aid us in all dealings with our horses.

KICKING AND PAWING IN THE STALL.

This is a very disagreeable habit, and unless the proper means are used at the outset it is also quite difficult to break up with a hope of permanent cure.

Fig. 5.

It can be prevented at any time; and as soon as the horse commences kicking the side of the stall or his stall companion, he should be shackled at the hind legs as shown in Fig. 5. A good, strong strap buckled around each hind leg above the ankle joints, with a coupling strap between, as shown, will effectually prevent it, and if persevered in its use will usually cure the habit.

Pawing is prevented by shackling the front legs in the same manner as shown also in Fig. 5.

How frequently we see a pair of sharp shod horses put into a stall together and very soon find one, or both, so badly cut from kicking as to render them unserviceable. Now this could be prevented by shackles on the hind legs of both, and still giving them sufficient liberty to step about the stall or lie down and get up. It is best, however, to first put the shackles on for once or twice before getting sharp shod to get them used to them and to prevent calking themselves. Many a valuable young horse has been ruined in the hind legs from kicking the stall, generally acquiring the habit for the want of exercise. He has no chance to exercise, consequently he goes to kicking the stall until it becomes a confirmed habit. Pawing in the stall generally results from the same cause. The shackles are very effectual with no

danger after the first few minutes, and then only from self-calking. A trial will convince the most skeptical.

EDUCATING THE HORSE TO BACK.

Almost everybody endeavors to educate their horses to back by pulling on the reins, and in the majority of cases they are successful; but there are many horses that do not understand what is wanted of them, and become sullen, and then it is almost an impossibility to force them backwards by the bits.

A very simple and effectual method is to stand in front of the horse and, by only a gentle pressure on the bit with one hand, and a push with the extended fingers of the other hand between the point of the shoulder and breast-bone, he will readily go back-

Fig. 6.

ward as shown in Fig. 6. In doing this we should always associate the pressure of the fingers with the word "back," and in a very few minutes the horse realizes our wants and moves backward at the word alone. If we have a sluggish or sullen horse a piece of wood (not sharp) may be used to advantage instead of the fingers, but usually the fingers alone are sufficient. Don't make the lesson very long, at first, and by the third or fourth trial the horse will respond to the word, together with gentle pressure on the bit.

It is altogether wrong to "jerk" or "see-saw" the bit through the mouth to get the horse to back, when one, two or three lessons, as indicated, will make a willing servant in backing the horse without punishment or excitement. With the horse, backing is an art, and must be cultivated with great patience to make a complete success.

CONTROLLING THE ACTIONS OF THE HORSE BY HIS TAIL.

There are other uses for a horse's tail than to brush off the flies. In our hands it becomes a great medium for controlling the actions of the horse. Our experience with plains' horses is, that there is no other means by which we can accomplish so much in so short a time, as by hitching the subject's head to his own tail so close that he is obliged to gyrate or whirl around in a very small compass. Yes, but the natural query comes to almost everybody, how we are to accomplish this connection of head and tail without danger of getting hurt. Our answer is, that it is best done the very first time he is ever caught with the lasso, and then he should never again have his liberty until he is thoroughly acquainted with his controller man. This thing of catching the wild horse and then letting him go again and again, soon educates him to have a dread fear of man; besides, he is very apt to learn how to evade the fatal noose, which only serves to make him the more dangerous whenever anything out of the ordinary routine of his experience transpires.

When he is lassoed and thrown is just the time to put the halter on his head and secure it to his tail before letting him up. Then, with a long, limber pole, something like a fishing-rod, we begin his education. He has the use of his legs—his means of escape and defense—and at our approach and the touch of the pole he attempts to get away by flight; but his run away is only in a small circle, and, notwithstanding he exerts himself to the utmost of his ability, he does not succeed in getting away from the touch of the pole. If he attempts to kick or strike at the pole he is almost certain to fall, which, of itself, is an admonition that he had better not repeat that action.

This whirling motion requires but a very few minutes to render him so dizzy he must either stop or fall, and he generally prefers the former; but in either case, it is the time we should get in our work with the pole without hurting him. We should bring it in contact with every part of his body—as we advised with the young colt and the use of the hand in our first visit to him when he is but one hour or one day old—and as soon as the wild horse finds that the pole does not hurt him, and he has done his very best to get away from it and failed, he becomes more docile, and we may now be able to get

near enough to him to touch him with the hand. But it is far better to use articles of clothing, such as an old vest, a pair of pants, a coat or a hat securely fastened to shorter poles, and show him that he cannot get away from any of these. We very soon find that he makes less and less exertion at each attempt with new objects until finally we get our hands on him. If we make no mistakes, in half an hour we have accomplished more in satisfying the wild horse that his attempts to get away from man are fruitless, than could be accomplished in three months by the ordinary process of "breaking," and no danger to horse or man of a serious character.

The successful manner of tying the halter-strap or rope to the tail, is so important that we have made illustrations to show to a certainty just how it should be done for convenience and security. We puzzled our brain more than thirty-five years ago to evolve this knot, or manner of tying, for this purpose.

MANNER OF TYING THE HALTER STRAP TO THE TAIL.

Of course there are a number of methods, but to our mind the best, easiest, surest and safest is the one we have used for many, many years.

A strap with a snap attachment to the head-stall of the halter is preferable. Detach from the head-stall,

Fig. 7.

then grasp all the hair of the tail just below the termination of the tail-bone, pull the tail around to the side, lay the strap across the tail with the snap-end just about where the girth or surcingle should encircle the body as shown in Fig. 7. Mark the strap as

shown by the arrow, so as to preserve this proper length; then turn all the hair of the tail back towards the body and hold with the left hand, while we reach under and bring the other or tapering end of the strap around the tail, and tuck under as shown in Fig. 8. This is a knot that is very easily tied, perfectly secure, and instantly untied by pulling on the pendant end of the strap, and we also have hold of the horse by the head at the same time when thus untied. When we have the knot tied and the strap of the proper length to attach to the halter, we are ready for active operations.

Fig. 8.

It is always best to select some place free from stones, posts or other objects of injury, and then suddenly bring the horse's head far enough around to his side to attach the snap to the ring of the halter and let him go. Then, with a long, slender pole, we approach him near enough so that the legs of the horse come in contact with the pole at every turn, as shown in Fig. 9. If he is a sensitive, touchy, wild fellow, he will make desperate exertions to get away from the pole, but if we attend to business and follow him up, he does all the work and we look calmly on until he stops or falls, when we try to touch all parts of his body without hurting him with the pole.

After he becomes familiar with the pole, then we bring other objects of all kinds to him until he no longer exerts himself to get away, and then we begin handling his legs on the side to which his head is inclined; first, by the use of a soft strap, he allows us to lift his fore and hind leg, then with the hand. Now unsnap from that side securing his head and tail on the opposite side and see if he will try to run the

other way, (which he may a little) then handle the legs of that side to which the head is inclined. If he is a western or wild horse that we have difficulty in catching, we now put on the shackles on all the legs as shown in Figs. 5 and 10, and instead of giving him his entire liberty of head, we have a ring or loop tied

Fig. 9.

in his tail through which we run the strap of the halter and attach a long rope, (as seen in Fig. 10) so that at any time when we wish to approach him if he tries to get away, we have only to pick up the rope, and by pulling on it we are able instantly to bring his head and tail together as shown in Fig. 11, and if he persists in turning around he only winds himself up and becomes perfectly helpless, so we can go to him without danger of being hurt. We continue going to

Fig. 10.

him and handling him, watering and feeding from the hand, caressing him, showing him new objects, etc., etc., until he seems pleased at our coming. Then we unshackle him, or at least lengthen the shackles out until he has more or less use of his legs, and then

begin his education of following us, backing, the word "whoa," harnessing him, etc., when he soon becomes a valuable horse, if he is endowed with a fair share of intelligence.

It must not be forgotten that the shackle-straps must have the edges nicely rounded or lined with lamb's wool to prevent chafing. The coupling straps for the front and hind legs of shackles should be kept about the same length.

If the reader has followed us closely, with frequent reference to the cuts, he can at once see that these appliances are founded on right principles and lead to the ends to be attained in the control of the wild horse without injury to horse or man. We should never let the wild horse get away from us or take the advantage of us in any particular from the first time we come in contact with him until he has full confidence

Fig. 11.

in us; neither should we ever hurt him when in immediate contact with him, if we expect him to have confidence in us.

NOVEL, BUT PRACTICAL METHOD OF HITCHING HORSES.

On our large prairies it is not always that we can readily find a post or object to which we can tie or hitch our horses. We have tried various methods, but the one shown in our illustration, Fig. 12, is as convenient and practical as any we have used where we have two horses. The illustration speaks for itself and consists only in tying each horse to the other's tail, just sufficiently long to enable them to get their heads to the ground when we want them to graze, and when we want them they can be found not far from the spot where we left them, as each one must follow the other in a circle. This is a safer manner

of picketing horses than a stake and rope. This is an excellent method to educate little colts to the halter if they are tied short. They soon learn to follow the halter.

Fig. 12.

CONTROLLING THE HIND FEET IN SHOEING.

So many people have trouble in handling the hind legs of horses, in caring for the feet, shoeing, etc., that we think best to give an illustration and a little advice in the manner and method of doing it easily.

Fig. 13.

We first take a strap or rope two or three feet long and double it. Then lay it across the tail double as seen in Fig. 7, tying a similar knot with the double end of the rope or strap as near the tail as possible, as represented in Fig. 13. Into this double end buckle a strap or tie a rope, let it drop to the ground; then buckle a short strap around the pastern and over the strap or rope; pass the strap or rope up through the

double end of the tail tie, and an assistant can hold the hind foot up with ease in spite of the horse's efforts.

POSITION OF THE HORSE IN SHOEING IMPORTANT.

The position in which the horse is made to stand while being shod or having his feet cared for, is of more importance than the majority of people or smiths even think.

Usually when horses' feet are being handled, and especially while young, they should always be controlled by an attendant holding the horse's head. Now, the attendant's position in relation to that of the horse, is of the utmost importance. Almost invariably we see the attendant standing on the oppo-

Fig. 14.

site side of the horse from the operator, and generally with the horse's head inclined towards him as seen in Fig. 14, and the result is the weight of the horse (to a degree at least) is thrown on the man hold of the foot as also seen in Fig. 14, and, as a natural result, any struggles of the horse will be towards the operator, rendering his position necessarily more or less dangerous; but if the attendant will always stand on the same side as the operator and incline the horse's head a little to the same side, the operator is relieved of the bearing down of the horse, as that inclines the weight on the opposite legs as seen in Fig. 15. Besides the easy position thus obtained, there is little or no danger in the horse's struggles, as they will all be away from the operator instead of towards him. The reader may, at first sight, think this frivolous, but if it is once tested with care, it will, ever after, be practiced, as the results show for themselves.

The details of any department of animal husbandry go to make up the sum total of success, and while we have in this article only dealt with a few of the many, a careful study and practice of these will be preparatory for the many more to come, the sole object of which is to render our horses of more service to us by showing our fellow men some of the little details of the methods, as we fully believe, of true horse education, resulting from our long experience.

Fig. 15.

We must ever take matters as we find them, and conduct ourselves according to circumstances and conditions. If we will commence the proper education of our horses when they are very young, we will find the same results as with our children who have the proper training in their youth—no trouble in after life, if naturally well disposed; but if we let our horses run wild until they have attained their mature growth, we must certainly use such means and methods (without violence) as will positively demonstrate to them that we are masters of the situation, yet merciful to the end.

We do not obtain our education in a day, week, month or year; then why expect the horse to understand all that is needed of him in the unreasonably short period that is ordinarily required? Because we have herein indicated, as well as shown, the means of control, we sincerely hope none of our readers will look upon it as a means of revenge for some of the actions of horses and severely punish them simply because advantages can be so readily taken of them. The whole principle is to avoid danger and trouble with our horses, rather than the correction of acquired bad habits. Let us commence right, ever keep right, and we will always be right.

BEECHER ON THE HORSE.

The following article from the pen of the late Rev. Henry Ward Beecher was published in the New York Ledger, April 5, 1862. The title of the article as it originally appeared was "Driving Fast Horses Fast:" "My Dear Mr. Bonner: You once promised me a ride with your never-to-be-excelled horses, and to-day is the very day for it. The sky is clear. It is a long while since we have had bright, clear days. They have been sad and cloudy. Sometimes snow, sometimes rain, sometimes a miserable compromise between both. But to-day is of one mind, and that a good mind. Nature is in her sweet and grand mood. It is the first day on which she has cared to have it known that her mind was made up to have spring weather. The secret is out now. Snow is melting. I saw grass with a fresh growth of green this very morning. No birds yet. But the grass said birds as plainly as if it had spoken English. They can not be far off.

"Is not this a day for a ride? No mud yet; the road is hard and moist. Just the kind for a spin. For I do not want any of your lazy, jogging gaits. I am entirely of your mind that if a horse has had swiftness put in him, it is fair to give him a chance to develop his gifts. Of course there is a bound. Reason in all things. Even in trotting it is easier and pleasanter for some horses to go twelve miles an hour than for others to go three. They were made so. Does it hurt a swallow to go swifter than an ox? Why not? Because he was made so. It is easy to do the thing we were made to do easily. And a good horse was made on purpose to go fast. He does it, when wild, of his own accord. He does not lose the relish of speed even when domesticated.

"Take a fine fed horse, who in harness looks as if he were a pattern of moderation, a very deacon of sobriety, and turn him loose in pasture. Whew, what a change. He takes one or two steps slowly, just to be sure that you have let go of him, and then, with a squeal, he lets fly his heels high in the air, till the sun flashes from his polished shoes, and then off he goes, faster and fiercer, clear across the lot, till the fence brings him up. And then, his eye flashing, his mane lifted and swelling, his tail up like a king's scepter, he snorts defiance to you from afar, and, with a series of rearings, running sidewise, pawings and plungings, friskings and whrils, he starts again, with immense enjoyment, into another round

of running. Do you not see that it is more than fun? It is ecstasy. It is horse rapture.

"I never see such a spectacle that I am not painfully impressed with the inhumanity of not letting horses run. Fastness is a virtue. Our mistaken moderation is depriving him of it. I drive fast on principle. I do it for the sake of being at one with nature. To drive slow only and always is to treat a horse as if he were an ox. You may be slow if you think proper, but your horse should be kept up to nature. He would have had but two legs if it was meant that he should go only on a 'go-to-meeting' pace. He has four legs. Of course he ought to do a great deal with them.

"Now why do I say these things to you? Not to convince you of your duty; but I feared lest taking me out to ride you would be disposed to think that I had scruples, and would jog along moderately, as if doing me a favor. Not at all. The wind does not go fast enough to suit me. If I were engineer of a sixty-mile-an-hour express train I should covet twenty miles an hour more.

"Let the horse be well groomed, well harnessed. Let the wagon be thoroughly looked to—no screw loose, no flaw just ready to betray us. Mount. I am by your side. The whip is not needed, yet let it stand in its place, the graceful hint of authority in reserve, which is always wholesome to men and horses.

"Now get out of town cautiously. No speed here. This is a place for sobriety, moderation and propriety in driving. But, once having shaken off the crowd, I give you a look and disappear instantly in a wild excitement, as if all the trees were crazy and had started off in a race, as if the fences were chalk-lines, as if the earth and skies were commingled and everything were wildly mixed in a supernatural excitement, neither of earth nor of the skies!

"The wind has risen since we started. It did not blow at this rate, surely. These tears are not of sorrow. But, really, this going like a rocket is new to every sense. Do not laugh if I clutch the seat more firmly. I am not afraid. It is only excitement. You may be used to this bird's business of flying. But don't draw the rein. I am getting calm. See that play of muscle! Splendid machinery was put into those horses. Twenty-horse power, at least, in each! And how they enjoy it! No forcing here. They do it to please themselves, and thank you for a chance. Look at that head! Those ears speak like a tongue. The eyes flash with eagerness and will. Is it three

miles? Impossible! It is not more than half a mile!

"Well, draw up. Let me get off now and see these brave creatures. What! Not enough yet? No painful puffing, no throbbing of the flanks. They step nervously and champ the bit, and lean to your caress, as if they said, 'All this we have done to please you; now just let us go on to please ourselves!'"

HORSES' TEETH.

As the art of veterinary dentistry is, as yet, comparatively, only in its infancy, few people understand the extent to which a horse's teeth may become diseased and the amount of suffering the poor animal has to endure, says the Kansas Farmer. Colts, unlike children, suffer little or no inconvenience from their temporary dentition. But during the cutting of the permanent teeth is the critical epoch in the life of the young horse. Between the ages of two and three is where the trouble generally begins, and it continues until the process of dentition is complete, being at its worst between the ages of four and five, this being the time when the greatest number of dental changes are taking place. Hence the common saying that "a three-year-old can do more work than a four-year-old." A horse's upper jaw is always wider than the lower one, and sometimes this difference exists to such an extent as to become a malformation. The upper teeth are also beveled downward and outward, while the lower ones are beveled inward and upward, and this, with their limited lateral motion, causes sharp projecting points to wear on the outer edge of the projecting teeth, which lacerate the cheeks, and on the inner edge of the lower ones, which lacerate the tongue. Small stones, nails and other hard substances often get into the grain, and the horse biting on these, breaks off all or part of a tooth, then caries sets in, the nerves become exposed, and the animal must evidently suffer great pain. When a tooth is thus broken off or decayed the tooth in the jaw opposite receiving no pressure, keeps on growing up or down, as the case may be, until it lacerates the gums of the opposite jaw in a frightful manner. These irregularities and diseased conditions are generally indicated by one or more such symptoms as slobbering and frothing at the mouth, weak eyes or partial blindness, bolting the grain while grinding, stopping short while eating and dropping the grain from the mouth, quidding the hay, turning the head on one side while eating or after drinking

cold water, loss of appetite, loss of flesh, tender mouth when being driven, carrying the head on one side, pulling on one rein, nasal gleet, swelling or abscesses about the jaws, etc., and the horse is allowed to suffer on for months, and often dosed with strong medicines, when an examination by a competent man would have revealed the true cause of the difficulty and a few minutes' work on the horse's teeth would have relieved the animal's sufferings and enhanced its value to the owner, as well.

HOW LONG HAVE HORSES WORN SHOES?

In the ninth century they began to shoe horses, but strange to say, only in time of frost. King William I. introduced horse-shoeing in England, and six horse shoes are on the coat of arms of the descendants of the man to whom he gave vast estates for caring for his horses in this way. No improvement has been made in horse shoes for years. Better iron has been used and better nails, but no change has come in shape or manner of putting them on. The "smithy" is a dingy-looking place, with its rows of shoes along the rafters, its big bellows and its fire and anvil; but the "smith—he's a fine, sturdy fellow," full of anecdotes and news. The nearest thing we find to the horse shoe of to-day was found in the grave of an old king of France who died in 481. There were four nail holes in the shoe, and this is the first mention of nailing on a shoe. It might be well to notice, just here, the fact that the horse shoe "kept evil spirits away" even as long ago as in the days of this old king, 1500 years ago, and was doubtless placed on his grave for this purpose.

MAN'S GREAT HELPER.

The horse is so closely allied to man he may well be considered as his subordinate. Wherever civilization extends you will find him. The prosperity of a country depends upon the quality, quantity and efficiency of its horses. His importance to the agricultural and commercial life of a country is incalculable. When the epizootic prevailed so extensively a few years ago among the horses in some of our principal cities we remember what a depressing effect it had upon business. The street cars ceased to run, the familiar rumble of the heavy transportation wagon was no longer heard. The freight houses became full for the want of this noble animal to move the grain

away. In fact, the wheels of commerce were in a measure blocked. The railroad is but the auxiliary of the horse. The railroad could not exist without him. As I said before, the agricultural and commercial thrift of a country depends, largely, upon the efficiency of its horses. One reason to which Napoleon attributed the failure of his disastrous invasion of Russia was the superiority of the Russian over the Norman horse. In every phase of social, political and national life, the horse fills a conspicuous place. In the opening of the mine, the development of the resources of the country, in the consummation of its wars, he forms a component part. In fact, through the modern invention of machinery, he has superseded the slave. In an agricultural sense he does all the work. He plows all of the ground, plants all of the seed, cultivates all of the crops, cuts down all of the grass, rakes it up, loads it, puts it in the mow, harvests all the grain, draws it to market and, in connection with all this, is burdened with drawing his lazy driver over the fields all day, who, when night comes, is often too lazy to properly care for him. We should never neglect so great a friend as the horse is to us. We should not abuse him in any way. We should take great pains in showing him just what we expect of him and in a manner to be intelligent to him, and, our word for it, we will greatly improve the further usefulness of our horses.

FEEDING HORSES.

The great amount of hard work for the horses of the farm is over in the fall, and, as now they have little or no work to do, it is essential that farmers look to the amount of feed they give them, and especially to the amount of hay.

When a horse is working hard all day we give him a liberal supply of grain and usually all the hay he will eat. This is right; but when he is idle most of the time, or at light work, it is a different thing and he should be fed accordingly. Some have fallen into to erroneous idea that as long as a horse will eat hay it should be placed before him, but this is a mistaken idea and should be carefully guarded against, especially at a time when the dollars roll into the farmers' pockets as slowly as they do at the present time.

Most of our barns in the fall are nearly filled with hay, but before spring the mows will present a very different appearance, and the thought tells us to be as saving with the hay as possible. It is better for our

horses that we give them a little more grain and less hay. They winter better and if they are well groomed and well blanketed after having been driven, will come out in the spring in better condition and be much better fitted to do the hard spring and summer's work than would otherwise be the case.

A careful farmer will feed a certain amount to his horses each day, at regular intervals, and will always be found working on the principle that "a penny saved is a penny earned."—National Stockman and Farmer.

ADIRONDACK MURRAY ON SHOEING.

There never lived a man who "knew horse" or better understood the noble animal, his needs and the art of caring for him than the once famous W. H. H. Murray, "Adirondack Murray." What he did not know about making the most of a good horse and keeping him sound and healthy no one need bother to ascertain, and Adirondack Murray has laid down a rule in regard to trimming a horse's foot that every horseman in the world should cut out and paste in his hat. "Never," he says, "allow the knife to touch the sole of your horse's foot, nor the least bit of it to be pared away, because nature needs the full bulk of it and has amply provided for its removal at the proper time. Secondly, never allow a knife to be put to the frog, because nature never provides too much of it to answer the purpose for which the Creator designed it, and the larger it is the more swiftly, easily and safely will your horse go."

TEACHING TEAMS TO PULL.

It is a real pleasure to have a team that can be relied upon to pull whenever wanted to do so. Any team, if not of a too highly nervous temperament, may be trained to perfect reliability. We need, first of all and forever after, to recognize that the horse has a mind and, at least, the mental qualities of memory and affection. The consideration of paramount importance in this matter, according to the view of the writer in Stockman, is to develop the team's confidence in themselves and in their driver. It is just as true of a horse as of man, that he will not exert himself greatly over what he has no hope of accomplishing. But different from man, the horse thinks of previous loads instead of the one to which he is attached. This is the reason a balky horse is apt to

refuse to pull a very light load. He has no way of estimating his load only by pulling upon it. Hitch a horse to a very heavy load, let him pull upon it, then transfer him to any empty wagon and start him. You will see him gather himself for a pull. He has in mind the heavy load. Had the horse been stalled with a heavy load, and whipped until the driver and horse were both certain he could not pull it, you would have a horse thoroughly broken not to pull. This writer says:

"Let me impress the truth of this by calling to mind another illustration of the result of similar treatment. I have seen men who had horses given to pulling upon the halter, put one on them they were confident the horses could not break, and then whip them over the head in order to make them pull. Nearly always when a horse finds he cannot pull loose he will walk up to the hitching post. I have heard men argue that a horse could be so thoroughly broken in this way that a tow-string would hold him. There is some truth in it, though not all horses are to be managed in the same way. A horse of nervous temperament should never be excited. They will always do their best in a perfectly calm state of mind.

"Have a definite and small vocabulary to use with your team, and always use the same word for one purpose. Keep the same two horses working together, and always on the same side. Use open bridles, so that the team can see what is going on around them. Keep all attachments strong, that your team will not be in fear of straining themselves through something breaking. Use close-fitting collars and harness, and never allow a horse to become sore from any part of the harness. Teach your team to start together. Keep them strong and in good spirits by good and regular feeding, and good care in every particular. Let them come to heavy pulling gradually, and not at all until their bones are well matured."

HORSES NEED LIGHT.

The importance of having stables ventilated in accordance with correct principles of hygiene is generally admitted. That the supply of fresh air should be ample is frequently insisted upon, but that the light should also be abundant is not so commonly recognized. Some stables are at midday in a state of semi-darkness—a condition, to say the least, anything but conducive to the well-being of the horse. No animal enjoys the light of day more than he. In his wild state he frequents the open plain or mountain side in the

full light of day. Wild horses are never found to inhabit gloomy forests or dark ravines. The horse is a child of light and he should be treated accordingly in domestication, if he is to be kept in perfect health and spirits with his eyesight unimpaired. The frequent transition from a dark stable into full glare of day cannot fail to act prejudicially on his visual organs, and so also must almost permanent gloom and darkness. If we studied only his comfort, we would give him at all times a stable full of cheerful light as well as refreshing air.—London Live Stock Journal.

MEANS AND METHODS FOR CONTROLLING OUR HORSES.

While we shall endeavor to impress upon the mind of every reader the fact that there is fully as much virtue in the methods as the means used, we are quite certain too many will adopt the means of control, (as the key of success) and ignore the methods, (manner of using the appliances) and then failing in the desired results, will condemn the author.

In compliance with the proper methods for using electricity, it has been found to be a valuable servant, but how is it when the means are used regardless of the well established methods? Why, death too often results.

The means and methods herein given have often been used by the author and found the most valuable of any he has tried. They are not a mere theory, but principles established upon experience. We have, in the preceding paragraphs, tried to impress upon the minds of our readers the importance of complying with the simple laws governing our animals and we cannot do justice to our noble servant—the horse—without referring briefly to them again, and, possibly, in a manner that will make it more impressive.

SOME OF THE LAWS GOVERNING OUR HORSES.

1st. Whatever transpires at the front of the horse impels him backward.

2d. Whatever takes place at the rear of the horse, inclines forward action.

3d. All side motion effect in like manner—in opposite direction.

4th. In all of our operations with the horse, it

should be our highest aim to avoid giving him pain when in close contact with him.

5th. Whenever he becomes entangled by accident, or we do it purposely, we should stay away from him until he realizes his utter helplessness to free himself, then go to his assistance and kindly relieve him, when he will appreciate us, and readily become our willing servant. But, if, by entanglement, we abuse him for it, then, whenever he finds himself encumbered in any way, he naturally goes to work to free himself and get away from his handler—making a dangerous horse, instead of what he should be—kind and gentle.

6th. We should endeavor to control our horses by means and methods that will demonstrate to them that we are the stronger, (through the means used) but associated with kindness whenever in close contact with them.

7th. In connection with the means to demonstrate our superior power over the horse, we should never forget, that the medium of the stomach is the most direct road to his affections—consequently, notwithstanding, we may lay him down, deprive him of the use of his legs, etc., we should feed him sugar, sweet apples, cookies, or whatever he relishes from our hand, and it is astonishing, to the masses, how soon the wild or even vicious horse is as docile as a lamb.

8th. The reader will observe that the means set forth, in this article, are not intended to injure the horse in any way, but to enable his handler to demonstrate his superior muscular power (through these means) over that of the horse, without any manifestation of anger or abuse on the part of the handler.

9th. We should endeavor at all times to keep the horse cool and quiet, and endeavor to show him kindly what is expected of him, rather than to try to force him to do what he does not understand.

10th. We should always make the lessons short and impressive, and never try to progress faster than the horse fully understands what we want of him.

HANDLING BY THE HEAD.

As most of our horses are controlled, through the medium of the mouth, we have thought best to begin our illustrated part with easy and effective means and methods of controlling the horse through the mouth. We are decidedly opposed to the use of harsh bits which lacerate and mutilate the sensitive part of the

(No. 1.)

(No. 2.)

horse (through its sensitive character) by which we communicate our very thoughts, to this noble animal, through the medium of the reins. For many reasons, we like to begin our education of the horse through the medium of the mouth, with a small (comparatively soft) rope, instead of iron bits. It is much more effective, will not bruise the soft, sensitive tissues and by its binding character, in which it is applied, makes our work more readily appreciated by the horse. For instance, when we pull on the rope, it binds in the mouth, and does not let go until the horse comes to us or we go to him and loosen it, which is at once appreciated by the horse, and makes us looked upon as a friend in need, and not an enemy.

STALLION OR SAFETY BRIDLE.

We take about twenty feet of one-fourth inch manilla rope, with which we make a better stallion bridle than we have ever used of any other character.

We first throw one end of the rope over the neck of the horse, with the left hand; reach under the neck, with the right hand and grasp the end of the rope, and tie a bow—bowline knot quite snug to the neck, (but not really tight or too close) now pass the left hand under this part around the neck, and draw through enough rope to go in the mouth, as shown in cut No. 1. Next stand with the face toward the rear of the horse, taking the rope in the right hand about

one foot from the neck of the horse, then reaching over the rope with the left hand, take hold of the rope, with the back of the hand up and forward, as seen in cut No. 1.

We now pass this rope, as held in this way, over the horse's head, bringing the right hand to the base of the ear and left hand down under the neck, as seen in cut No. 2.

APPLYING THE SAFETY BRIDLE.

Now change hands, taking hold of the rope with the right hand where held by the left and open the

(No. 3.)

mouth of the horse by pressing the soft end of the finger, or thumb of the left hand, against the roof of the horse's mouth, when he will readily open the mouth, and we pass the rope through the mouth, and, changing hands again, taking hold of the rope, just at the left side of the mouth, with the left hand; then pull on the long part of the rope, with the right hand, to adapt the rope to head, and we have the most effective bridle for the control of strong, vicious horses, or biting stallions.

By pulling on this rope, only moderately, the lips of the horse are forced between the molar teeth, so that it is impossible for him to close his mouth and bite, even though we put our hand into his mouth, and hold it there.

METHOD OF USING THE SAFETY BRIDLE.

When we have it snugly applied to the head of the horse, (not loosely) we permit him to run away from us, the length of the rope, and with a sudden pull, pivot him on his hind feet, or stop him. He is will-

izes that he had better not get to the full length of the rope away from us, or if he does, the rope binds his mouth as before. But if he will come to us, we never disappoint him in relief, and kind attentions, when in close contact with him, which insures his confidence in us, that no matter what troubles he encounters, he is assured we will help him out of the difficulty.

We have given a full description of the method of applying the safety handling bridle, so that our readers can readily comprehend the principle of handling our vicious horses without serious abuse or danger. The horse is a very apt scholar, to learn either good or evil, and it is for us to direct him aright.

A GOOD CHEAP RIDING BRIDLE.

Cut. No. 3 represents a cheap and very effective riding bridle. It consists of a piece of quarter inch

(No. 4.)

(No. 5.)—Blinding the Horse with an Umbrella.

ing to stop, no matter how well he feels, for he finds that his head and mouth are in a vice, as it were, with apparently no relief. Now, if he does not come to us, we go to him, pat him caressingly on the cheek, and gently loosen the rope in his mouth. He is now free again, and, possibly, may be so reckless as to try it again, with the same results. We do as before, three or four times if necessary, when he fully real-

manilla, or cotton rope, from six to eight feet long. By placing the middle part on top of the horse's head, drawing down on either side of the face and passing through the mouth from each side, up on top of the neck, and tying a knot at the withers to keep from dropping out of the mouth, you have a good bridle, as illustrated in cut No. 3; down in front of the horse as well as applied to his head.

HANDLING UMBRELLA.

For remember the law, as previously referred to, that what happens at, or toward, the rear of the horse, impels him forward, as well as that in front of him, forces him backward. It is well illustrated in cuts 4 and 5 in handling an umbrella on horseback. When the umbrella is back of the center of his body, and he takes fright, he naturally tries to run, but by bringing the umbrella over his head, as seen in cut 5, he stops instantly, and reverses his action so suddenly,

from every object he is afraid of. We must not get in a hurry in the education of our horses, if we would have them fully understand our meaning in all we do with them.

POWER OF MAN OVER THE HORSE.

Whenever we find the horse does not feel disposed to give us his undivided attention, with the application of the safety bridle, and its associate treatment, then we proceed to demonstrate to him our superior

(No. 6).—Cheap Casting Harness.

(No. 7).—The Horse in Trouble.

that we must be on our guard, or we will go over his head. Now, how much better it is to understand this law, and hold on to the umbrella, until the horse finds he cannot get away from it, than to throw it away at first fright, and ever after incline him to run away

strength, through the means we use, together with very kind treatment.

We first take about fifteen feet of three-eighth inch rope, double it at about one-third its length, and slip a two-inch iron ring over this doubled portion, and

tie a knot in the double rope, so as to hold the ring in such position, that the doubled end will make a crupper and back piece the required length, to have the ring rest at the point of the back, where the saddle of the harness should be. The remaining portion of the rope forms a circingle as seen in cut 6. Now, we take a fourth inch rope, twenty or thirty feet long, pass one end through the ring on the back, pass it along the right side of the neck of the horse, through the ring of the halter, and back to the ring referred to on the back, and tie securely. Next we take the hold-back or side strap to a single harness, or a good ham-strap will answer, pass it around the pastern of the left front leg, passing through the keeper, so that the buckle will be on the outside of the leg when the strap is pulled backward. Then we lift up the left front foot of the horse, run the strap under the circingle, with the hair, and buckle up quickly and short, as seen in cut 6. As soon as the leg is securely fastened, we let the horse have his liberty to about the

slight tension on the small rope, he will soon get tired, and drop on his knees, when his head should be pulled to his side, as seen in cut No. 7. We continue to stay away from the horse and, holding him in this uncomfortable position until he falls over on his side, we pull hard enough on the small rope to bring his nose to the ring on his back as seen in cut No. 8.

If the reader does not believe this is an uncomfortable position, let him try to look back over his shoulder one minute by the watch and see how his neck will ache. After the horse has lain in this position one-half minute to a minute, he will make a desperate struggle to rise but if the small rope is kept

(No. 8.)—The Horse in Greater Trouble.

(No. 9.)—The Horse in a Comfortable Position.

length of the rope, when he is apt to be halted, as seen in cut No. 6. We do not try to throw him down, but allow him to hobble around on three legs, until he gets tired, being sure to keep at a distance from him all the time, letting him realize that he is in trouble. By keeping his head inclined to one side, with

tight it is impossible for him to get up. Just as soon as the struggle is over we approach him, (keeping the hand rope tight) caress him on the head and neck and begin relaxing on the hand rope until he is stretched out on the ground in an easy position as seen in cut No. 9.

If he fails to appreciate the comfortable position we have given him, and attempts to get up, we simply spring away from him and again get him into that same uncomfortable position by pulling on the hand rope as before. Now we hold him in this very uncomfortable position a short time, to let him know that we are gone from him and he unable to extricate himself. If he struggles again, we do as before; but if he

body, lying, sitting, or standing, we then begin with other objects, such as the noise of bells, pans, drums, etc. The sight and touch of blankets, robes, or umbrellas, open or closed, as shown in cut No. 10.

By bringing objects to the horse when down, we can make him acquainted with them, without his getting away from us, or injury in any way. The horse examines all things very much as we do, first by sight,

(No. 10.)—Bringing Objects to the Horse.

submits without a struggle, we never keep him long in this position, but go to him and relieve him as before. By the second or third round of trial to get up, he fully comprehends that when we are in close contact with him, he is relieved of his troubles; also, that when he attempts to rise we are suddenly gone, and he is at once in that same uncomfortable position again.

As soon as the horse discovers that we do not mean to hurt him, and that whenever he is in serious trouble we come to his relief, he, very naturally, has confidence in us, and cares but little what we do to him, or with him, that does not give him pain.

While we have the horse down in this way, it is a good time to make him familiar with us, from every position, holding on to the hand rope all the time, and being ready to pull his nose to his side at any moment, he should strive to avoid us.

As soon as the horse is familiar with us from every position, also with our weight, on any part of his

and then by touch. But if the sight is sufficient to frighten him away, he never fully satisfies himself by the touch; he stays away from the object through fear. Consequently, the importance of having him in a position by which we can bring the objects in contact with his body, and shown him, by touch, that there is no cause for pain from them. If we have done our work consistently, and in such order that we have carried the horse along with us, in understanding, step by step, we may now take every incumbrance from him, and he will appear as seen in cut No. 11, confident and contented.

The above cut was made from a photograph of a handsome four year old mare, and the writer, after having had a lesson of about twenty minutes, on the fair grounds at Madison, Minn. She was a powerful mare, active and very nervous to begin with, but very soon became remarkably docile, as almost all horses will, when properly handled.

Now, dear reader, please remember what we have

repeatedly said, that there is as much virtue in the methods as the means. To be sure we can, by the means here represented, throw the horse with considerable violence, and punish him severely while down and in close contact with him, without his being able to help himself; but by so doing we defeat the very object aimed at, viz., every time thereafter, remembering the punishment received, he would refuse to submit until entirely exhausted. But by our cool, quiet method and not being in too great a hurry, the horse realizes his trouble, gets weary, lies down, finds

horse through the medium of his legs, we will mention but two or three.

We commence our operations by taking the saddle and crupper of a single harness. We use both girths in order to retain the shaft-holders down in position.

The lines, for driving, we pass through the shaft-holders, instead of the terrets on the saddle. By having the lines through the shaft-holders, the horse is prevented from turning around, and facing us, as the lines pull across his thighs, instead of over his back and we are enabled to keep his head from us.

(No. 11.)—Contentment of Horse and Man.

he is unable to rise of his own efforts, yet finds he has a friend in us, who comes to his assistance in time of need, and he certainly appreciates it with a kindly remembrance. Don't let us ever forget that the horse is endowed with intelligence, kindness, fear, passion and revenge; and we must conduct ourselves accordingly, observing closely the laws of correlation between men and animals. Having made ourselves familiar with the horse, by laying him down and proving our superior power, (through the means used) and at the same time relieving him when he got into any serious entanglements, if he still persists in asserting his wishes as soon as he is assisted to his feet again, then we use other means to control his powers of locomotion.

CONTROLLING THE HORSE BY HIS LEGS.

Of the many ways and means of controlling the

(No. 12.)—Reins to the Legs, Better than the Bits.

When we have the lines so adjusted, we then buckle a strap around each front pastern. Then take about twenty feet of quarter inch rope and with one end in the hand we put it under the girth of the harness against the hair, pass it down, and under the strap of the pastern, of the right leg, and back under the girth again, with the hair, and down to, and attach to the strap of the pastern, of the left leg, when we take the rope and lines in hand, and get behind the horse, and commence proceedings as seen in cut No. 12. If with this means applied, the horse persists in trying to get away from us, or rears, we proceed to draw his front feet to his body, as seen in cut No. 12, by pulling on the rope; or if he attempts to run from the start, we pull on the rope, for the same purpose as seen in cut No. 13.

(No. 13.)—The Would be Runaway Secured.

When the horse is determined to get away, with even good treatment, the use of the double foot attachment, is very effective, if in the hands of a considerate, and affectionate horseman. If the horse starts by rearing, or running, and we pull on the rope, the result is the same, in both cases, and is very well shown in cut No. 14.

Now, that we have the horse, in this helpless condition, we must not keep him here long, or he will get discouraged, and lie down, and possibly refuse to get up. But if we hold him in this position but a moment, or until he becomes comparatively quiet, then go to him calmly, caress him, put our arm under his neck, loosen the reins, and rope, and lift on him a little, with an encouraging word to get up; he will get to his feet promptly, and be a little more careful afterwards. If we find he is getting warm and excited, we must stop

for a few moments and give him time for reflection, or rest, as you may choose to call it.

If we observe conditions carefully, he will soon be driving about cool and docile as seen in cut No. 15.

FIRST LESSON IN HARNESS SATISFACTORY.

The extremes of use and abuse of this appliance for the control of our horse is very wide apart.

One handler will use it with the most satisfactory results by going slow and careful, not dropping the horse on his knees, but once or twice, and the horse realizing the advantage taken of him, and not becoming confused, quietly adapts himself to the wishes of his teacher, while another handler with the same horse would make some mistakes, get confused or angry himself, and soon get the horse excited and have a

real fight between horse and man; a condition that should be avoided at all times and under all conditions, as no good can result. The natural query to the reader, then, would be, is this method valuable or dangerous in my hands? We can answer only by saying, that by these means we can prevent the horse from running away, or doing much mischief in any way, which we consider valuable to both man and horse. But we would urge all handlers not to put the horse down on his knees any more than can possibly be avoided, for the best results. The horse can travel with this appliance about as well as without it. We would advise the use of knee-pads if, the horse is to be driven on the hard rough roads.

This appliance is more serviceable in driving with only the harness on single, than double harness, and our next device is well adapted for double team.

PERSUASIVE CONTROL OF THE HORSE.

Now, dear readers, please don't complain of our heading; because we mean it in its most forcible sense. Persuasive influence, with both men and animals, is certainly the most effective, as we shall try to show here; and if our readers will apply the means and methods here laid down, instead of the whip and other brutal force, we are confident of gaining our point, with both the horse and his handler.

Means and methods, you will observe, are our principles of convincing the horse, that if he is determined to have a struggle, it must be mostly with himself. We want to take as little part in it as possible. con-

(No. 14.)—The Horse in a Helpless Position.

(No. 15.)—Persuasive Control of the Horse.

sequently, try to devise the means, by which he can demonstrate to himself that he is fighting himself rather than his handler. In the preceding example of handling the horse by his feet, and taking both front feet from him, we thereby stop him in further progress of locomotion, of which if persevered in, will have a tendency to anger or discourage the horse. While we like this method of taking the front feet from the horse, in his very first lesson in harness to convince him that at the word whoa, or in an attempt to run away with us, to rear, or kick, we can at once demonstrate to him (without pain) that he is powerless to do so, to any satisfactory degree. But it has its objectional features, as we have before indicated, beyond the first short lesson, which we always use to begin with, to be sure we have all the advantage on our side; after which, we use the persuader, until the

horse fully understands what we wish him to do for us.

We do not like to depend on the bit, and especially harsh bits, to control the young, ambitious, or even vicious horse, because, in his eagerness to get away, or do mischief, we are too apt to injure his mouth, to such a degree, that it is ever after tender and sore, or, so calloused, that he is a "puller," (lugger,) ever after. But, if we apply our "persuasive" influence, as hereinafter described, we are of the opinion all users will be pleased with its effect, and not take the chances of making a runaway, kicking, dangerous horse, in his primary lessons in harness. By the use of the "persuader," we are enabled to make the horse a cripple, for the time being, and yet not necessarily stop, or hurt him; but impede his progress to such a

degree that it is not really dangerous to his handler or encouraging to the horse.

If the horse proves to be a runaway, we let him run upon three legs instead of all four. If he is a kicker, he must stand on one front leg to do the most of his kicking. If he is restless and uneasy about standing, we let him stand on three legs, part of the time.

When we find we have a confirmed kicker it is best to attach, bells, tin pans, a fourth of a sack of bran, or other objects to the crupper of the harness, and let it hang down to the hocks or near there, and drive about without being hitched to a vehicle at first, as seen in cut No. 16.

The cut represents the horse in the act of doing his utmost to rid himself from the bells attached to the crupper of his harness, before the persuader has been put into operation. The "persuader" is applied, by having a strap around one front pastern only, then take the end of the small rope, and pass under the

(No. 16.)—The "Persuader" applied to a Kicker.

(No. 17.)—The "Persuader" applied to a Restless Horse.

girth from the rear, down under the strap around the pastern and tie to the girth. See cut No. 17. With the confirmed kicker, we prefer to first give him the opportunity once or twice, or even more, at the object attached to induce him to kick, before making it hard work for him by the use of the "persuader."

As soon as he gets warmed up to his work in earnest, or starts to run, we pull on the rope which takes one front foot from him, so that he is compelled to balance himself on one foot while he does his kicking, which soon persuades him that he is making hard

work of it for himself. Or, if he attempts to run and kick, he must do so on three legs, by which he is soon persuaded is too hard work to be enjoyed. If he is a powerful horse and starts to run and kick, we always incline his head toward the opposite side from the leg that is held up, which induces him to run in as small a circle as possible, and by a sudden turn of the head he is very apt to fall broad side, which again persuades him he is making hard work of the kicking business, which must be the object to be attained in the correction of the kicker.

Mere preventives, such as kicking straps, high checking, etc., rarely ever cure the kicking habit. But if we give the horse the opportunity to kick at something that cannot hurt him, and have him in such position that does not necessarily prevent him from kicking, but makes hard work of it, he is soon persuaded, that he prefers to have anything hanging to him or hitting his heels, rather than work so hard to get rid of it and fail, too.

Everything attached to the harness to induce him to show what his natural inclination is should be securely fastened, as every time he succeeds in getting rid of it, is an evidence to the horse that he can accomplish his object if he only tries long enough, and he is perfectly willing to try as long as he sees any possibility of succeeding.

The restless, uneasy and impatient horse can, ordinarily, soon be persuaded to stand until we are ready to give him the word to move, by simply letting him stand on three legs a part of the time when he is most anxious to go. But as soon as he becomes at all quiet—even for a few seconds—he should have the benefit of all four of his feet, to assure him that we will give him this benefit if he will only be quiet. This is fairly well shown in cut No. 17.

It will be seen by cut No. 17, that the horse is standing on two feet only, which requires good balancing power to maintain his equilibrium.

Now isn't it plain that if this is all done quietly, and without apparent effort to simply annoy and tease the horse, that he will soon be persuaded that he is only working against himself, and conclude that he is doing a great amount of hard work for nothing? Isn't it also apparent, to even the casual observer, that we can permit the horse to still keep going, though somewhat crippled in one leg, that he will be persuaded to go quietly, much sooner than he will if we take both front feet from him, which stops him from moving entirely?

We neglected to state before, that when we are ready to hitch the kicker to a vehicle, we prefer to first drive in double harness and be sure to have the "persuader" on the outside front foot, so that if he should fall at any time he will fall outwardly, instead of on the pole, and so, possibly, break it. As a precautionary measure we always apply the "persuader" to every colt when first harnessed to a wagon or other vehicle, so as to persuade him, at once, that if he attempts to run or kick, that he must necessarily find it a hard undertaking.

Before closing our remarks in regard to all the preceding appliances for the sure and safe education of our horses, we would again impress on the reader's mind that a knowledge of the methods is of more importance than to know how to make and adjust the means. They go hand in hand and must be used humanly, or the objects aimed at will be utter failures. We consider this one of the very best appliances, properly used, to persuade the horse to become man's willing servant, that we have ever had anything to do with. It can be used without any inconvenience to the action of the horse and, if required, can be put in to immediate effect with the very best results.

THE WILLFULLY VICIOUS KICKER.

If the persuader, and other means and methods, fail to accomplish the desired results with the confirmed kicker, then we try a means of self-punishment that we have never had fail us with this class of unruly horses. It is valuable for the reason that the punishment is dealt out the very instant of the violation, and at the

(No. 18).—Kicking Attachment for Single or Double Harness.

other, or front end of the horse, which, naturally, attracts his attention to the point of punishment with such force that he, as naturally, forgets what has transpired at the rear. The means to accomplish the work, consists of one piece, of one-fourth, or three-eighth inch rope, about twelve or fourteen feet long and another piece of five-sixteenths inch rope, about six feet long; a pulley; four straps one inch and a

fourth wide and about one foot long, each, and two iron rings, one and a half inches in diameter.

First, thread the long rope through the eye of the pulley, and the short rope around the pulley itself. Now, check the horse's head, the desired height, with a good, strong, overhead check. Next draw the short rope backwardly, from the front, and under the girth, so the pulley will rest just back of the girth, as shown in cut No. 18.

Next, take the ends of the small rope, carry each to the rings of the bridle-bit, at either side, passing through the rings, from the outside, (which will bring the rope over the head, under the headstall of the bridle), and carry over the head, from each side, and pass through the rings again from the inside, and let them hang there until the balance of the attachment has been adjusted. First, by buckling the straps, above, and below the hocks, and through the rings, as seen in cut No. 18. Then tie the larger and shorter rope into these rings at the hocks, by half hitches, so as to leave the pulley just back of the girth, and furnish the adjustment by drawing the ropes, moderately taut, at the bit, and tie on either side, by half hitches, also, (which makes the rope easily untied, no matter how tight drawn), and we are ready for the first trial.

We always prefer to commence this first lesson with only the harness and reins, because the first kick may be a terrible one; but, in all probability, it will be the last severe one, as it will never be forgotten by the horse. We are, naturally, asked why. Well, we will tell you. It is for the reason that, when the hind legs are forced backward, the rope, over the head, has drawn the bit so far up into the angles of the mouth, and holds it there, that the horse forgets what happened at the rear, from the fact that he is into so much trouble at his front end (the mouth.)

It should be our duty to go to the horse's head and draw the bit down into the mouth away from the angles, and caress him immediately after a hard kick, satisfying him that notwithstanding he got himself into trouble we are charitable enough to help him out of it. If, by the first hard kick, any part of the kicking attachment has been broken, it should be repaired before relieving the horse at the head. This attachment is applicable to either single or double harness, the wagon, plow or other vehicle; but we never like to hitch a kicking horse to any kind of vehicle, where he can injure himself or break the carriage, un-

til we are satisfied he knows better than to kick hard, at least.

With this kicking attachment the horse can walk, trot or pace, but cannot run to much purpose, as when the hind legs are brought backward together it must produce an effect on the mouth; whereas, the movements of walking, trotting or pacing, move one leg at a time, the leg rope plays back and forth, through the pulley, without any appreciable affect on the mouth.

Except, in a very straight hock, the straps will stay in their places, especially if both upper and lower straps are of the proper length to allow the ring to draw from the center of the hock.

The reader may wonder why we want to pass the long, small rope up over the horse's head and tie into the bit-ring on the opposite side; but, say to himself, it is just as well to tie to the bit-ring on either side, instead of going to the trouble of passing it over the head and tying on the other side. We answer by saying, if tied directly to the bit-ring, and the horse should kick hard, he will certainly bruise his mouth badly, and may break the bit and get his freedom; whereas, when the rope is passed over the head, as directed, the hard kick draws the bit up into the angles of the mouth so tightly (and the rope being under the head-stall of the bridle), that the pressure continues until relief is brought to the horse by his handler pulling the bit down into the mouth, which, if done in the spirit of kindness, will soon satisfy the horse that it don't pay to kick any more. Its use should be persevered in for a considerable time.

THE SWITCHER AND REIN CATCHER.

(No. 19.)—Prevention and Probable Cure.

(No. 20.)—The Balky Horse, Hitched for the Start.

The rein catcher, with the tail, is often a dangerous character; notwithstanding he, or she, may otherwise be a very valuable animal.

(No. 21.)—The Balky Horse Pulling by His Tail.

It is very bad policy to try to suddenly pull the rein from under the tail whenever caught by accident or purposely. But, if it is possible to let the rein loose, or the tail can be lifted from off the rein, quietly, by the hand, the animal may soon recover from any nervousness in consequence.

It too often happens that the mischief is done by some unthinking, or inexperienced driver, and the animal rendered dangerous, or, at least, troublesome, to say the least.

Mares are generally worse than geldings, and, while they have free use of the tail, may constantly keep trying to catch the rein under the tail.

When the habit of catching the rein, with the tail, has become a constant practice, we endeavor to prevent it by tying into a portion of the hair of the tail a little above the terminal end of the tail bone, the middle portion of a string of sufficient length to extend to the tugs, or traces, on either side, and securely tie, as shown in cut No. 19. The tie in the tail should be made securely; something in manner of tying the tail of the horse, in the first section of this department, Figs. 7 and 8, but, with only a small portion of the hair on the under side of the tail, about the size of a pencil, to that of the size of the finger. If it is done in this style the string should be wrapped two or three times around the bunch of hair to prevent its becoming loose.

The string* to the tugs should be drawn taut to be

gin with, and, as the animal becomes used to the rein it may, from time to time, be tied more loosely.

It will thus be seen that it is impossible for the animal to securely catch and hold the rein with the tail where this device is used; and, by gently dropping the rein from side to side, without teasing the animal, we soon establish confidence between us and the animal, and the habit is eventually forgotten. We once used this device a whole summer on a very nervous mare before she entirely gave it up. Prevention an

confidence must be established before the habit is broken up.

THE BALKY HORSE.

The reader will, naturally, say to himself, you have "tackled" a subject in which we are all interested. But few of us know how to handle it (we refer to the horse), but all of us want to learn.

WHAT IS A BALKY HORSE?

A balky horse is one that has been badly handled or overloaded. His shoulders are sore or he is discouraged, disgusted, or prevented from going when he wanted to, and, naturally, says to himself, you have stopped me, now I will go when I get ready. Here we are, and the question is "what are we going to do about it?" Well, most people will begin to whip, yell, yank and pound the poor horse, and

at the rear, sends him forward. Now we must take advantage of this law in applying the remedy to the balky horse. Instead of the usual confusion, excitement and punishment, we quietly get down from the wagon, caress him as though nothing was wrong. We then take a rope or strap strong enough to draw the load, and from eight to ten feet long, with the short end toward us we lay the rope or strap across the tail of the horse, as seen in the first section of this department, Figs. 7 and 8, just below the end of the tail bone about three feet from the end of the rope or strap; now turn all the hair of the tail back toward the body of the horse, holding the same with the left hand. Reach under the tail and grasp the long part of the rope or strap with the right hand, bring it around the tail and tuck it under that part around the tail double, as shown in cut No. 20.

As soon as the knot in the tail is drawn firmly, we tie the short end of the rope or strap to the end of the

(No. 22.)

so confuse him that he loses what horse sense he had and stands there like a post, puts his head over the other horse, or, throwing himself to the ground, breaks some part of the harness or wagon, and thus gains his point in the large majority of cases.

REMEDY FOR BALKY HORSES.

Before giving the remedy, we must repeat the law governing the horse, to-wit: Whatever happens at the front of the horse impels him backward; and that

then we quietly get into the wagon, taking the long end of the rope or strap into the wagon, as is well shown in cut No. 20, ready for the start. When we are all ready to start (not before) we touch the other horse with the whip or rein for a sudden start, which pulls on the other fellow's tail, and he wonders what has so suddenly happened to him at the rear end, which induces him to, at once, move forward without further ceremony, which is very nicely represented in cut No. 21.

We prefer to keep the horse pulling by his tail un-

The Stake Winner. King Leaf, Chestnut Horse. Bred by J. D. Smith, Muir, Ky., Registered No. 15735. Owned by The Errol Farm, Plymouth, Fla.

til he becomes fairly reconciled to that way of drawing and going steadily, when we quietly pull on the rope or strap we have in the wagon, which releases his tail and permits him to pull in the usual manner without stopping. This should be done while the horse is in motion, and, if he does not appreciate the change and should stop, we again get down, as quietly as before, and connect him to the wagon by the tail and start as before, and keep it up much longer, repeating as often as necessary, until the horse decides that he prefers to draw the loads by his shoulders, rather than his tail, as shown in cut No. 22.

Our object in writing these articles is twofold: first, to give a more complete description of the means and especially the methods, than we have heretofore observed by other writers on the subject; second, to

be able, at least, to a degree to ameliorate the sufferings of our horses in the hands of those who would treat them more humanely if they only knew the means and methods by which they could effectively do so in an intelligent manner. We do not charge the abuse of our horses to the naturally cruel dispositions of their handlers, but to want of the proper means, and, also, to the inherited impression that the horse is only a brute to be driven, driven, driven, without giving this noble servant credit for scarcely any of his innate intelligence.

We have given this subject close attention for more than 40 years, and have studied the natural laws by which the horse can be made as obedient, and useful an animal, as treads the earth through the means and methods of his education. We hope our articles will awaken an interest in the young men of the South, to a better treatment of our greatest animal servant, the Horse.

A Typical Southern Horse. Owned on Diversification Farm No. 3, Uniontown, Ala.

NOTE —Photographs on pages 339, 347, 370, 372, 379 and 395 were taken by Mr. William F. Nelson especially for this Book.

DOSES AND ACTIONS OF DRUGS

NAME OF DRUG	ACTION	HORSES	CATTLE	SHEEP AND SWINE	DOGS
Acetanilid . . .	Reduces fever	1 to 8 drams . . .	2 to 10 dr. . . .	10 to 60 gr . . .	2 to 10 gr
Acid, Boric. . . .	External and intestinal antiseptic	2 to 8 drams . . .	2 to 10 dr. . . .	30 to 60 gr . . .	5 to 15 gr
“ Carbolic	External and internal antiseptic	15 to 30 grains . .	15 to 60 gr. . . .	5 to 10 gr . . .	1 to 2 drops
“ Gallic	Internal astringent	1 to 2 drams . . .	2 to 3 dr	10 to 30 grains . .	5 to 15 gr
“ Salicylic	Intestinal antiseptic, anti-rheumatic	1 to 6 dr	2 to 10 dr. . . .	15 to 30 gr . . .	5 to 10 gr
“ Tannic	External and internal astringent	1 to 4 dr	2 to 5 dr. . . .	30 to 60 gr . . .	1 to 10 gr
Aconite, Powder . .	Decrease the force and frequency of the heart	5 to 15 gr	5 to 20 gr. . . .	½ to 2 gr	1 10 to 1 gr
“ Extract	Decrease the force and frequency of the heart.	2 to 5	2 to 6 gr	1/5 to ½ gr	1 10 to 1/3 gr
“ Fluid extract . .	Decrease the force and frequency of the heart.	5 to 20 m	5 to 30 m	½ to 2 m	1 5 to 1 m.
Aconitine	Powerful heart depressant and toxic	1 30 to 1 10 gr . .	1 30 to 1 8 gr . .	1 100 to 1 50 gr .	1 200 to 1 50 gr.
Alcohol	Increases force and frequency of heart.	1 to 2 oz.	2 to 3 oz.	1 to 3 dr.	½ to 1 dr
Aloes	Purgative	2 to 10 dr. . . .	3 to 12 dr	1 to 4 dr	4 to 60 gr
Alum	Astringent and irritant to stomach and intestines.	1 to 3 dr	1 to 4 dr	10 to 30 gr . . .	1 to 5 dr
Ammonia water . . .	Heart and respiratory stimulant, anti-acid.	1 to 2 dr	1 to 4 dr	½ to 1 dr	2 to 10 m
“ Spirit	Heart and respiratory stimulant, anti-acid.	4 to 12 dr	5 to 15 dr. . . .	1 to 2 dr	5 to 30 m
“ Spt aromatic . . .	Heart, respiratory stim, expectorant, stomachic.	4 to 12 dr	5 to 15 dr	1 to 2 dr	5 to 60 m.
Ammonium Acetate .	Diuretic, depurative and anti-acid.	2 to 6 oz.	3 to 7 oz	4 to 8 dr	1 to 4 dr
“ Carbonate	Heart and respiratory stimulant, expectorant, emetic.	1 to 3 dr	1 to 4 dr	15 to 40 gr . . .	1 to 8 gr
Areca Nut	Kills round and tape worms in intestines.	4 to 8 dr	5 to 10 dr	30 to 90 gr . . .	15 to 60 gr
Arnica, tinct. of flowers	Stimulates skin. Little value internally.	½ to 1 oz	½ to 1 oz	1 to 2 dr	15 to 40 m
Arnica, tinct. of root	Stimulates skin. Little value internally.	½ to 1 oz	½ to 1 oz	1 to 2 dr	10 to 20 m
Arsenic	Poison. Destroys intestinal parasites. Tonic.	3 to 6 gr	4 to 10 gr. . . .	½ to 1 gr	1/60 to 1 10 gr
“ Fowler's so- lution	Poison. Tonic	2 to 8 dr	3 to 10 dr	½ to 1 dr	2 to 10 m
“ Donovan's so- lution	Poison. Tonic	2 to 8 dr	3 to 10 dr	½ to 1 dr	2 to 10 m
Aspidium F Ext. . .	Destroys round and tape worms in intestines.	3 to 6 dr	4 to 8 dr	½ to 1 dr	15 to 60 m
“ Oleo resin	Destroys round and tape worms in intestines.	3 to 6 dr	4 to 8 dr	½ to 1 dr	15 to 60 m
Atropine sulphate. .	Increases frequency of heart. Checks secre- tions.	½ to 1½ gr	½ to 2 gr	1 15 to 1 12 gr . .	1 100 to 1 20 gr.
Belladonna F. Ext of Leaves	Increases frequency of heart. Checks secre- tions.	1 to 2 dr	1 to 3 dr	10 to 15 m	1 to 3 m
Barium Chloride . . .	Purgative, stimulates involuntary muscles.	1 to 2 dr	2 to 4 dr	2 to 5 gr	1/3 to 1 gr
Bismuth Subnitrate .	Protects mucous surfaces	1 to 4 dr	2 to 5 dr	1 to 2 dr	10 to 30 gr
Brandy	Stimulates heart.	2 to 4 oz.	3 to 6 oz	1 to 2 oz	1 to 4 dr
Buchu leaves	Stimulates kidneys.	1 to 2 oz.	2 to 3 oz.	½ to 1 dr	10 to 30 gr
Calomel	Purgative.	1 to 2 dr.	2 to 4 dr	2 to 20 gr	1 to 5 gr .
Camphor spirits . . .	Stimulates heart, respirations of stomach and intestines.	1 to 2 oz	1 to 2 oz. . . .	2 to 4 dr	½ to 1 dr
Capsicum.	Stimulates mucosa of digestive tract	20 to 60 gr. . . .	20 to 90 gr	5 to 15 gr	1 to 8 gr
Charcoal	Absorbs gas when dry	1 to 2 oz.	1 to 4 oz	2 to 6 dr	10 to 60 gr
Castor Oil	Purgative	½ to 1½ pts. . . .	1 to 2 pts	3 to 6 oz	2 to 4 dr.
Chloral hydrate . . .	Depresses brain, heart, respirations, anti-septic.	1 to 2 oz.	1 to 2 oz.	1 to 3 dr	5 to 20 gr
Chloroform	Used in colic, diarrhoea, cough, anaesthesia	1 to 8 dr.	2 to 10 dr	20 to 60 m	10 to 30 m
Cinchoric bark . . .	Tonic, astringent, anti-periodic	2 to 6 dr.	2 to 10 dr	1 to 4 dr	10 to 60 gr
Copper Sulphate . . .	Antiseptic, astringent, kills round worms.	1 to 2 dr.	2 to 3 dr	3 to 20 gr	1/4 to 2 gr
Croton oil	Irritant purgative.	15 to 30 m. . . .	20 to 40 m	5 to 10 m	1/2 to 3 m
Digitals tinct	Increases force of heart, and diuretic.	3 to 6 dr.	4 to 8 dr	½ to 2 dr	10 to 40 m
Epsom salts	Saline purgatives for cattle and sheep.	4 to 16 oz.	8 to 32 oz.	1 to 3 oz	1 to 4 dr
Ergot	Stimulates uterus: checks internal bleeding	½ to 1 oz.	½ to 1 oz	1 to 2 dr	½ to 1 dr
Ether, nitrous	General stimulant and diuretic.	1 to 2 oz.	1 to 2 oz	2 to 4 dr	10 to 60 m
Gentian	Bitter Tonic and stomachic.	½ to 1 oz.	½ to 2 oz	1 to 3 dr	5 to 30 gr
“ tinct comp	Bitter Tonic and stomachic.	1 to 4 oz.	2 to 4 oz.	4 to 8 dr	1 to 4 dr
Ginger	Improves appetite, aids in expelling gases.	2 to 8 dr.	4 to 10 dr	1 to 3 dr	5 to 30 dr
“ Fld ext	Stomachic and carminative.	2 to 8 dr.	3 to 10 dr	1 to 3 dr	5 to 30 m
“ tinct	Stomachic and carminative.	1 to 2 oz.	1 to 3 oz	2 to 4 dr.	10 to 60 m
Glycerine	Laxative and protective. Purgative	2 to 4 oz.	3 to 6 oz.	1 to 2 oz	1 to 3 dr
Glycerin-hiza	Laxative and Demulcent.	4 to 8 dr.	5 to 10 dr	1 to 4 dr	10 to 60 dr
Hamamelis F ext. . .	Astringent used in diarrhoea	1 to 2 oz.	1 to 2 oz	2 to 4 dr	½ to 2 dr
Hydrast's (Golden Seal)	Stimulates motion and secretion in stomach and uterus.	2 to 8 dr	3 to 10 dr	1 to 2 dr	5 to 60 gr
Hydrogen Dioxide . .	Antiseptic external and internal.	1 to 2 oz	1 to 3 oz. . . .	1 to 4 dr	½ to 2 dr
Hyascyamus	Increases frequency of heart beats. Checks secretions.	½ to 1 oz.	4 to 10 dr	½ to 1 dr	15 to 15 gr

NAME OF DRUG	ACTION	HORSES	CATTLE	SHEEP AND SWINE	DOGS
Hyascyamus, fld. ext.	Increases frequency of heart beats, dilates pupils.	4 to 8 dr.	4 to 10 dr.	½ to 1 dr.	5 to 15 m
Hypophosphites, c. syr.	Stimulates cell activity, and nutritive.	1 to 2 oz.	1 to 3 oz.	2 to 4 dr.	1 dr
Iodine " Lugol's Sol. . .	Antiseptic, irritant, checks secretions.	½ to 1 dr.	1 to 2 dr.	10 to 20 gr.	2 to 8 gr
" Tinct.	Antiseptic, irritant, checks secretions.	2 to 4 dr.	2 to 4 dr.	20 to 40 m.	2 to 10 m
Iodoform	Antiseptic, irritant, checks secretions.	2 to 4 dr.	2 to 4 dr.	20 to 40 m.	2 to 10 m
Ipine	Expectorant.	4 to 8 dr.	5 to 10 dr.	10 to 30 gr.	2 to 8 gr
Ipicac	Emetic.	1 to 2 dr.	2 to 3 dr.	½ to 1 dr.	½ to 2 gr
Iron chloride tinct. . .	Tonic, astringent, antiseptic, destroys worms.	½ to 1 dr.	½ to 1 dr.	½ to 1 dr.	15 to 30 gr
Iron and Quinine citrate	Tonic, astringent, antiseptic, antiperiodic.	20 to 60 m.	20 to 60 m.	20 to 60 m.	5 to 30 m
Iron sulphate.	Tonic, astringent, antiseptic, destroys worms.	1 to 4 dr.	1 to 8 dr.	10 to 30 gr.	5 to 10, gr
Lime water	Anti-acid. Checks diarrhoea.	1 to 2 dr.	1 to 3 dr.	20 to 30 gr.	1 to 5 gr
Linseed oil	Purgative and protective.	4 to 6 oz.	5 to 8 oz.	1 to 3 oz.	1 to 8 dr
Magnesia	Used to check diarrhoea in calves and colts.	½ to 1½ pt.	1 to 2 pts.	3 to 12 oz.	4 to 8 dr
Magnesium sulphate . .	Saline purgative (best for cattle)	1 to 4 dr.	2 to 4 dr.	1 to 2 dr.	5 to 60 gr
Mercury with chalk . .	For diarrhoea in calves and colts.	1 to 2 lb.	1 to 2 lbs.	4 to 8 oz.	
Mercury bichloride . .	Externally antiseptic 1 to 1000. Internally antiseptic, etc.	10 to 15 gr.	10 to 30 gr.	1 to 10 gr.	1 to 3 gr
Mercury red iodide . .	Used as blister, 1 part in 4 to 8 of lard or vaseline	5 to 8 gr.	5 to 10 gr.	1 to 3 gr.	1/30 to 1, 8 gr
Morphine and its salts	Narcotic, antispasmodic.	3 to 10 gr.	4 to 12 gr.	1 to 2 gr.	1/8 to 1/2 gr
Mustard	In water, externally, mild blister, int. a stimulant	4 to 8 dr.	4 to 10 gr.	1 to 2 dr.	10 to 15 gr
Mustard	as an emetic.			4 to 8 dr.	4 dr
Nux vomica	Respiratory, heart and bowel stimulant.	½ to 2 dr.	2 to 3 dr.	10 to 20 gr.	1 to 2 gr
" " tinct. . .	Respiratory, heart and bowel stimulant.	1 to 6 dr.	2 to 8 dr.	20 to 40 m.	5 to 15 m
Olive oil	Laxative, purgative and protective.	1 to 1½ pt.	1 to 2 pt.	4 to 8 oz.	1 to 3 oz
Opium	Narcotic, depresses action and secretion of bowels.	1 to 2 dr.	2 to 4 dr.	5 to 30 gr.	1 to 3 gr
" Tincture . . .	Narcotic, depresses action and secretion of bowels.	1 to 2 oz.	1 to 3 oz.	2 to 6 dr.	3 to 30 m
" " Camphor . .	Paregoric, narcotic, depresses action and secretion of bowels.	2 to 4 oz.	2 to 6 oz.	4 to 8 dr.	1 to 4 dr
Pumpkin Seed	Destroys tape worms.			1 to 8 oz.	1 to 2 oz
Petroleum (vaseline) . .	For sore throat when dry, rough or raw.	1 to 8 oz.	1 to 10 oz.	2 to 4 dr.	1 to 2 dr
Phystostigmine	Salicylate or sulphate, purgative, hypodermically	1 to 1½ gr.	1 to 2 gr.		
Pilocarpine and salts . .	Increases saliva and stimulates intestines.	1 to 3 gr.	3 to 6 gr.		
Podophyllin	Stimulates liver, purgative.	1 to 2 dr.	2 to 4 dr.	5 to 30 gr.	1 to 3 gr
Potassium Carbonate . .	Anti-acid, alkaliizer of the plasma of the blood.	4 to 8 oz.	6 to 10 dr.	30 to 60 gr.	5 to 20 gr
" Iodide	Stimulates cell activity and lymph glands.	4 to 8 dr.	4 to 8 dr.	10 to 30 gr.	2 to 15 gr
" nitrate	Depresses heart, stimulates kidneys.	4 to 8 dr.	4 to 10 dr.	30 to 60 gr.	5 to 20 gr
" permanganate . .	Used chiefly as mild antiseptic externally.				
Pyrethrum	Used chiefly to drive away fleas, etc.				
Quinine and Salts . . .	Tonic (small doses) to reduce fever large dose . . .	½ to 5 dr.	1 to 8 dr.	5 to 40 gr.	2 to 10 gr
Santonin	Destroy intestinal worms.	4 to 8 dr.	4 to 10 dr.	1 to 3 dr.	2 to 20 gr
Sodium bicarbonate. . .	Gastric Sedative, alkaliizer of blood plasma.	1 to 4 oz.	2 to 5 oz.	2 to 4 dr.	5 to 30 gr
Sodium bromide	Nerve depressant. Narcotic.	1 to 2 oz.	1 to 3 oz.	2 to 4 dr.	5 to 60 gr
Sodium hyposulphite . .	Gastro-intestinal, antiseptic, laxative.	1 to 2 oz.	1 to 3 oz.	30 to 60 gr.	5 to 30 gr
" salicylate	Anti-rheumatic, intestinal antiseptic.	2 to 8 dr.	2 to 10 dr.	½ to 2 dr.	5 to 30 gr
" sulphate	Glauber's Salts, purgative.	8 to 16 oz.	1 to 2 lb.	1 to 2 oz.	5 to 30 gr
Stramonium, fld ext. . .	(Jimson weed) action same as Belladonna.	20 to 60 m.	30 to 90 m.	5 to 10 m.	1 to 5 m
Strophanthus tinct. . .	Decreases frequency and increases force of heart.	1 to 4 dr.	1 to 8 dr.	5 to 30 m.	2 to 10 m
Strychnine and salts . .	Stimulates heart, respirations and spinal motor nerves.	½ to 2 gr.	1 to 2 gr.	1/30 to 1/5 gr.	1/120 to 1/30 gr
Sulphur	Gastro-intestinal disinfectant. Purges	2 to 4 oz.	3 to 6 oz.	1 to 2 oz.	1 to 4 dr
Sweet spirits of nitre . .	Same as nitrous ether				
Tallianine	Given intravenously in lung fever, etc.	2½ dr.	3 dr.	5 to 15 m.	2 to 6 m
Turpentine	To destroy intestinal worms.	1 to 3 oz.	2 to 4 oz.	½ to 1 oz.	½ to 4 dr
Turpentine	To stimulate the kidneys.	2 to 6 dr.	3 to 8 dr.	1 to 2 dr.	5 to 10 m
Turpentine	To expel gases from intestines and antiseptic.	1 to 2 oz.	1 to 3 oz.	1 to 4 dr.	10 to 30 m
Veratrum viride, fld. ext.	Depresses heart and acts like aconite.	2 to 3 dr.	2 to 3 oz.	40 to 60 m.	2 to 8 m
Virburnum, prun, fld ext.	Depress Uterus, prevent abortion.	1 to 4 oz.	2 to 5 oz.	2 to 4 dr.	10 to 60 m

BOOK XII

HOG DEPARTMENT

.. EDITED AND REVISED BY ..

GEN. THOMAS T. MUMFORD,

Manager

U. S. Diversification Farm No. 3, at Oakland, near
Uniontown, Alabama.

A Southern Scene.

INTRODUCTION.

The Department of Agriculture at Washington, D. C., has opened the way for a new era. They have established a Diversification Farm No. 3, on Oakland, the Munford Plantation, near Uniontown, Alabama. It is an object lesson, a reality, and not an experiment. There they teach how hogs are raised economically. It is a specialty. The hogs are grazed and fed on alfalfa, Bermuda grass, hairy vetch, white clover, peas, beans and sorghum, and the last three weeks of their lives corn and cotton seed thor-

to the importer of these Western shippers, who supply not only their corn fed hogs, but also a large part of their corn.

We now come to the real business of this matter. Prof. W. J. Spillman, representing the Bureau of Animal Industry, at Washington, D. C., paid a visit to this section of Alabama, and addressed by invitation a body of planters of this vicinity. He made this proposition: "That the Department of Agriculture could demonstrate at a minimum cost the price of a pound of bacon, which could be raised on our lands, if the opportunity was afforded." He said that he

Fig. 1.—Weighed when 1 year old 535 lbs. Present weight 901 lbs. Owned by E. C. Shafner, Mulberry, Tenn.

oughly fermented in their food. The aim is not to winter pigs which are intended to be slaughtered, but that the brood sows should be farrowed in April and May and their pigs killed in January or February, the same year, weighing from 150 to 200 pounds, and raised at a minimum cost.

I have heard it said that everybody cannot raise hogs for profit. Our population increases over 2,000,000 annually in the U. S. The census shows that about 47,000,000 hogs are raised annually, and that their money value points to \$289,000,000.00. Every man knows that in every village and town of the South, tons of hog products are brought into the town, and heavy tribute is paid to the railroads and

was prepared to furnish the proper seed and to demonstrate how the land should be prepared, and would guarantee the best results, if the owner of the land would furnish the land and do the labor, and follow implicitly his plans and specifications. I offered him all that he required, and have been delighted with the progress and results. He suggested that hogs be the specialty and the entire product of the land should in one form or another pass through the hog,—in other words, we would raise hogs.

I asked what kind of hogs? He replied that, personally, he preferred one kind, that it was a matter of fancy or taste; that there are many valuable breeds and that he would leave that to me. The Berkshire

breed pleased both of us, and I at once formulated my plans, but he winked at me and suggested that time was an important factor, for said he. "we must first prepare the food and then get the hogs." "Ours is an object lesson, and I will have sent to you enough alfalfa seed to occupy fifteen acres, and some varieties of corn and peas different from what you have, and some sorghum seed, and when these have grown in sight, we will talk about how to use them." We began to prepare for alfalfa in February and in March it came up beautifully. We used twenty lbs. of seed per acre. In April we had a beautiful green field and in May it was ready to be foraged. This was for the hogs. We had a first-rate old Bermuda pasture well sprinkled with white clover, which is invaluable in wet and muddy weather, as the hogs do not cut it up.

We "ring" all our hogs in their noses, and find that a good piece of wire answers as well as anything seen on the market as "Hog Nose Rings." With a keen punch we make an opening, through which the wire is promptly inserted, a stick a half an inch in diameter is placed next to the nose, pulled over and twisted and cut with a pair of nippers, and it will generally stay there as long as they live. The wild hog's maxim is "root pig or die" and a choice tuba of many kinds whets his appetite, but it is work. If he is placed where he can get tender herbage at will, and plenty of fresh water, he will eat until he is full and not "pester" himself much about what is under the ground, unless there are roots planted for his consumption, and upon which he has to depend. We planted fifteen acres in early corn and laid it by, by seeding about two bushels of peas to the acre, which we covered with a weeder. (And we here exhibit an object lesson from a photograph of the alfalfa, corn, peas and sorghum.)

Having seen what was intended to be fed, I collected as fine Berkshire hogs as I could find in Maryland, Virginia, North Carolina and Kentucky, including crossing of the best imported English Berkshire. Our young boar is a picture. At eighteen months old, he weighed four hundred and fifty-three pounds gross, and we have endeavored to keep down his flesh, rather than crowd him by extra feeding.

I now come to shelters. When I asked what I should build, the reply was "that depends upon your taste and surroundings." Professor Spillman only wished an object lesson. Men must be governed by their ability, and are here to raise hogs economically, but there are prerequisites or cardinal principles in-

involved to ensure success. I see no necessity for elaborate buildings. What we demand for our hogs is good, warm, dry shelter from cold winds and rains. Good beds and plank floors are needed, and good troughs to feed in that are not in the mud. The hogs must be kept free from dust and vermin, for these are enemies to hogs and pigs. A plenty of fresh, clean water is absolutely necessary for them to drink. It is a good plan to have charcoal for them, as it is a fine sedative. It is carbon in a different form, and is assimilated in large quantities and hogs improve on it. Also salt, wood ashes and a little sulphur mixed is acceptable to the hogs.

They will eat it when they require it. When anything is wrong with a hog he should be immediately taken from the rest, and if he dies he should be burned or buried. Dogs and buzzards, the scavengers of the farm, often contaminate water by their voiding, and propagate diseases as violent as the fly and the mosquito does, and should be guarded against. All ill-formed, sick or injured pigs had better be given away than mar the beauty of a fine herd of hogs or pigs.

Lice can readily be detected and gotten rid of by using a spray of kerosene oil, turpentine soap and warm water. The hog in self-defense seeks a wallow and plasters head, ears and back with soft mud, which no vermin can live in. The vermin are encased in this mud and when it dries, the hog rakes it all off by scratching post. If this scratching post is wrapped with a bag which has been saturated with kerosene oil, the hogs will rub against it, and this will greatly aid in keeping the vermin off.

FEEDING.

We believe that the hog will consume as much grass in proportion to size as any other animal, and when just grain enough to keep them gentle, will thrive as much, and grow as fast towards maturity as any other animal. They delight in tender herbage. A handful of meal given to them daily seems to stick to their kidneys and they lay on fat rapidly. A little corn or rice meal, and well fermented cotton seed fed daily to hogs will make an astonishing increase in their weight, and it is a perfectly safe feed. Raw cotton seed in any quantity is a poison to them. For fancy hogs, skimmed milk is an ideal ration, also will be found to be excellent for pigs. Alfalfa will make a hog as cheap as any ration I can use.

Brood sows should be especially provided for. She should have a good, dry place to sleep and a dry floor sloping so as to drain well. A rail should be arranged as a shield for the young pigs. It should be about eight inches from the floor to prevent the sow from laying upon the pigs and killing them at farrowing time.

We believe that the Berkshire thorough-bred boar is the most desirable head of the herd. They seem to propagate their great muscular power and activity, their fine forms and their uniformity of color and marks. The boar should be kept separate from the brood sows, except when to be mated. He should have exercise, and should not be used more than once a day.

The cross of the Berkshire boar with the native sow produces the best crosses for what is known as Smithfield bacon. These hams sell at wholesale for

you give them plenty of salt and wood ashes, you will not be troubled with disease, as otherwise you would be.

PURE WATER.

Investigations carried on by the Bureau of Animal Industry of the Agricultural Department show that hogs often contract diseases, although there is no apparent cause, when they have access to stream of running water. Investigation shows that germs which cause many of the diseases of hogs are transmitted by means of the water from one locality to another. Hogs need plenty of fresh water, and they need it a great deal. A good place to wallow will help them, provided it is kept clean. Mud is not filthy, but the wallowing place can become filthy. Keep plenty of good, pure water for him to drink and bathe in. They do this in order to cool off.

RAISING HOGS A PROFITABLE INDUSTRY.

The farmers of the South certainly need to raise their own meat. Every farmer can raise meat enough to do his family and hands without any cost practically, and when he fails to do so he is not taking advantage of the opportunities that are his. There is more money in hogs than there is in cotton. The great advantage in raising hogs is that they consume a great deal of matter that would otherwise be wasted were it not for them. In raising hogs it will pay you to have a pasture for them to run in. Raise your own meat. If you cannot do this you cannot succeed in the highest sense of the word as a farmer.

THE BREEDS.

It does not make so much difference as to the breed of hogs a man uses. He should select that breed which best suits his taste or fancy best. One breed would suit one man, while another breed would suit another. The better the breed of hogs, the more care they will have to have. If you are not going to look after your hogs, you had better get old familiar razor back, for they require little attention. However, you do not secure as good pork from the old razor back as you would from a better breed. If you have fine Poland-China, and are going to allow them to root for a living as you would the razor back, you will get very poor returns. The raising of hogs is a

Fig. 2.—Hogs on Erroll Farm, Plymouth, Fla.

twenty to thirty cents per pound and the demand far exceeds the supply. Breakfast bacon of this kind brings twenty cents per pound. A good brood sow should raise from twelve to nineteen pigs each year, and the pigs if kept thrifty are marketable at any season of the year.

SALT AND ASHES.

A box of salt should always be kept in one corner of the pen where the hogs can have free access to it. They should also have free access to wood ashes. If

business and requires attention and thought. If you succeed you must study your business.

Berkshire.—The Berkshire is a black hog with white feet, white line in the face, pug, up-turned nose, with occasional white spots over the body. Ears are erect. The sows are prolific and active. Good shoats weigh from 250 to 300 pounds at from nine to twelve months old. Their bones are small, and consequently are not so good for shipping, as their legs are easily broken. This is a very popular breed in the South.

Poland-China.—The Poland-Chinas are black and white spotted hogs weighing from 250 pounds and on upwards from nine to twelve months old. They have large hams, short, strong legs, and for that reason make fine shippers. This breed is grown more by the Western farmers.

mature. They sunscald easily in the South, but are very popular breeds in the East and North.

Victorias.—The Victorias are made up of two distinct breeds, the Davis and Curtis. Both are white hogs and weigh from 300 to 400 pounds from nine to twelve months old. It is claimed for the Victorias that they are little subject to mange and sunscald here in the South. The sows are prolific and are good mothers.

Yorkshire.—The small Yorkshires are pure white hogs with pink skin. These hogs weigh when mature from 375 to 400 pounds. They will do as well in the South as any of the white breeds, but it is claimed that they cannot compete with the black haired hogs.

Let it be added here with emphasis that the larger

Fig. 3.—Hogs on U. S. Diversification Farm No. 3. Uniontown, Ala.

Duroc-Jersey.—The Duroc-Jersey is a red haired hog, and very much resembles the Poland-China. Well matured shoats from nine to twelve months weigh about 250 to 300 pounds. They are excellent feeders, stand forcing well, and never sun scald. The bones are large, and the sows are very prolific. The hogs when mature weigh from 600 to 700 pounds.

The Chester-Whites and the **Improved Chester-Whites** are both white breeds. The hogs dress from 175 to 250 pounds when from eight to nine months old, and go anywhere from 600 to 700 pounds when

breeds do not always pay. If a good large prize is offered for the largest hog grown in the country, you may compete for the prize, but I would advise not to attempt to raise extra large hogs. Large hogs are not wanted at the butcher pen, and they are not as profitable to the producer as a medium size hog. It does not pay to keep hogs until they are old, for they will soon eat up the profits. Spring pigs should be fattened the same year, for it does not pay to keep them over. They are more liable to disease, and eat too much. Anywhere from 200 to 300 pounds is a very good weight for a hog. To go over that weight

is a waste of money. The same corn will produce more meat in smaller hogs.

HOW TO RAISE HOGS.

In raising hogs common sense should prevail. They must be protected from the cold. Now, of course, it will not be argued that they should have as elaborate buildings as are required in the North. But they should have ample protection. Their sleeping places should be dry and clean. When it comes to pastures and pens, circumstances will have to determine. We would not advise using pens for any length of time. It is much cheaper to have a pasture. A hog pasture does not mean a dust lot with a few old weeds in it, but it means a good range with a lot of good feed in there for them. It is a losing game to try to raise hogs in a dry lot, using nothing but corn for food. While in the pen some green food, such as Bermuda grass, should be fed.

In raising hogs, the owner must have good fences about his pasture. A hog can make himself an intolerable nuisance unless he be kept in an enclosure, and good fences are necessary to keep him there.

The boar is ready for service at from six to eight months old, but it is far better to allow him to become ten months old before he is allowed to serve. The sow is capable of breeding when she is seven or eight months old, but it is better that she not bring her first litter of pigs until she is fourteen or fifteen months old. Two litters of pigs per year is all that a sow should be allowed to raise, and many breeders are satisfied with one. It is better that the first litter come by the first of March, and then by the first of the following year they are ready to kill. Pigs thus raised will bring one cent per pound more than if they had been wintered and weighed fifty pounds more. The thing to do is to push their fattening from the time they are born until they are killed, for the daily increase in flesh becomes less and less as the animal increases in age.

Pigs should be weaned in the spring from six to seven weeks old, and in the fall from seven to eight weeks old. In weaning them they should have skimmed milk, butter milk, corn meal, or some soft feed. Corn meal is a very poor food for pigs, as it furnishes fat only, and should not be used except to fatten hogs. Pigs should be castrated when from two to three weeks old, as it is far better to castrate them then than to allow them to get older, as they should

have ample time to get well, which requires three weeks, before they are weaned. Castration is a simple operation. Anyone who has ever seen it done can do so without any trouble. Gestation in sows is accomplished in three months, three weeks and three days. When you once get a good sow, hold on to her, for young sows are quite frequently bad mothers. A sow should continue to be prolific for about eight years, unless she is allowed to become too fat.

HOG FEED.

Since hogs must be fed the question of greatest importance is the feed question. We will consider briefly some of the best foods that are used for hogs.

The peanut is hard to beat for hogs, especially in the South, and in counties where the land is poor. The good part about peanuts is, that they will grow on land where nothing else scarcely will grow. Land that will not produce other things, often will produce fine peanuts, and these cannot be better used than in feeding to pigs. The place where they are planted should be fenced, and the hogs will do their own harvesting. The value of peanuts as a fattening food was tested by experiment, and found that it is greater than either soy beans, corn or chufas. The fat produced by the peanuts is softer and more oily than any of the others. Perhaps the table of the experiment will be of interest to some. This experiment was published in Bulletin No. 54 of the Arkansas Station.

RESULTS OF PIG-FEEDING EXPERIMENT.

	Number of Pigs	Weight of Lot at beginning. Pounds	Weight of Lot at end of 32 days. Lbs.	Weight of Lot at end of 46 days. Lbs.	Gain of Lot in 32 days. Pounds	Gain per pig per day in 46 days. Pounds
Lot 1 (peanuts)	4	466	760	844	294	2.2
Lot 2 (soy beans)	4	499	590	...	91	...
Lot 3 (corn)	3	417	646	754	229	2.4
Lot 4 (chufas)	3	364	482	562	118	1.4

Corn and corn meal are used to fatten hogs, but should not be used when the pigs are growing. In other words, while the pig is growing they must have something that will produce bone and muscle, and this corn does not do. Shorts is one of the very best feeds for growing pigs, as it contains a plenty of matter for bone and muscle.

There are many other feeds that can be raised in the South, and they should be adopted. Molasses that until recently found no sale, has been found to be quite valuable as a hog food, and now commands a good price as such.

As to pastures, rape makes a very fine pasture, and is being grown for that purpose quite a great deal now. It makes a quick pasture, and you get quick returns.

SCRATCHING POST.

Hogs enjoy a good scratch. They are not only comfortable to the hog, but they can be of great service to hog men, in that they can be wrapped with burlap, which is oiled, and when the hog scratches he gets greased, which will keep vermin off of him. Or you may wrap around the post a good Manilla

Fig. 4.—Head of the Herd.

rope as high as the hog stands, and saturate this with crude petroleum, or kerosene, though petroleum is better, and you have an ideal scratching post. This oil is fatal to lice and mites.

KEEPING MEAT THROUGH THE SUMMER.

Allow all the animal heat to escape by killing the day before packing. Block out the meat over evening, taking off the head, feet, loose fat, backbone and spareribs, and allow it to cool in such blocks, being careful not to let it freeze. After the meat has thoroughly cooled in that manner, then trim it, taking off the lard and sausage meat that is needed. Cut the meat in sizes that you desire, being careful to rub

each piece thoroughly with salt, and pack in a box with plenty of salt. When the meat has taken enough salt, take it out of the box, scrape the salt off, and hang it up. Smoke it with hickory, or corn cobs, using a pod of pepper to drive away flies. When dry, pack away the meat in a box, but do not allow the meat to touch the box, using corn cobs between the meat and box. The hams should not be packed down, but should be hung after you have covered them with a paste made from ground black pepper and syrup or molasses. This paste should be thoroughly rubbed in, and the hams hung where the rats cannot get to them. Borax spoils the flavor of the meat, and should not be used. Saltpeter should not be put on the meat if it will take the salt without it, as it hardens the meat.

TO PICKLE MEAT.

Dress the hog late in the afternoon or evening. Cut up and remove the bone, and let it lie until morning. Make a strong brine,—just as strong as salt will make it, boil and skim, and allow it to cool. Then place the pork in it, taking care that it be covered. Let it stand forty-eight hours. Then remove the pork, and empty the brine, and boil for five minutes and skim. Cool the brine, and place the meat in as before. Allow it to stand for twenty-four hours, remove the pork and boil as before, placing it back after the brine has cooled. Then place the brine and pork in a cool place and allow it to stand there. If the meat gets too salty, soak in water before cooking.

Another good plan is as follows:

To 400 pounds of meat (fresh):

One-fourth ounce pulverized red pepper.

One-half ounce saltpeter.

Four pounds sugar.

One gallon salt.

Mix together and salt down in the usual way and keep the meat weighted down under the brine. Of course, meat managed in this manner would have to be well bled, hung up to drip an hour or two. That is, leave the hogs hanging after dressing so there will be as little blood as possible, as you do not take it up after first putting down. Beef is especially nice pickled this way.

WHY HE FAILED WITH HOGS

Because he bred from worn-out stock.

Because his pigs took the scours from sleeping in cold, damp beds.

Because he failed to provide ample range for his sows.

Because he had some litters coming in mid-winter.

Because he did not know that a pig's stomach is small, and needs constantly replenishing.

Because he did not keep his pigs in clean beds.

Because he did not use his brain in keeping and looking after his pigs.

Because he did not feed them plenty of good, wholesome food.

Because he did not provide that his pigs should have plenty of good water.

Because he did not have a good pasture for his hogs to run in, and depended on keeping them up and feeding them corn.

HOG PHILOSOPHY.

The bacon hog does not stay a bacon hog very long on corn.

Seven or eight pigs to the litter is the proper caper; if you will just save and raise them.

A runty pig is one that eats his head off three or four times a year.

Hogs when properly raised are good mortgage lifters.

Do not feed the sow until the litter of pigs is a day or two old. It is better that she go hungry a day or so, than to feed her right away.

The bed for the brood sow should be changed occasionally.

In choosing a brood sow, look well to one that has depth of body, good quarters and length, with nice ears common to her kind.

Keep the pigs growing from the start. A setback to growing pigs is quite easy and it takes more time and feed to recover the loss than many are aware of.

STATION OFFICERS.

J. M. RICHESON, M. S., DIRECTOR AND SECRETARY.
J. F. CONNOR, V. M. D. VETERINARIAN
WM. MUNFORD, TREASURER

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UNIONTOWN, ALA.

Jan 12th 1908.

Gen. T. J. Munford Uniontown Ala

Hear Sir:- I have examined the manuscript
submitted for inspection and, ^{believing that} where a diagnosis
can be made that the suggestions offered
will prove valuable to swine breeders
generally

Yours truly

J. F. Connor.

CONTAGIOUS DISEASES

SWINE PLAGUE OR HOG CHOLERA.

Cause.—The greatest draw-back to the hog industry is the disease commonly known as Hog Cholera, or Swine Plague. The two diseases, Swine Plague, and Hog Cholera, are so closely related that it is indeed difficult to tell them apart, and the treatment for one is the same as that of the other, so they will be treated together here. This is a germ disease of a virulent nature and very contagious and proves fatal nearly every time. The disease is so important that it will doubtless be well to go into details. While it is a germ disease, and is brought on by being where other hogs have it, or in any manner receiving the germs from them, still there are certain surroundings that cause hogs to be affected when they would not be, were they in different conditions. It is almost invariably the case that hog cholera is due to the owner not having suitable accommodations for his hogs. It used to be that the woods afforded plenty of shelter for hogs, but not so now. A great many people have the idea that hogs do not require any shelter. A greater mistake was never made. Place a lot of hogs in a filthy lot, with a foul hole of water in it, without a shelter to go in, and feed them filthy food, and you cannot be surprised that you have the hog cholera. Just such as that puts the hog in first-class position to get sick. The disease cannot spread without the small microbes getting from the affected animal to those not affected. These germs or microbes can be carried in several ways: by the hogs themselves; on the clothing of persons, so you see how unwise it is for you to go over to see your neighbors' hogs that are affected, and come back and give yours the same disease, by bringing the germs with you; by vehicles; in feeds; dogs; streams, and, in fact, several other ways. It is very important not to let your hogs get the cholera.

Symptoms.—The disease seldom appears in the summer, and usually appears when the first cold spell appears in the fall, the hog taking cold. Some of them run at the nose, others thump at the sides, while others refuse to eat. Sometimes they swell up in the joints and get down so that they cannot walk. They

frequently have high fevers, and the hair comes out. Sometimes they die immediately, and sometimes they linger for a month, or perhaps not quite so long. Frequently they swell up all over, and their eyes will close up. The appetite is very poor. At times their jaws appear to be locked, and their ears will get sore and rot off.

Treatment.—Hog cholera is a very difficult disease to treat. Prevention is far better than cure. We give, however, some remedies that have been used extensively:

One-half pound sulphur,
One-half pound copperas,
One-half pound black antimony,
One gallon powdered charcoal,
One pint of salt,
One peck of hard wood (oak, hickory) ashes.

Mix thoroughly and place under shed where the hogs can get to it at will.

Another treatment:

One pound wood charcoal,
One pound sulphur,
Two pounds sodium chloride, or common salt,
Two pounds sodium bi-carbonate,
Two pounds sodium hypo-sulphate,
One pound sodium sulphate,
One pound antimony sulphid, (black antimony.)

A large tablespoonful once a day for each 200 pounds live weight of hogs to be given as a dose. These ingredients should be thoroughly pulverized and thoroughly mixed. The medicine should be thoroughly mixed with the feed, which should be soft, such as bran, middlings, corn meal, ground wheat or oats mixed with hot water. If the hogs will not eat, they should be drenched. Now there are wrong ideas about drenching hogs. They can be drenched, but should never be turned on their backs to drench them. The medicine should be poured very slowly down them, as it is an easy matter to suffocate them.

Prevention.—There are several ways of preventing the disease from spreading. The following remedy is said to be a good preventative:

Two parts common salt,
One part pulverized sulphur,
One part pulverized copperas.

Cooking soda, one ounce to ten pounds of the mixture.

Give one tablespoonful to each grown hog twice a week in their feed.

Cleanliness is certainly needed with hogs. It is a wrong idea that hogs should not be kept clean. Hogs should have dry, warm, well ventilated pens. The average hog pen of the South is a disgrace to the owner. Many people have no business whatever with hogs, for they certainly do not take care of them. A hog is not going to stay in a filthy place, unless compelled to do so. The trough in which a hog is fed should be kept clean, and the drinking water pure. I know that this is not the practice, and I also know that losses in hogs are caused by this. Care should be observed that the hogs do not drink water, or go into a stream which is infected. Keep the hog wallows filled as well as possible. Another thing that should be kept watch on, and that is not to allow too many hogs to sleep together. It is better to have too few in a pen, than to have too many.

The effect of a quarantine is good, and when a man's hogs take the cholera they should not only be kept up, but the farmer himself should not visit his neighbors, and he should not allow his neighbors in his own hog lot. The contagion is so easily carried that the strictest measures should be adopted.

As soon as sickness appears in a herd of hogs, the unaffected hogs should be removed at once to a clean disinfected spot. If any of the hogs die, the carcass should be burned, as this is the only safe method of disposing of them. It is a good idea to burn the carcass at the place where it dies, but if it has to be removed, see to it that this place is thoroughly infected. The quarters in which the sickness first occurred should be thoroughly disinfected. The hog cholera bacilli can live in the ground for three months, so it is very important that everything that is liable to be infected be thoroughly fumigated. Hogs should not be allowed to run at large, for they will cause much trouble. Use lime whitewash to disinfect the premises. Whitewash everything about the place.

PNEUMONIA OR INFLAMMATION OF THE LUNGS.

Cause.—This disease is caused by the same thing

that produces it in other animals, that is, sudden change in temperature, allowing the animals to suffer from colds or exposure to winds and storms, taking animals exposed to the weather in the pasture.

Symptoms.—The animal stands up or sits up most of the time; temperature is raised, hog has shivering fits; limbs become cold, frequent cough.

Treatment.—Put the animal in comfortable quarters. Give the following mixture:

Two drams bi-sulphate of soda,

Two drams nitrate of potash.

This should be thoroughly mixed with a pint of gruel, and fed to the animal. Feed the hog all the nourishing food that he will eat.

APOPLEXY, STAGGERS OR CONGESTION OF THE BRAIN.

Hogs are affected with the staggers quite frequently. The animal will be stupid, eyes red; pulse very rapid; bowels constipated. After the disease has developed, the animal becomes blind, running against objects, and finally becomes unconscious.

Treatment.—If possible let a stream of cold water fall on his head from a considerable height.

PARALYSIS OF HOGS.

Cause.—This disease for the past few years has been quite prevalent. The young pigs are the ones affected most by the disease, and it is caused by over-feeding pigs, especially feeding them too much corn and water. Fat is put on the pigs too rapidly, and as a result the bones of a growing pig are unable to support the flesh.

Symptoms.—The first symptoms of paralysis is that the hogs refuse their feed and walk rather stiffly, continuing to grow worse until they are not able to drag themselves about, especially are their hind quarters weak.

Treatment.—Prevention is certainly better than cure, especially with hogs, for they are not very good patients, and it is a difficult thing to administer treatment. Pigs while nursing their mother should be fed very little corn, but they should be fed some, gradually increasing the amount of corn. When they are weaned, feed ground feed or bran shorts, corn meal, milk, etc.

After young pigs become paralyzed, all corn should be taken away from them, and see to it that they are placed at a trough of milk in which has been stirred bran, and the following tonic, which is recommended by the Bureau of Animal Industry as a preventative against Swine Plague, or Hog Cholera, and which is a very good tonic for hogs.

One pound wood charcoal,
One pound sulphur,
One pound sodium chloride,
One pound sodium bi-carbonate,
One pound sodium hyposulphite,
One pound sodium sulphate,
One pound antimony sulphide (black antimony.)

These ingredients should be thoroughly pulverized and mixed. The dose of this mixture is a large tablespoonful for each 200 pounds of live weight of hogs to be treated, and should be given once a day. It is a good idea not to feed corn at all, but feed soft feeds. It is said that hogs are very fond of this food, and when once fed on it, they will eat it although nothing else tempts them. If the hogs are too sick to eat their food, they should be drenched. Care should be observed in drenching them, not to pour the medicine down too fast, as hogs are easily suffocated. A great many hogs are lost in this manner. Never turn a hog on his back to drench him.

Another Treatment.—After removing hogs to a comfortable place, stop feeding corn at all, but instead feed some soft food, and give very little of that. Give the hog ten drops tincture of nux vomica twice a day for ten days.

RHEUMATISM.

Rheumatism is caused by cold, damp premises, and exposure. When the hog is affected with rheumatism, it is with difficulty that the animal walks, and can only stand on its front legs. When standing, if it stands at all, looks like a badly sprung kneed horse. When the hog attempts to walk, it falls on his knees and goes that way.

Treatment.—Remove the hog from the others, so that it can be quiet, in warm, dry quarters. Administer a purgative, such as from one to five grains calomel, or one to two ounces salts, or an ounce of castor oil. After this medicine has acted, give the hog from twenty to twenty-five grains salicylate of

soda three times a day for five or six days. Recovery should take place in from one to two weeks.

SUNSTROKE.

During hot weather hogs in a pasture that is not abundantly supplied with shade are subject to sunstroke. Also hogs that are driven any distance in hot weather are subject to sunstroke. The first symptoms are fatigue, drooping of the ears, staggering gait, which result in collapse and unconsciousness. Convulsions set in at this stage and death results. There is no treatment for sunstroke, so the only thing to do is to prevent the trouble. No animal can stand the rays of sun so little as the hog, therefore all hog men, or people who raise hogs should provide them with plenty of shelter. You do not realize how much better they will do where they have access to a shelter during the hot days of the summer. Feeding is not all that is required to produce hogs, you should look to the comfort of the animal.

Fig. 6.—As they are bred in the South.

THUMPS.

Thumps is caused, like most of the diseases of the hogs, on account of not having a good place to sleep in. Also to lack of exercise. Give pigs three grains of calomel to the 100 lbs, which should be mixed with some kind of gruel.

ECZEMA.

Eczema is a breaking out that appears on the hogs. They are frequently weak in the back. If it is allowed to continue they become sore all over.

Treatment.—Have the hogs to sleep in new places, where they will have clean bedding. Give them a

good washing with soda and water, and then apply a two per cent. creolin solution, such as zenolium. If you cannot get the zenolium, use a mixture of tar and lard, using the same amount of each.

KIDNEY WORMS.

For kidney worms which affect the loins of the hogs, causing them to be crippled in the fore and hind legs, use one teaspoonful spirits of turpentine per hundred pounds live weight, given in milk.

Another Treatment.—Take equal parts of worm seed and arnica nut and give one teaspoonful in corn meal to each animal once a day for three days.

PREVENTION AND DESTRUCTION OF VERMIN.

Hogs often suffer very much from vermin. Lice are introduced from neighboring herds, and the losses in feeding are often severe, especially among young pigs, where death is sometimes a secondary if not an immediate result. When very numerous, lice are a serious drain on vitality, fattening is prevented, and in case of exposure to disease the lousy hogs are much more liable to contract and succumb to it.

Vermin are most common around the ears, inside the legs and in the folds of the skin on the jowl, sides and flanks. In light and isolated cases they may be destroyed by washing the hogs. In severe cases, however, especially where the whole herd is affected, thorough spraying or dipping should be resorted to.

In this case a dipping tank will be a great convenience.

One of the most effective and cheapest preparations to use as a dip is a two per cent. solution of creolin. The common tobacco dips used for sheep scab are also efficacious. If the hogs are washed, apply the solution with a broom; if they are sprayed, use the ordinary spray pump; for dipping, use a dipping tank. When being washed or sprayed the hogs should stand on a tight board floor.

Newly purchased hogs should be carefully examined for vermin, and they should not be turned with the herd until they are known to be free from these pests.

When the herd is found to be badly infested with lice, all bedding should be burned and loose floors and partitions torn out. Old boards and rubbish should be burned. The quarters should then be thoroughly disinfected by spraying with one of the solutions mentioned. (The creolin solution is good). After disinfection, as in the case of a disease outbreak, everything about the place, inside and out, should be thoroughly whitewashed.

In these remarks on sanitation no attempt has been made to go into the details of the disease affecting hogs or their treatment. They are simply intended to call attention to the simple measures which may be used by any farmer to avoid, to a large extent, the decimation of his herd by epidemics. Cleanliness and rational methods of management are relied upon by thousands of farmers to keep their herds in health and vigor. They are the marks of the good farmer and successful hog breeder.

BOOK XIII
SHEEP DEPARTMENT.

EDITED AND REVISED BY
WILLIAM LEA,
Marietta, Georgia.

Angora Goats, Anderson's Farms, Marietta, Ga.

Young Does, Anderson's Farms, Marietta, Ga.

A Typical Angora Goat.

SHEEP DEPARTMENT.

Many sections of the South have found it profitable to engage in sheep raising. They are profitable both for wool and for mutton. From the very earliest ages the raising of sheep has been found to be a profitable industry. Away back in the Biblical times we hear much of the sheep industry. Abraham had great flocks of sheep. The demand for mutton is steadily on the increase. New York City requires over a million pounds of mutton per year. Mutton is taking the place of pork on many tables, and the raising of sheep for mutton is largely increasing. One reason why sheep have not received more attention is on account of ignorance on the part of the sheep raiser. As to the kind of sheep that are in demand now, one of the greatest needs of to-day is a mutton sheep, distinctively, which is represented by legs of from 16 to 20 pounds in weight. The sheep producers as a rule, especially in the South, do not give sufficient thought to sheep raising. Not only is the item of food produced by the sheep important, but the returns in fleece are quite important, and must be taken into consideration. It will require a great many more sheep in the United States to produce the wool needed, for a great deal of wool is imported.

WHAT IT TAKES TO SUCCEED WITH SHEEP

There are two or three requisites for sheep business. In the first place, it is important that you get a suitable location. Sheep cannot stand wet quarters, therefore you do not want an undrained pasture for sheep. Land that is best suited for sheep is a well drained sandy loam or gravelly loam. It should be hilly or rolling rather than flat or level. Low spots or marshes should be avoided, for one place of this kind on a farm that is all right in other respects may cause the sheep to contract deadly diseases. Perhaps there is no animal so easily affected by surroundings as sheep. There is more in prevention of disease in sheep than there is in curing them. If the proper care is observed in handling sheep, there will be little sickness in the flock. Another requisite for success in sheep raising is that the raiser have a love for the work. Not only must he have a love for his

work, but he must possess tact, patience and perseverance. There will come seasons of depressions, and there will come temptations to abandon sheep raising for some temporarily more promising pursuit.

BREEDS OF SHEEP.

There are many breeds of sheep, but attention will only be given to those breeds that are adapted to the South.

The Hampshire-Downs.—This is a mixed breed brought about by crossing the South-Down on the native breed of the Hampshire, followed later by the Gotswold. This breed was very popular before the Civil War, in the South. They are a hornless breed, and have a black face, Roman nose.

The South-Downs.—This was once one of the most celebrated breed of sheep, but here of late it is not produced so much. They are models of what a mutton sheep should be. Wherever it is desired to produce a mutton sheep, perhaps this breed will answer the requirements better than any other. The ewes are very prolific.

The American Merino.—This breed is known all over the United States. It is not necessary to give a description of them.

SHROPSHIRE.

A breed of sheep that has won popularity more than all the others in the same length of time is the Shropshire.

They are some larger than the South-Down. The face and legs are a blackish brown; the ears are of the same color, and should be short and thick. The wool should extend down over the face, head and on the legs to the hoof. The fleece of the Shropshire is longer than on the South-Down, and closely set on a clear pinkish skin. A good ordinary flock of Shropshire will shear from seven to eight pounds per head.

The Shropshire is a short legged block built

sheep, furnishing a carcass for mutton that is not surpassed by any breed.

For the grading up of the common sheep of the South, the Shropshire ram by experience, has proved his superiority over all breeds. Adding size, increase of fleece, and stamina to his offspring.

An industry that would be very profitable to the Southern farmer is that of growing early or hot-house lambs, as it is termed in the East. The two breeds of sheep used for this purpose, are the Dorsets and the Tunis. The Dorset sheep are white faced and white legged, with a tuft of wool in the forehead.

The ewes are horned as well as the bucks. They are very solidly built, having a broad back and short legs.

Their most prominent characteristic, however, is their unrivaled fecundity. The ewes will take the ram in May, thereby dropping the lambs in October so that they are ready for the holiday markets. They can be bred again soon after dropping this fall lamb, and bring another, or other lambs in March and April.

With the proper management and handling this is the most prolific of all the breeds of sheep. The Dorsets are pretty well raised in the Eastern States and as far South as Virginia, supplying New York, Boston, Washington and other Eastern cities with their early lambs.

The sheep is a great scavenger, and can be used on the farm to clean the weeds to a great advantage. But the idea that has gotten into the Southern farmer's head that a sheep does not require much feeding has brought about his great failure along this line. When we learn to know that we can grow fine root crops here in the South, such as turnips, rutabagas, sugar beets, etc., and that rape, rye, clover and the cultivated grasses will furnish us plenty of grazing for the winter, we will be on the road to success along the sheep line. Then added to this, Bermuda and other native grasses, with the by-products of our cotton, cotton-seed hulls and meal, pea vine hay and sorghum hay, we have a ration that cannot be surpassed. The growing and feeding of root crops to sheep, has made England famous along this line.

The Englishman can grow sheep profitably on land worth \$4.00 to \$5.00 per acre. Why can't we on land worth from \$5.00 to \$25.00 per acre?

The next in importance to good feeding is dipping. This should be done twice a year to free the sheep of lice, ticks, and other external parasites, as well as im-

proving the condition of the skin. A good healthy skin produces a good fleece.

As to the kind of dip that we should use, will say that the day of the home-made dip is past. By actual experience it has been proven that home-made dips that are made from lime and sulphur are very injurious to the wool, and the sheep as well.

We have on market at present a number of prepared dips that are safe, effective and cheap.

Every sheep shed or barn should have a creep for the lambs to go to for a feed of chopped oats and bran. This creep should have entrances so that only the lambs could go into, keeping the old sheep out. There should be rollers on each side of the entrance so that the lambs would not tear their fleece in squeezing through. The lamb must be kept growing, as it is the steady advance that counts.

Of all the diseases of the sheep the internal parasites are the most trouble, and the worst of these are the stomach worms—*strongylus contortus*. They inhabit the fourth stomach of the sheep and goat. These worms are little thread-like worms; red, and from five to ten inches long. The symptoms arising from this parasite in the stomach are weakness, paleness of the skin and membranes, some fever, diarrhoea, and wasting of the body generally. A flock of sheep that are infested with these worms is a pretty hard proposition.

The eggs pass out with the droppings of the sheep waiting a favorable time to hatch out on the ground then the young worm crawls up on a blade of grass awaiting an opportunity to attract the young lambs. One reason why sheep should never be allowed to drink water around stagnated places is on account of such places being the breeding grounds of stomach worms. A remedy that has proved very effective for this disease is gasoline given to the lambs in teaspoonful doses, well shaken up in a half pint of sweet milk for three mornings in succession.

The lamb should be kept away from feed for twelve hours before administering the gasoline. This and dogs, we consider the two greatest enemies to the sheep industry of the South.

THE AVERAGE WOOL PER SHEEP.

In the United States the average weight of wool per fleece is over five pounds, in Australia it is over four pounds, in Great Britain four and three-quarter pounds, in the German empire three and two-thirds

pounds, in France nearly five pounds. So we see by this comparison that the United States has a greater average than any other country in the world. And yet the United States does not produce all the wool necessary for home use.

THE BREEDING AGE OF SHEEP.

The proper age for sheep to breed is two years. In the autumn after the ewe is one year old, she may be placed with the buck. As a rule it does not pay to breed sheep after they are seven or eight years old. One ram should be kept for forty or fifty ewes.

WATER FOR SHEEP.

Some people claim that sheep do not require water when they are pastured. This is a mistake, and you should not pay any attention to such folly. On very juicy grasses they will use very little water, but they need some, and they should always have access to plenty of fresh water. At times they require more water than at others. Sheep are especially sensitive to impure water, and therefore do not depend upon stagnant pools to furnish them water. This is quite important, for it is a very easy matter for them to contract disease from impure water.

SHELTER FOR SHEEP.

The house for the sheep need not be expensive, but some place should be provided where they can get in from the rain and wind. There are two or three important things in connection with the barn for sheep. In the first place it must have a good location, and be well drained. Sheep and water do not go well together. Do not place your barn on a location where it is wet and marshy. It is a poor policy to place any barn in a damp location, but to place a sheep

barn in such a place is the height of folly. The barn should be well ventilated. Sheep need plenty of fresh air, but do not need a draft.

FEEDING PLACES.

It will be found necessary to feed sheep some, and this should not be done on the ground. Have a trough made for them, but do not place it too high. The feeding arrangement here in the South need not be so extensive as in the North, where they have to feed more than here.

DISEASES OF SHEEP.

GRUBS IN THE HEAD, OR GADFLY.

The gadfly deposits eggs in the nostrils of the sheep in July and August. When these eggs are hatched out, the maggots find their way through the meat, causing the sheep much pain. You can generally tell when the gadflies are seeking the sheep, for the sheep will crowd together, keeping their nose to the ground, stamping violently.

Remedy.—After the gadfly has once taken hold, it is a difficult job to dislocate him. The following remedy will do good sometimes: Inject up the nose equal parts of sweet oil and turpentine, but be careful not to strangle the sheep.

Prevention.—It is much easier to prevent sheep from getting sick than it is to get them well after they have taken sick. Smear the nose of the sheep with pine tar during the fly season. If you have a large flock, smear the inside of the salt trough with pine tar, and when they go to get salt, they will do the rest.

GOAT INDUSTRY

The goat industry is not so important in America as it would be were it not for the prejudices of people. It is quite frequently the case that you hear people say that they do not like kid, but they are fond of mutton. Now, the truth about the whole matter

is, that few people can tell the difference between mutton and kid. When we come to consider the facts in the case, much so-called mutton that is sold from our city butcher shops, is nothing else but kid. Yes, it is just a goat that has been killed and named

mutton. It is very often the case that people who say they cannot eat kid are fooled and eat it very gladly when it is called mutton. Most authors tell us that goat is not much esteemed in the United States as a food, but notwithstanding this assertion, kids always find a ready market in the cities.

The goat will live and do well on less attention than any animal known. They require practically no attention in the summer, and very little in the winter. They will live where other domestic animals would literally starve. If farmers who have a few hill tops that are unproductive will fence it, and place a few goats in there, they will find it quite profitable. The goats will often bring them in some return when cotton is out of the season. What the South wants is diversification, and the adoption of the goat industry will help to bring this about. Many farmers are now raising cotton, and depending upon that crop altogether, when they could raise a few goats without any outlay of money, and find it a paying investment. And one great advantage in the goat business is that they are so hardy. There is one enemy to the goat in the South, and that is dogs. If you can keep the dogs away from them, there should be little trouble in raising goats. They are subject to very few diseases, have unusual digestive ability, will thrive on oak leaves and a little of nothing.

As to what kind of goats you should raise depends upon the object you have in raising them. If you desire to raise them for the fleece, you would want the Angora, but if you simply wanted to raise them for the meat, a short haired goat would answer your purpose better than a long haired goat. You should not cross the long haired and the short haired goats, for they will not do well.

THE ANGORA GOAT.

The Angora goat gets its name from Angora, a province in Turkey, Asia Minor. People who are not posted on the subject often make the mistake of calling the Angora goats Cashmere. We feel safe in saying that there is not a Cashmere goat in America.

During the administration of President Polk, the Sultan of Turkey requested of him that he recommend some one who would experiment in the culture of cotton in Turkey, S. D. James B. Davis, of Columbia, S. C., was recommended, and received the appointment. Dr. Davis' work proved so satisfactory to the Sultan, that he desired to reciprocate the

courtesy of the President, presented him with nine choice goats of his domain.

So these were the first Angoras ever brought into the U. S. During the year 1854, Col. Richard Peters, of Atlanta, Ga., bought all or a part of these goats from Davis, and from all information at hand Col. Peters owned about all the Angoras in the U. S. previous to the outbreak of the Civil War. Two of these goats were sold in the spring of 1854 to William M. Landrum, of San Joaquin County, California. Mr. Landrum is still breeding Angoras at Laguna, Tex. More than half the Angora goats of the U. S. would trace back to these nine goats. We mention this little sketch just to show what wonderful development can come from a small beginning and it will interest many, especially in the South, to know that this great industry had its origin here.

We will say in the outset that there are three principal reasons for the present interest in the industry, which are as follows: (1) They are very effective brushweed and weed destroyers; (2) they are mohair producers; (3) they yield a carcass that is very palatable and highly nutritious.

DESCRIPTION OF THE MODERN ANGORA GOAT.

While there has been no effort by an association or body of goat breeders to adopt a standard or a description of an ideal goat, we believe that the following description will be accepted by most breeders:

The Angora is smaller than the ordinary goat. It will weigh from 60 to 100 pounds, although some will weigh considerably more. The back should be straight with shoulders and hips of equal height. The chest should be broad and deep, denoting a good constitution, the body round, legs short and strong. The head should be erect, clean cut, with bright eyes and broad muzzle. The horns are grayish, never black. All grades show more or less kemp. There is a demand for fleeces that are over twelve inches, and they will bring on the New York market from one to two dollars per pound. New York and Boston are the markets for mohair in the United States.

All goats are browsers by nature, but the Angora is more so than all others. We have never seen any kind of weed, vine or bush that an Angora would not eat. After he has his fill of pine tops, sumach berries, sassafras buds, and what not, he will finish up on

the bark gnawed from thunder wood, (or poison, for sumach is a very deadly poison,) never seeming the worse for the same. They will clean up all the undergrowth in two years where enough is put on for the space to be cleaned. Every leaf and twig in their reach is greedily eaten, and this constant nibbling off of the leaves and buds soon kills out the weeds and bushes. They will desert the finest grass pasture for such an outlay. A thicket so dense that a man cannot get through will soon be converted into an open woodland. Angoras have done some wonderful work for us here, cleaning up such places, while at the same time he is paying more than any other live stock on the farm. The South has thousands of acres where they could be used profitably for the only purpose of cleaning up the land. Then the land is left rich after they have cleaned it up, from their droppings, and the grasses native to the locality "come in," making a fine pasture for other stock.

Different from most other animals, the Angora buck comes into heat. Their breeding season is from July through a period of about six months and the gestation in goats is about five months. The mating of the buck to the does should be along in November so as to have the kids to drop in April or May, so that there will be plenty of green browse for the does to furnish a good flow of milk for the kids. Angora kids are delicate for the first week or two and cannot stand exposure to cold, damp weather. After the kids are two or three weeks old they are very hardy and active, and can care for themselves as well as any animal of the same age. We think that there is no animal so pretty and intelligent as the Angora kid.

A good, strong, healthy buck that is in good health can be mated to from forty to sixty does. A buck like any other domestic animal should be in the best possible condition when put to service. Pure bred Angoras do not generally drop more than one kid at a time. We always figure on an increase of 100 per cent, during the year. There is generally enough twins dropped to make up for any losses that may occur. When an Angora buck is used on common or grade does, they drop the usual number of kids, two to three. The increase in a flock of Angoras depends on the care and management of the same. We have

known of an increase as high as 120 per cent. from a pure bred flock.

In this section of the country we shear only once a year, during April or May, but in some sections of the South-west they shear twice a year. The shearing of the goat is the same as the shearing of sheep. Anyone who is a good sheep shearer can shear goats, the only difference being that one should use shears with short, blunt blades when they are sheared by hand. We have used here with success the hand power clipping machine. With the clippers there is no double cutting of the mohair, and then it does smoother work.

Another source of profit from Angoras is their skins. Taken when the mohair is from 4 to 6 inches long they make the most beautiful rugs and robes. The mohair retains its original luster and may be used in the natural white, or dyed any color desired. The demand for these rugs cannot be supplied. They bring on the market from four to eight dollars each. The kid's finest fleeces adorn the collar and border of the ladies' most handsome opera cloaks. In the stores they are sold under some peculiar name, the purchaser being unaware of the true name of the "furs."

Angoras can stand any amount of heat and cold. They must not be allowed to stay out in the cold rains. If they stand in a cold rain during the winter season, when they are carrying heavy fleeces, it will prove detrimental to them, causing them to take cold, bringing on rheumatism, and the does to lose their kids. They need a good dry shed to go in. It need not be a warm one, just so it is dry.

Goats need very little feed in the South. A few cotton seed during the severest weather, along with some hay will keep them in good shape.

There is a great demand in the South for Angoras at the present time, and we know of no like stock that will pay as well. It has been fully demonstrated that they will do well here. They are subject to no disease and much of our hilly or rough country could be profitably turned into this industry. We have the browse, the good, pure water, and an abundance of rough land that is good for nothing else. We think that the opportunity is ripe for the goat industry in this section, and the first man into the field will reap the benefits of the same.

BOOK XIV.
COW DEPARTMENT

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DISEASES OF CATTLE.

CONTAGIOUS DISEASES.

Contagious Pleuro-Pneumonia.

Cause.—This is a contagious disease, and one of the most fatal that cows are subject to. It was introduced in America in 1843 in Brooklin, L. I. when a cow was purchased from an English captain. It is caused by a specific virus which gains access to the system through the lungs. It is slow in developing, sometimes going for two months before there is any outward manifestation. It was stamped out by the U. S. Bureau of Animal Industry, and no cases reported in America for several years.

Symptoms.—The first symptoms likely to be noticed are a rise in the temperature to 103 to 106 de-

grees live a long time before they develop, and the whole herd is liable to be affected.

Treatment.—There is no medical treatment that will avail anything. When the disease gets started there is no cure. Sometimes people think that they have a cure, but not so. Mild cases show signs of recovery; they appear to be in good health, will feed well, fatten fast; the milk cows produce milk again, but they have not recovered, and are liable to break out at any time. As soon as the disease is known to be contagious Pleuro-Pneumonia, have the animal killed at once, and buried. Do not attempt to save the hides, for it may mean the loss of more of your cattle. Place quick lime on the carcass.

Prevention.—It is certainly true in this case that "an ounce of prevention is worth a pound of cure." There are three methods of prevention:

Fig. 1.—View of farm of W. R. Clifton, Waldo, Tex., where Red Polled cattle are bred as near perfection as pure blood, proper breeding and treatment can make them.

grees Fahrenheit, there is a loss of appetite, cough, slight shivering, loss of milk, scanty urine. There will follow tenderness upon pressure between the ribs over the lungs; cough increases; the hind legs will be drawn under the body. Later on there will be a watery, or sometimes a thicker discharge from the eyes and nose. Sometimes the disease kills immediately, and sometimes it runs from two to eight weeks. If one suspects that his cattle are affected he should have an expert veterinarian called in at once, as it is of the most contagious type, and the

First. Quarantine Regulations. Stock imported to this country should be quarantined for at least 2 months so that there can be no danger of disease from them.

Second. Inoculation.—Inoculation for Contagious Pleuro-Pneumonia is a recent thing, having been practiced for only a few years. At first it was not successful, but it has been improved, until now it is used with great success. Inoculation does not produce the disease itself, but a fever which the animal overcomes readily. The virus which is taken from

the lungs of an affected animal is used to inoculate the animals. The tip of the tail is the place to inoculate, for the danger from gangrene is less here than at any other place. One drop of the virus is sufficient.

Third. Disinfection.—When any animal has suffered from the disease, the rest of the herd should be isolated, and the premises thoroughly fumigated. The best and cheapest way to do this is to burn sulphur in the buildings, closing them as tight as possible, and to whitewash every part of the building, roof, shed and all with lime whitewash, using one pint of crude carbolic acid to each bucketful of whitewash.

VARIOLA VACCINAE OR COW POX.

Cause.—This is also a contagious disease. It is to the cow what smallpox is to men; either can be produced in either men or cattle by inoculation from the other species. To have either, secures immunity from the other from a subsequent attack, at least for a time. Cow pox is a blood poison that has a period of incubation from three to nine days. It is a very common trouble, and almost every cow will be subject to it at some time of life.

Symptoms.—The local symptoms of cow pox are heat, swelling, tenderness of the teats for three or four days, followed by irregular pimples on the teats, udder, flanks, around the vulva, nose, mouth and eyes. These pimples are red at first and enlarge from day to day until they become about a half inch in diameter, and then they become yellow and burst.

Treatment.—The best treatment is good nursing. The disease rarely proves fatal. Give the cow a good dose of salts, and after each milking bath the teats and udder with diluted carbolic acid, and smear with lard, vaseline, or any healing ointment.

ANTHRAX, OR CHARBON.

Cause.—This disease is known by different names, such as Anthrax, bloody Murrain, Black Leg, Black Quarter, etc. It is contagious. It rises spontaneously in low, dam pastures, also in pastures where there is a great amount of organic matter, and on account of cattle being fed on food that is too rich and juicy,

especially clover, great changes in the temperature between day and night favor its development.

Symptoms.—Anthrax has two ways of manifesting itself: with external wounds, and without them. Black Leg is not a typical anthrax, but is related, and occurs in young, fast growing cattle. Its effect is

Fig. 2.—Hypodermic Syringe for injecting Blackleg Vaccine. (Bureau Animal Industry)

very rapid. In the morning a calf is dead of blackleg, when nothing appeared to ail it the night before. There is a stiffness in the affected quarters, with some diffuse swelling and heat, fever, the swollen part soon mortifies, becomes cold, gas forms under the skin, and crackles if rubbed. The black tongue as seen in animals is known by the red, purple, or black blisters on the tongue, palate and cheeks, and these blisters at times get as large as a hen's egg. Then they burst and run a watery, colorless matter, and the sore becomes an ulcer in appearance, and has

discharges. As it runs from the mouth, the discharge is bloody, the fever runs high.

Treatment.—There is no successful treatment for Anthrax or Blackleg. The only thing to do is to prevent it by inoculation with vaccines prepared for the purpose. They should be inoculated every year.

Prevention.—Prevention is better than cure with all contagious diseases. Drain the soil in the pastures, do not give the cattle much juicy food. Late in the summer, and early fall shelter the stock at night, when the days are hot, and the nights cool. Give the stock plenty of fresh, good water. Stock appreciate good water as much as people do, but they do not always get it as they should. The dead animals should be burned, hide and all. Fumigate the

For this reason, we go into details. The disease is caused by micro-parasites getting into the blood of cattle, and using up the red corpuscles of the blood. The disease is, as a rule, carried from one cow to another by ticks. As to whether the disease originates in the blood of one cow, and is carried to another, or whether it originates in the tick, and is transmitted to the cow is not settled. Indeed, there are many peculiarities of this disease that are yet to be explained. It sometimes appears where there are no ticks, but as a rule it only appears where there are ticks. When the ticks bite through the skin of susceptible animals, and introduce the fever germs, they begin to multiply very rapidly. After being in the blood for eight or ten days they attack the red cells of the blood and destroy them in large numbers. They have destroyed

Fig. 3.—Adult Cattle Ticks and their eggs.

(From Mississippi Experiment Station, Bulletin No. 73)

buildings where animals have died or been sick. Do not handle stock with blackleg any more than possible, and when it is compulsory wash the hands before and after handling them with a solution of carbolic acid, using one part acid to one hundred parts water.

TICK FEVER OR SPLENETIC FEVER.

Cause. One of the greatest drawbacks in the South to the cattle industry is the tick or Splenetic fever, or what is commonly known as Texas Fever. The disease was called Texas Fever because of so many deaths in Texas on its account during the early history of the disease. It is hard to compute the amount lost by the South each year on account of this disease.

half the usual number in a week's time by actual count. This drain of vital force of course weakens the animal, and it finally dies, because of the great amount of broken down waste matter which must be disposed of by the kidneys, liver, spleen and bowels.

Symptoms. The symptoms of Tick Fever are loss of appetite, constipation, hot, dry muzzle, temperature from 104 degrees to 106 degrees F. If it be a milk cow the flow of milk will cease almost suddenly. These symptoms are intensified as the disease advances, the head is held down, the back arched, ear drooped, red urine is frequently passed. The Ticks that are seen at this time are frequently small. If the animal has never had ticks on her before, and has any at all now, or has been where she could get them on her, there can be no doubt but that she has tick fever.

After the fever has run for a while, the animal becomes weaker, and shows that she is suffering greatly. The animal holds her head either back in the flank or straight forward, when she is lying down. Many die within two or three days, while others go

Fig. 4.—Instruments used in Blood Inoculation. 1. Trocar and Canula. 2. Lancet or Knife. 3. Wire Whip Stirrer. 4. Glass Jar. 5. Hypodermic Syringe.

from five to ten days. If the animal is able to go over eight days, there is hope for recovery.

Treatment. There is no specific treatment for Tick Fever that can be relied upon. The most important thing is to get the bowels open freely as early as possible, and to keep them in good working order, also keep the kidneys working well. In fact, much depends upon the kidneys, for the recovery is dependent upon the ability of the kidneys to throw off the waste matter. As soon as the animal is discovered sick,

clean off all the ticks immediately, and give the following purgative, one and a half pound Epsom salts, one quarter pound table salt, one tablespoon ground ginger, all dissolved in a quart of warm water to be given as a drench. In case the salts is not convenient, one or two pints of castor-oil may be used. Give the animal plenty of fresh, cool water. After the fever is over, say after eight or nine days, the fever may suddenly leave, and the temperature drop suddenly below the normal temperature of the body, and the animal dies from collapse. The animal should be watched at this time, and should there be much fall in the temperature, stimulants should be administered.

Prevention. Since Tick Fever is spread as a result of ticks, we will enter into this matter in details. At birth calves are only slightly susceptible to Tick Fever. Few calves under six months old ever die of Tick Fever. After six months old, the Tick Fever becomes more dangerous. When cattle once have the Tick Fever, there is little, if any danger of their having it a second time. Therefore cattle raised where ticks are plentiful become immune to the disease from tick bites early in life when the disease has little or no effect upon them. How long they are immune from disease is a matter of doubt among veterinarians. It is known, however, that after cattle have been where there are no ticks for a few years, they can contract the disease again.

Perhaps something of the life history of ticks would be of interest here. The most common tick that we see is the adult female tick, which is about the size of a grain of corn, and of a dull lead or bluish color. These ticks drop from the cattle to the ground, hide under grass or trash, and in four or five days begin to lay eggs. Each tick will lay from 1500 to 3000 eggs, and then die. After about twenty or thirty days these eggs begin to hatch, if the weather is favorable. As soon as hatched, these small ticks begin to crawl about, getting on grass, waiting until some animal comes near enough for them to crawl upon them. As soon as a cow lies down they get a foothold upon her, and crawl to the tenderest parts about her, such as the neck, brisket, belly, inside the thighs, around the udder. The male tick always remains small, something about the size of a pin-head. The female ticks begin at once to grow, and gorging themselves with blood. In about three or four weeks

they are mature, when they fall to the ground, begin laying eggs, and then die. Thus they go on from season to season. If there is no agency to destroy these eggs, it would be a matter of little time until they would take the world. These eggs cannot hatch in the sunlight, hence we have more ticks in the woods, and places where they can be in the shade. The effect of the rays of the sun has doubtless had a great deal to do with keeping them down. The effect of water upon the tick eggs is very little if any at all. They are often carried some distance by water, from one pasture to another. This is only true when

by disinfection of the pastures, and second by killing the ticks on cattle.

Ticks may be exterminated from the pastures by keeping the cattle away. The cattle can be taken off in the spring, and by November all the ticks will have starved to death. Or the cattle may be taken off in mid-summer, when there will be no ticks by the next spring. If the cattle are taken off in November, by the following July there will be some ticks left, as they will be carried through the winter unhatched, and will hatch out in the summer, and will not starve

Fig. 5.—Drawing Immune Blood from Supply Animal.

they float in bunches, for when the individual ticks become separated, they soon drown in the water. The effect of cold is very slight, if any, on the tick eggs as long as they remain unhatched. The seed ticks, however, cannot stand so much cold. The young ticks after being hatched will live four or five months without food, that is, without getting onto an animal.

There are two methods of getting rid of ticks: first

before July 1st. A better plan is to divide the pastures, keeping the cattle in one pasture one year, and the next year in the other pasture. In doing this care should be observed that the cattle do not carry the ticks into the disinfected pasture. If you have not sufficient land to allow one pasture to lie out, then you may cultivate the land not in use for a pasture. Ticks do not crawl far, nor do they go from one animal to another, so there will be little difficulty in

keeping them from going from one pasture to another. A board placed tight on the ground, or two fences of wire, say six or eight feet apart will be sufficient.

The "feed-lot" method of cleansing cattle advocated by Professor Morgan, of the Tennessee Experiment Station, is based upon the fact that the parasitic period (from attachment as seed tick to dropping to ground as a fully engorged female) of the fever tick is not more than forty days; less in summer. In this method a portion of the ground is set apart, half of which is of sufficient size to accommodate the number of cattle on hand. The area selected should be convenient to plenty of feed and water. Surround and divide the lot with a double fence (8 to 10-foot space). Feed the cattle for 20 days on one side, then remove them to the other for 15 or 20 days longer. Every tick will have dropped, and the cattle may then be placed upon such field or pasture as may be tick-free and available. By this method entire farms may be cleaned during a summer period of not exceeding four months. In the early spring select a field with water and shade available to be devoted to broadcast sorghum, corn or millet, or all three. On June 1 fence off the feed-lot (within the forage field), in which place all the cattle on the farm, and feed and rotate as described above for forty days. At the end of this period the cattle may be turned into the field of sorghum, millet or corn, and there pastured until October 15 or November 1, by which time all fever ticks

Fig. 6.—Inoculating Calf with Immune Blood.

upon the entire property outside of the feed-lots will have perished.

After the animals are removed the feed-lots should be immediately plowed and thoroughly cultivated, and their edges completely sprayed with crude petroleum, zenoleum solutions, or other substances destructive to tick life.

Fig. 8.—Dipping Vat for Cattle.

The second plan of getting rid of ticks is to kill them on the cattle. This plan requires more labor than the other, but it is quicker, and more successful than the other. The plan is to grease the legs, belly, and under parts of all cattle once or twice a week, and pick or scrape off all ticks, taking care to destroy those that you get off by burning them. The grease used should be one part kerosene and three parts of some crude, cheap oil, such as cottonseed oil in crude form, or axle grease, and it may be applied with a large paint brush. However it frequently happens that the herd is too large to give so much attention to each cow, in which case we use dipping or spraying. The cattle can be held in a chute while they are sprayed with a kerosene emulsion, or with a ten per cent. solution of Chloro-Naphtholeum or Zenoleum.

The plan used by the U. S. Government is not practical for the average farmer or cattle raiser, but we give it for the benefit of those that can use it. Have a narrow wooden vat some thirty or forty feet long, and about six feet deep. At one end have the floor slanting so that the cattle will have no trouble in getting out. This vat is filled with water, and on top is placed a layer of oil or disinfecting fluid about an inch thick. The cattle are driven to this vat, and either pushed into it, or allowed to drop in there by a

hinge trap door, and they have to swim out the other end. By this time they become coated with oil all over. The oils that are used are cottonseed oil, although it is quite expensive, Virginia Black Oil, crude Beaumont oil. The Beaumont oil is said to be the cheapest of all. To install such a plant will cost about \$150.00 and will cost anywhere from ten to fifty cents per head to dip the cattle.

dusty, and the animal ceases to lick herself, a dry, dull cough will be noticed; if the cow is with calf, abortion will take place; indigestion followed by diarrhoea; the animal is soon reduced to skin and bones. An infallible test for tuberculosis is tuberculin, which can be had from chemical supply houses, the Bureau of Animal Industry at Washington, D. C., or from some State Experiment Stations. The

Fig. 7.—Ayrshire Angus Heifers Nos. 14 and 15.

TUBERCULOSIS.

Cause.—Tuberculosis is caused by the introduction into the system of a germ, the bacillus tuberculosis. It has not been definitely settled as to whether it is the same disease that affects man or not. Dr. Koch, who discovered the bacillus of tuberculosis, says that the two are altogether different diseases. It is supposed to be caused by inhaling the germs as they are blown through the air, or it may be taken by the digestive tract. Close stableing, poor ventilation, feeding on innutritious foods, all predispose the animal to the disease. Of course, no matter how weak the animal may be, if these germs are not taken in the body, there will be no trouble from tuberculosis.

Symptoms.—It is hard to tell tuberculosis until it has developed to a great extent. The first sign is an unthrifty condition of the animal, the milk becoming poor in quality and quantity, appetite changeable, first good and then poor; skin and hair dry and

animal's temperature is first taken morning, noon and night in order to get the average temperature. Then at eleven o'clock at night inject the tuberculin, and the next morning at six o'clock begin taking the temperature, and take it every two hours until six o'clock at night. If the injection causes a rise in the temperature to 106 degrees Fahrenheit at any time during the day, the animal should be considered tuberculous. If an animal reacts or shows a rise of temperature between 103 and 103.9 degrees it should be tested within two weeks to confirm the work. Do not test an animal that has fever, nor cows just before nor just after calving, nor when in heat.

Treatment.—If an animal reacts to the test and is also in poor physical condition, it will be best to condemn and slaughter her at once. The carcass may be used for beef if it proves after slaughter to be only slightly affected with the tubercles. If extensively diseased, the carcass should be buried with lime.

If the reacting animals seem otherwise strong and

healthy, and are valuable for breeding purposes, they can be saved, if such cattle are given light and airy quarters and plenty of good food. The calves from such cows will invariably be free from any disease, but should be taken from their mothers immediately after birth and raised on milk cows that are known to be healthy.

Young animals may be vaccinated with mild tuberculosis serum, which seems to prevent them from contracting this disease during life. The German scientist, Von Behring, and Dr. Pearson, of Pennsylvania, are at work upon the production of vaccinated which have this effect, with much hope for success. It may be possible that a cure will be discovered before many years for tuberculosis in mild stages.

Fig. 9.—Sue, a grade Jersey, having a record of over 500 lbs. of butter per year. Owned by Mr. Williamson, Commerce, Georgia.

Disinfection.—Stables, yards or bedding used by animals affected should be kept well disinfected with lime or carbolic solutions, especially before putting a healthy animal in the same quarters.

LUMPY JAW, OR ACTINOMYCOSIS.

Cause.—This disease is said to be contagious, and is due to a ray shaped fungus germ called actinomycosis, which is taken with the food, and may locate anywhere in the body. It generally affects the jaw bones, tongue, glands around the head and throat, lungs, liver, and in the walls of the small intestines. The germ enters the jaw bone through a split or decayed tooth, and destroys the bone in every direction.

The disease is known by tumors being formed at

the seat of the infection. From this seat of infection, sprouts or small portions of the germ are carried by means of the blood to other portions of the body of the animal, hence it is important to stop it before it has time to spread. If the jaw bones are affected they frequently swell to an enormous size, the teeth get loose, the tumor bursts, and discharges a thick, yellowish white matter, containing little yellow masses or clusters of the fungus about the size of grains of sand. The bone has soft spots in it surrounded by hard shell.

Treatment.—If you find what the disease is before it has had time to develop too far, there is hope for a cure. But when it has had time to develop and get scattered over the system there is little hope for a cure. Give the animal one dram iodide of potash

Fig. 10.—Actinomycosis of the Lower Jaw

morning and evening in bran mash for three weeks. If the eyes should get watery, and a considerable amount of saliva run from the mouth, stop for a few days, and then begin the treatment again. Rub the lump once a week with a dram of biniodide of mercury, and one ounce of lard.

NON-CONTAGIOUS BLOOD DISEASES. PLETHORA.

Cause.—Plethora is caused by an over-fat condition of the blood. It is caused by feeding too rich food to young animals. When digestion and assimilation are unusually active the blood is supplied with more material than the system requires, and can use; the excess not being assimilated, degenerates and poisons the blood.

Symptoms.—Plethora is known by the full bounding beat of the pulse; redness of the mucous membrane, and a tendency to store up fat. Sometimes there is a slight fever which lasts only a short time.

Treatment.—As the disease is brought on by feeding too rich food, the first thing to be done is to remove the cause. Give four or five ounces of Epsom or Glauber Salts every six hours, until you have given one or two pounds. Bleeding for Plethora is not recommended.

ANAEMIA.

Cause.—This disease is just the reverse of plethora, and is seen when the animal is thin in flesh, on account of insufficient quantities of good, wholesome food; exposure to weather; impoverished by parasites.

Symptoms.—This disease is known by the lack of energy, languor, loss of appetite, tendency toward indigestion, and rapid wasting away.

Treatment.—Give the animal a complete change of diet. See to it that the food is wholesome. If the bowels be torpid, give a laxative; if diarrhoea is present, the bowels must be checked. If any parasites are plastering the animal they must be destroyed. Give the following tonic in one dose in the feed, repeating morning and night:

One half ounce of copperas.

One handful oil cake, meal, or ground flaxseed,

Powder and mix thoroughly.

RHEUMATISM.

Cause.—The cause of rheumatism is the accumulation of an acid in the blood which settles around the joints, covering the joints, lining membranes of the heart, muscles and ligaments. The affected parts in the acute form, swell, and discharge a considerable amount of pus, also some synovial fluid with the pus. Thin flesh, exposure to cold, dampness in stable and poor ventilation often are the indirect causes of it.

Symptoms.—Rheumatism is often known by the disinclination of the animal to move, and in the course of a few hours or days a swelling of the joints, which are quite hot and painful. The disease moves rapidly from one joint to another. The temperature is increased, the mucus membrane becomes red, bowels apt to be constipated.

Treatment.—If the disease be in its acute form,

give a good dose of Glauber's or Epsom Salts, following with the treatment here given, two or three times a day.

Two ounces bicarbonate potash.

One pint of water.

Another Treatment.—After placing the animal in a good, dry, warm place, give the following receipt morning and night in soft feed:

Two drams colchicum.

Two drams Nitrate of Potash.

Give this for a week. Then give the following treatment for a week; giving as a dose morning and night:

One-half ounce copperas.

One handful cottonseed meal, or ground flaxseed.

Fig. 11.—Imported, Agathas Foxull Keene, 1st prize yearling bull, Atlanta, 1905.

Then in a week change back to the treatment of colchicum, etc.

HAEMATURIA OR RED WATER.

Cause.—This disease is caused by the kidneys secreting with the urine large quantities of albumen, and some iron, which gives the urine the appearance of having blood in it. The disease is most commonly seen in low, swampy lands, and disappears in such cases as soon as the land is drained.

Symptoms.—Haematuria will be known in the first place by the color of the urine, which will assume a pale, pink color at first, and then change its color until it reaches a dark brown color. The urine increases greatly in quantity. For the first two or three

weeks there will be no damage noticeable, but then the milk will begin to fall off, the animal becomes thin; the bowels at first are loose, but become costive.

Treatment.—Make a complete change in the food, feed linseed meal as much as possible. Give the following as purgative:

Twelve ounces Epsom Salts,

One ounce Ginger,

One ounce Gentian,

Four ounces syrup.

Enough water to make two quarts.

Mix this thoroughly, and give as one dose. Follow the above dose with the following:

One half-ounce copperas,

One handful oil-cake.

Give night and morning.

Continue this dose for two or three weeks.

MALIGNANT CATARRH.

Cause.—This disease is due to a specific virus which affects the mucous membrane lining the sinews of the head and the nasal chambers.

Symptoms.—The disease will first be noticed with rigors, or a shivering fit; dullness and debility; the mucous membrane becomes a bluish red color, eyelids swollen; eyes closed; tears flowing over the cheeks, a kind of watery fluid, saliva flows from the mouth, a dry cough ensues; there is a great thirst but no appetite, urine scanty but high colored.

Treatment.—Enemas should be given to relieve constipation. Give two ounces of sweet spirits of nitre every four hours diluted in a pint of water. Make the animal inhale hot steam.

DISEASES OF THE RESPIRATORY ORGANS

SIMPLE CATARRH OR COLD, OR HOLLOW HORN.

Cause.—Catarrh is brought on by sudden change

in the temperature especially when the animals are poorly fed; damp, badly drained stables, exposure to storms and winds; sleeping on the cold ground, etc.

Symptoms.—The mucous membrane of the nose and eye is red and dry; more or less fever and fits of shivering; watery discharge from the eyes; pulse rapid and rather hard; appetite fails; urine scanty and highly colored. It sometimes affects the horns, since the hollow of the horn connects with the nose, and catarrh in the nose often affects the sinews of the horn. This is possibly the reason for the belief in hollow horn.

Treatment.—If the horns are affected, and the owner desires to keep the horns on the cow, little can be done to relieve the situation, but the trouble in the horns will usually get well as soon as the catarrh is cured. However, if the owner does not object to having the horns removed, and I can see no reason why he should, the horns should be sawed or clipped off close to the head, taking a ring of hair a quarter of an inch all around with the base of the horn. Clip off all the hair around before cutting, and dust the cut surfaces with a mixture of equal parts powdered alum and boric acid. If the cavities of the horn are filled with matter, take it out and wash the parts with a five per cent. solution of carbolic acid, that is, using one part acid, and nineteen parts water. Repeat the washings daily, and keep all matter out of the cavities. Squirt a little water into her head to make her throw out all matter. They should heal up in three or four weeks. If the bowels are constipated, give a pint of melted lard. If the bowels are loose, give the following as a drench of one dose:

One pint of infusion of quassia.

One ounce laudanum.

One-half ounce sulphuric ether.

One pint thin gruel, cold.

Repeat the dose in six or eight hours if there is no action. But whether the bowels are loose or constipated, use the following remedy:

Three ounces spirits of nitre,

Two drams tincture aconite root,

One-half ounce fluid extract belladonna.

Two ounces nitrate of potash,

Two ounces muriate of ammonia,

Water enough to make one quart.

Mix thoroughly, and give a half-teaspoonful every three hours until better. If the animal experiences

difficulty in breathing, steam the head by placing blanket over head as shown in the illustration.

SORE THROAT OR LARYNGITIS.

Cause.—This disease is caused by the same thing that produces cold, that is, standing in bad weather, lying upon damp, cold ground, exposure to winds and storms, etc. It is an inflammation of the upper windpipe, and interferes with the breathing.

Fig. 12.—Nose-bag for Steaming.

Symptoms.—The cow experiences difficulty in swallowing, has hard, tickling cough, loss of appetite, cud not chewed, and there is a flow of saliva from the mouth, when it is open. If the cow attempts to drink water it comes back through the nose.

Treatment.—Place a bran poultice on the back. If this does not relieve, rub mustard paste well on the throat. This should be washed off in an hour and more rubbed in. Give one-half ounce of salt-peter or chlorate of potash in the water, morning and evening.

BRONCHITIS.

Cause.—Bronchitis is an inflammation of the mucous membrane of the bronchial tubes. It is caused by exposure to wet and cold, inhaling smokes, fumes, or the introduction of foods and fluids into the windpipe.

Symptoms.—Wheezing, difficult breathing, deep, hard, distressing cough, and after it has run for several hours, a high fever will be noticed. By placing the ear by the front and sides of the chest, a dry, grating

sound will be heard. The cow lies down a great deal in this disease.

Treatment.—Place the animal in a warm, well-ventilated place. By a well-ventilated place, we do not mean where there will be a draft on the animal, as some would suppose, but where she can get fresh air without a draft. If the disease be in its first state, give the following:

Two ounces acetate of ammonia,

Twenty drops tincture of Aconite root,

One half-pint of water.

Mix thoroughly, and give as one dose. Repeat every two hours until the chill is over, and the pulse beats naturally. Then give the following remedy until the cow gets well:

Three drams copperas,

Two drams Gentian:

One dram Ginger,

One dram Foenugreek Seed,

Mix and give as one dose morning and night.

Mustard applied to the sides will be of much benefit to the animal. Allow her to drink all the water she desires, and give her plenty of soft feed.

PNEUMONIA.

Cause.—This is an inflammation of the lungs themselves, and should have prompt attention, for if relief is not furnished, the disease will prove fatal. In most cases it is the result of a cold or catarrh, laryngitis, bronchitis, etc. It is sometimes caused by permitting medicines to enter the windpipe and lungs when drenching the animal.

Symptoms.—The disease is first shown by the animal having a shivering fit, loss of appetite, quick and labored breathing, severe cough. The cow does not like to lie down as it increases the pressure upon her chest. If you tap the sides of the animal a dull, heavy sound is heard, the muzzle of the cow becomes dry and hot, the expired air is hot, the ribs are fixed.

Treatment.—The animal should be placed in a warm stall, which should be kept thoroughly clean. Feed the animal plenty of good, nutritious food, and give plenty of fresh water. Give the following each morning in a pint of gruel:

Two drams saltpeter,

Two drams Bisulphate of soda.

Apply mustard to the chest.

Another Treatment.—Use the same treatment as prescribed for Bronchitis.

PLEURISY.

Cause.—Pleurisy is an inflammation of the lining which lines the cavity of the chest, and infests the lungs. It is caused by exposure to cold, and injuries to the wall of the chest. This may be done by the animal swallowing a nail, and it working itself into the chest throughout the intestines usually from the second stomach.

Symptoms.—The breathing is painful, something like a person with pneumonia; the ribs fixed; pressure between the ribs cause intense pain. By applying the ear to the side, a grating, rasping sound is heard; the head is hung low, the ears drooped; the expired breath is not hot as in pneumonia.

Treatment.—No matter how slight the attack, the animal should be placed in a dry stall, with plenty of fresh air, the animal's body should be well clothed, the legs rubbed well, and bandaged. To reduce the fever, give from fifteen to twenty-five drops of tincture of aconite every two hours, and one-half ounce nitrate of potassium. If the animal appears to be suffering great pain, give one dram of opium three times a day in a little gruel. Blankets dipped in hot, boiling water and wrung out, and applied every half hour, should be used. If the pain continues after using the above treatment, apply a blister made of two drams of cantharides and one and a half ounces of lard. After the acute stage has passed, give the following stimulant:

One ounce tincture of Gentian,

One ounce Ginger,

One ounce chloride of Iron.

Give as a dose in a pint of water three times a day.

DISEASES OF THE DIGESTIVE ORGANS.

INFLAMMATION AND PARALYSIS OF THE TONGUE.

Cause.—Paralysis of the tongue is the effect of carelessness in drenching, that is, wounding the tongue,

and mouth, also by getting foreign bodies in the fodder, such as thorns, etc.

Symptoms.—By an examination of the tongue, one can readily tell if the tongue has been injured. Frequently the tongue will swell, and if the paralysis be complete, the tongue will hang out lifeless.

Treatment.—First examine the tongue and remove the cause, if it still be persistent. If the tongue hangs out of the mouth it should be bled slightly. Apply the following solutions:

One ounce vinegar,

Two ounces honey,

One half pint water.

Mix thoroughly and apply with swab three or four times a day to the tongue.

BLOAT, HOVEN, OR TYPHANITIS.

Cause.—This is a swelling of the paunch with gas on account of fermentation in the first stomach. It is usually indigestion. It is caused by feeding too much clover, green feed, or changing food too quickly.

Fig. 13—Trocar and Cannula.

Symptoms.—At first the animal shows signs of uneasiness, swells up badly, groans all the time; back is arched; if the hide is tapped between the last ribs and the point of the hip, it is resonant and sounds like a drum, especially on the left side; the nostrils are distended, the eyes blood-shot, and run matter, the pulse at times very slow and at other times very rapid.

Treatment.—Give one and a half pounds of Epsom salts in a half-gallon of water as a drench to cleanse the system. Add one ounce of vinegar to the drench. Then take

Four ounces sulphate of iron,

Two ounces of nux vomica,

Mix thoroughly together and divide into twenty-four doses, giving one morning and night in a bran mash.

Another Treatment.—Pour cold water continuously over the back and loins of the animal, and lead or drive her around the lot until the exercise brings relief.

Another Treatment.—If the animal be suffering too much, perhaps the following treatment is better. Plunge a trocar and cannula into the region of the greatest swelling at the point midway between the spines of the loins, last rib and point of hip, on the left side, pointing the trocar downwards, letting it

Fig. 14.—Showing where to insert trocar. Where ab dc cross is the place to insert trocar.

pass in obliquely to avoid the kidneys. The trocar is an instrument as shown here in this illustration. If the trocar be not convenient, use a pocket knife, keeping it in the wound until the largest quill obtainable can be inserted in its place, and the gas allowed to escape. When the gas has passed off, give a good dose of linseed oil. The wound being small, will usually heal without trouble.

IMPACTION OF THE THIRD STOMACH.

Impaction is otherwise called Dry Murrain, and Grass Staggers. It is occasionally mistaken for Spinal Meningitis. The trouble occurs in the third stomach, called the manifold, manyplies, or honeycomb, which becomes overloaded with coarse, hard feed, causing inflammation and stoppage of the entire digestive apparatus. Impaction may be caused by an excess of green feed, but it usually comes from eating hard, withered grass late in the summer when pastures are dry and short and the supply of water is insufficient. Eating smutted cornstalks, withered wheat or oat hay, or uncured vetch are also frequent causes.

The symptoms vary considerably with the severity of the disease. In light cases the signs are loss of

appetite, stopping of rumination or chewing the cud, bowels constipated, and the animal appears dull and feverish or sluggish. The cow lies down most of the time on the left side and moans frequently. There is much tenderness on the right side under the short ribs when punched with the fist, the back is often arched, and the hind legs unsteady. The hardened contents of the stomach can sometimes be felt with the hand, or bloating will occasionally be present, which should be treated by tapping.

In acute stages the animal becomes highly excited, bellowing and staggering, turning round and round, or falling in convulsion. They will rush blindly about, running over objects as if blind, or pushing the head against trees or fences for minutes at a time, and pawing the earth. The breathing is loud, the heart beats hard and fast, and toward the last profuse diarrhoea may set in. Death will occur often in a few hours after the first symptoms appear.

Treatment for Impaction.—As will be readily recognised from the nature of the disease, the first treatment should be to induce action of the stomach and bowels to throw off the offending substance. To accomplish this, it is sometimes necessary to use the strongest purgatives known to medicine, as well as frequent injections through the rectum. It would be best to begin with a medicine purgative, such as the following formula: Epsom salts, one pound, common salt, half-pound, ginger, two ounces, all dissolved in two or three pints warm water given as a drench. Another formula which is just as good would be; Castor-oil, one pint, raw linseed oil, half-pint, mixed and given as a drench. The animal should have plenty of water if it will drink and watery foods if it will eat. An injection with a large syringe or a spray pump and hose, forcing two or three gallons of warm watery soap-suds into the bowels should also be used.

If the bowels do not operate in eight or ten hours, repeat the purgative, or if the case is becoming desperate, use the following formula: Sulphate or soda, (Glauber salts) half pound, calomel, two drams, dissolved in a pint of water, and Croton oil, twenty-five or thirty drops, given as a drench. The only chance is to use sufficiently strong cathartics to break up the hardened contents of the stomach and force them out. During the time while the purgatives are acting, the strength and nervous force of the animal should be

kept up by stimulants, Any of the following will serve well; Powdered Nux Vomica, forty grains dissolved in a little water, or Carbonate of Ammonia, five or six drams in pint of water, or half-pint of whiskey diluted with water. This tonic may be given three times daily during the sickness. After free action of the bowels is secured it is best to use green foods, soft mashs, and plenty of water and even keep up small doses of salts to insure perfect breaking up of all the impaction. The tonic might also be continued for several days in small doses. It would probably be best to move the cattle away from land that has been in pasture many years to fresh spots.

DYSPEPSIA OR INDIGESTION.

Cause.—Indigestion or Dyspepsia is caused by improper feeding, exposure to colds and storms.

Treatment.—Give the cow one pound of Epsom salts, and one ounce ground ginger, dissolved in half-gallon cold water, at one dose. After this medicine has acted, boil a teacup of linseed into a pulp with a gallon of water, and while hot pour it over a half-pail of bran, making a mash of it. When the mash is cold put in some of the following powders:

Four ounces sulphate of iron,

Four ounces nitrate of potassium.

Divided into twenty-four doses. Give one daily for several weeks, if necessary.

Another Treatment.—Give phosphate of lime in the form of ground bones, and a little lime water, about a half-teacupful morning and night in bran mash.

Still Another Treatment.—Give morning and night the following prescription:

Three drams bicarbonate of soda,

Two drams gentian,

Two drams ginger.

Fig. 15.—Herd pure bred Jerseys, Anderson's Farms, Marietta, Georgia.

Symptoms.—One of the first symptoms that will be noticed in a cow suffering from indigestion is capricious appetite. They will eat constantly, but are never satisfied, will sometimes eat heartily of one diet once or twice, and then will not eat again until the diet is changed. Sometimes the animal will be seen licking the walls, eating dirt or lime, chewing sticks, trying to eat straw, rocks, coal, or other indigestible materials. The animal loses flesh, belches up most everything that she eats, manure is small in quantity, dry and glazed; she frequently has little thirst for water.

CONSTIPATION.

Cause.—Constipation is caused by feeding too hard food, insufficient or impure water and too little exercise.

Symptoms.—It can be readily recognised by hard dry manure which is sometimes glazed.

Treatment.—Make a complete change in the diet. If the attack be in the fall or winter, give from one to two quarts of melted lard, or a pint of raw linseed oil. If it be in the spring or summer, give once a day the following prescription:

Twelve ounces Epsom Salts,
One ounce ginger,
One ounce gentian,
Water sufficient to make two quarts.

Prevention.—The cattle should be salted twice a week in the winter, and three times a week in the summer, also give plenty of fresh water. Cattle suffer a great deal in the winter for lack of water. As a rule, the weather is cold, and the careless farmer allows his cattle to suffer for the want of fresh water. It is not sufficient that they have plenty of water, but the water should be of a temperature that they can drink with comfort. Just because the trough is full of water covered with ice an inch thick is not sufficient. Cattle do not enjoy ice water, when they are about to freeze from the chilling wind. See to it that your cattle have plenty of fresh water, of a temperature that they can drink, and plenty of salt, and they will not be troubled much with Constipation.

DIARRHOEA OR SCOURS.

Cause.—This disease is caused by improper feeding, and in calves impure milk, over heating, etc.

Symptoms.—The actions are too thin, watery, and occur too often. If it is allowed to continue, there is great thirst on account of the feverish condition of the stomach, but no appetite; the milk dries up, the belly is tucked up, and back arched. After a little the animal loses flesh and the temperature falls below normal.

Treatment.—If it be in the calf, special care should be given to the health of the mother. It is quite frequently the case that if you change the diet of the other, you will experience no further trouble. If there are irritating substances in the stomach or bowels, give the following:

Three ounces castor-oil,
One teaspoonful of Ginger.

Follow this with two ounces lime water, and two ounces infusion of gentian. Give this two or three times a day in the milk or linseed gruel. It is a good idea to add a half ounce of chlorate of potash to a pailful of water.

Especial Treatment for Calves.

Two drams Salol,

Four drams oxide bismuth,
One ounce carbonate of lime.

Mix thoroughly and divide into six equal doses, and give the first two doses at an interval of two hours, and the four remaining doses every four hours. Give the medicine in a glass of calomel infusion. If the calf be very bad, add a glass of wine.

Another good treatment for mild cases is to feed a teaspoonful of dried blood twice daily in the feed.

DYSENTERY.

Cause.—This disease is caused by eating poisonous plants, and by neglecting diarrhoea.

Symptoms.—This disease will be known by severe straining, watery, offensive and bloody discharges, high fever with excessive thirst; loss of appetite; cow ceases to give milk; eyes discharges; back arched and tail elevated

Treatment.—Give at one dose, one pint and a half raw linseed oil and two ounces tincture of opium. Then give the following:

One ounce turpentine,
One ounce prepared chalk,
One quart boiled flaxseed.

Mix and give as one dose. Give this three times a day.

Fig. 16—Showing Truss used for Rupture.

Another Treatment.—Give the following:

Seven ounces Epsom Salts,
Two drams powdered opium,
Two drams powdered gentian,
One pint of gruel.

Mix thoroughly and give as one dose once a day.

HERNIA OR RUPTURE.

Cause.—This is a rupture of the investing mem-

brane of the abdomen caused by some external injury or severe strain, letting the intestines out into the adjacent spaces. The swelling of the hernia as sometimes seen is as large as a half-bushel, but it is soft and can be easily pushed back. Sometimes a great quantity of the intestines are cut, and this is called strangulated hernia, and must be reduced, or death will follow from inflammation and mortification.

Treatment.—For calves a truss is used, as shown in the illustration. The skin may be pulled together and placed between two wooden clamps, but care should be exercised not to get it too tight. In the rupture of the belly, the same appliances can be used.

DISEASES OF THE URINARY ORGANS

CYSTITIS OR INFLAMMATION OF THE BLADDER.

Cause.—This is an inflammation of the lining of the bladder. It is caused by feeding on musty hay, over-ripe grasses, or grain; also from the improper use of diuretic medicines, especially is the cantharides apt to produce it, on account of being spread over too large a surface which is absorbed in large quantities, or being given in too large doses internally.

Symptoms.—Great uneasiness, colicky pains, nose turned towards the flank, efforts to vomit, if a male, the testicles are drawn up towards the body; urine is passed with pain, and is scanty; the urine in health, is alkaline, while during this disease it is acid.

Treatment.—Give the animal plenty of linseed tea, or gum arabic water. Evacuate the bladder by the use of the catheter.

GRAVEL OR LITHASIS.

Cause.—This is the formation of sand-like deposits in the bladder by the union of the acids or alkalis with the urea in a changed condition. These sand deposits cause the bladder to contract, and this causes the urination to be very painful. The disease affects the males more than it does the females.

Treatment.—

One dram citrate of lithium given in,
One half-pint of water daily.

Another Treatment.—

Twenty drops Hydrochloric acid,
Three drams gentian,
One pint oat meal gruel.

Give this morning and night for a few days. In some cases the stones have to be removed, in which cases an operation must be performed. If an operation is necessary a veterinarian should be called in.

DISEASES OF THE NERVOUS SYSTEM.

INFLAMMATION OF THE BRAIN.

Cause.—The immediate cause of this disease is too great flow of blood which presses on the arteries and causes increased action in all circulatory vessels

Symptoms.—The pulse in the temporal arteries will be strong, the cow will suffer greatly, and will be raving; eyes inflamed; the animal will fall suddenly; will attempt to rise again.

Treatment.—Keep the head of the animal cool by using ice or the coldest water that can be had. Give once a day the following dose:

Twelve ounces Epsom salts.

One ounce Ginger,

One ounce gentian,

Water sufficient to make two quarts.

If this dose does not cleanse the system readily, injections of warm water and soap will prove beneficial.

LOCKJAW OR TETANUS.

Cause.—This disease is caused by the introduction through the wound of a microbe called bacillus tetani. This microbe thrives best in a wound where little or no air can get to it, hence in a small wound there is more danger of lockjaw than in a large wound. The microbe increases very rapidly, and produces a chemical poison that is absorbed by the blood, and poisons the nervous systems, producing cramps in the muscles. Lockjaw occurs mostly in wounds of the feet, for the microbe exists in the soil.

Symptoms.—The disease operates under cover, that is, in most cases you do not know that the animal is afflicted at all until the dangerous stage is upon us. Lockjaw does not always lock the jaws of the animal. The animal is usually dull, and disinclined to move; the muscles are stiff, and the head poked out in front, and the tail almost straight out behind; the animal persists in standing up; the hind legs are held apart; and frequently the back is depressed downward, and sometimes it is arched upwards.

Treatment.—The first thing to be done is to give a drench of

Ten ounces Epsom Salts,
Ten ounces common table salt,
Two drams calomel,
One ounce pulverized gentian,
Two quarts of warm water,

This should be given as a drench, if the jaws are not locked so as to prevent it. After giving the above drench, do not give any more drenches. You should now search for the wound. Remember that the wound may be, and probably is, very small, and it will be difficult to find, as it may be hid by the hair. When found wash it thoroughly, using hot water, soap, and a clean rag. Then apply to the wound some lotion made by using

Thirty grains bichloride of mercury.
One ounce pure carbolic acid.
One quart of water.

Pour some of it into the wound, and swab all parts with it. Do not be afraid of getting too much on, and rubbing it in too deep. Make soaking wet with some lotion on absorbent cotton, and bind the wound with it, changing the dressing once a day. Keep the animal in a dark stall, give her any food that she will eat. If the jaws are locked you cannot give anything internally, but you can use the latter part of this treatment. But little hope is offered where the jaws are locked. A serum is now offered on the market, which is a great aid in preventing tetanus or curing it in the earlier stages, by injecting the material under the skin.

PARASITIC DISEASES.

LICE.

Poor, neglected, half-starved animals are the ones

most seriously affected with lice. One of the simplest and best remedies for lice, or any other parasitic disease is a decoction of tobacco. Take two or three ounces to a quart of water.

Another Treatment.—Take forty per cent. solution of pennyroyal, and apply every fourth day.

Another Simple Treatment is the use of kerosene in small quantities. Too much kerosene will likely remove the hair. Whenever the modern coal tar disinfectants are available, such as Creolin, Chloro, Naphtholeum, Carsul, etc., they will serve the purpose of killing parasites and producing healthy growth of skin and hair better than almost any other material.

WOLVES OR GRUBS.

For wolves in cattle, saturate the lumps on the cow's back three times a week with spirits of turpentine, cottonseed oil, or kerosene. Usually three applications are sufficient, but sometimes more is required. The grubs may also be squeezed out and killed to prevent further propagation.

RINGWORM.

This affection is due to a fungus or vegetable parasite that gets into the hair. It is very contagious, going from man to the lower animal, and from lower animal to man. It will be known by the circular patch of scaly crusts, which first appear to stick close to the hide, but which in time become detached.

Treatment.—The first thing to be done is to separate the affected animal from the rest. Remove the crusts and destroy them so that some other animal or man will not take the disease. After cleansing the parts with soap and water, apply the following:

One half dram iodine,
One half dram of iodide of potash,
One ounce vaseline.

Another Treatment.—After cleansing the affected parts as above directed, paint the places with

One part carbolic acid,
Twenty parts acetic acid.

ECZEMA.

This is an affection causing great itching. In treat-

ing this affection, change the food if possible. Bathe the affected parts with a half-ounce carbolic acid, and two quarts of water. The disease should be attended to as promptly as possible, for if neglected, it will become chronic, the skin thickens and cracks, from which cracks there is a constant discharge of semi-purulent fluid.

MILK FEVER.

This disease usually occurs within three days following the time of calving, and never occurs after the first calving, and rarely after the second. It most frequently occurs after the third, and subsequent calving times. Cows that are in good condition, and good milkers are more subject to this disease than any other. The symptoms are: weakness; muscular tremors; unsteady gait; inability to stand; loss of appetite; while the cow is down, the head is generally thrown around on the side; consciousness is lost to a great degree; the cow not noticing her calf; saliva drops from the mouth; bloating sometimes takes place, but this as a rule is the result of too liberal feeding just at the time of calving.

Treatment.—Treatment should begin as soon as the first symptoms are observed. It is a very good idea to keep close watch over the cow for the first three days after calving, so if the disease should begin, you can check it.

In treating this disease, the udder should first be filled with either air, oxygen, or a solution of iodide of potash. The air treatment is the latest discovery, and when successful, no other work is necessary. The only apparatus required is a tube to insert in the teat, connected with a syringe bulb, bicycle air pump, or bellows. The best teat tubes are metal, but in emergencies a small rubber or glass tube, or a small chicken quill may be used. The instruments should be clean and the air pure.

The older treatment with solution of iodide of potash was performed with a teat tube, a long rubber tubing, and a funnel through which to pour the liquid into the udder. The solution is prepared by dissolving two drams of iodide of potash in a quart of clean, boiled water, that has been cooled to blood heat. Divide the quart of solution into four equal parts and inject or pour one part into each of the quarters of the udder, hands and instruments clean. Some practitioners have used warm water and an ordinary house-

hold bulb syringe with good effect. The new air treatment is doubtless the best.

Additional medical treatment is sometimes necessary to get the bowels and stomach started to work well again after an attack of milk fever. A good purgative may help matters, such as salts or oil, and a tonic, such as copperas or nux vomica.

MISCELLANEOUS RECEIPTS AND DISEASES.

INFLAMMATION OF UDDER OR MAMMITIS.

Cause.—This disease is most common just after calving, and before the secretion of the milk has as-

Fig. 18—Queen Bessie Landseer, Farm of E. J. Hewlett, Stephenville, Tex.

sumed a normal condition. However, it frequently has no connection with calving, and is contracted by lying on cold, damp ground. Cows that are in poor condition, or are neglected are most affected by it.

Symptoms.—The bag swells, becomes hard, red and sore, and very tender; the milk is often curdled and sometimes bloody.

Treatment.—The trouble should receive attention as early as possible. If allowed to continue, it may go into suppuration, that is, the formation of pus, which is discharged inside and comes out with the milk. Sometimes the pus does not come out with the milk, but through an opening in the outside. In such cases the milk from that affected quarter will usually be

soiled. Give the animal one and a half pounds of Epsom Salts, and one ounce pulverized ginger, dissolved in a half gallon of warm water, and give as one drench. After this medicine has acted, give the animal half an ounce of nitrate of potassium twice a day in the water she drinks. This should be continued for three or four days. From the first, bathe the udder with hot water, for an hour, three times a day. After each bathing, rub in well a mixture of one half ounce acetate of lead, one half ounce sulphate of zinc, and one quart of salt water, shake well before using. Continue this until all the inflammation is gone.

and abuses her. Remember that the cow has feelings, and if her teats are sore, that it hurts her to be milked. After milking rub on

Two ounces Witch Hazel,
Two ounces sulphate of zinc,
Two ounces of lard,

Rub on the affected parts a few times. This is a favorite treatment among dairymen.

Another Treatment.—After milking use
One dram pulverized alum.
Two ounces vaseline.

Fig. 19—Imported Red Polled Heifers. Owned by W. R. Clifton, Waco, Texas.

Another Treatment.—Give the internal treatment as prescribed in the treatment above, but bathe the udder with the following lotion:

Four ounces liquid camphor,
One ounce turpentine.
Two ounces of lard,
One teaspoonful of coal-oil, or kerosene.

SORE TEATS.

A cow's teats frequently become sore, chapped, and cracked. In such cases, the milking is quite painful to the cow, and annoying to the milker. The milker frequently becomes enraged because the cow suffers.

LUMPS IN TEATS.

For some cause, lumps are formed in the bag, and they frequently get down in the teats, which prevents the milk from coming down those teats. Sometimes the lumps can be forced back in the bag, in which case the lump will doubtless disappear before the next season. If not, you will have to use a milk tube, which can be procured from your druggist.

HARD MILKER.

If frequently happens that cows that are valuable are hard milkers. In such cases, it is of the greatest

importance to remedy this defect. Take a chicken feather, from the wings is best, and insert it in the teat, without touching the feather with a knife, for that would then cause the feather to hurt the teat; work it up gently, turning it around and around, until you have worked it up an inch or more. Then draw it out, and proceed with the milking. Do this for a week or more, and the cure will be permanent. Sometimes it requires the operation of a veterinarian to open up the teats. Metal teat dilators may also be secured from any surgical house.

GARGET.

Cause.—This disease affects heavy milking cattle more than others. It is often the result of careless or rough treatment or neglect.

The carelessness of persons who do the milking in leaving some of the milk in the udder is one of the most prolific causes of garget. Care should be exercised to see that the udder is milked out clean at every milking.

Symptoms.—The symptoms of the disease are similar to those of inflammation of the udder. Lumps form in one quarter, and from the teats of these sides frequently no milk can be drawn. The glands of the udder become inflamed, and when this inflammation goes far enough, the glands "break down" which results in pus forming.

Treatment.—This trouble is hard to cure. In fact, a cow once affected is liable to a second attack at any time.

The cause of the trouble must be allayed or removed. If caused by cold, keep the cow in a warm, dry place and cover with blankets. If caused by improper milking, blows or germ infection, the udder should be thoroughly milked out by hand or milking tube. Then bathe and foment the udder with water as hot as the hand will bear, for half an hour or more at a time. Continuous hot bathing and active rubbing with the hands will give more relief than any other treatment. The udder should be thoroughly kneaded at the same time, the lumps manipulated, and all the caesin and pus forced out as completely as possible. In order to keep heat around the udder, it is advisable to use a cloth bandage padded with cotton over the entire udder, supported by cloth or straps running over

the cow's back, and pour hot water on the padding continuously.

Soothing ointments should then be rubbed all over the outside of the affected parts. In slight case the use of lard or vaseline mixed with camphor will answer; but in the worst cases it is necessary to apply solid extract of Belladonna or strong mercurial ointment to relieve pain and soften the bag. The entire process of hot baths and rubbing with ointment should be repeated frequently, as often as once every hour until some relief is secured. When interior abscesses form, or in case of germ infection, the quarter should be milked out and injected frequently, through a milking tube and syringe, with a 1 per cent. solution of peroxide of hydrogen, allowing this to remain half an hour, and then milking out. If an abscess forms near the outside and the teat should be blocked up, the only resource is to open the abscess with a knife and allow the pus to escape, afterward treating the wound with antiseptics and glycerine until healed.

Dr. A. T. Peters, of the Nebraska Experiment Station, recommends filling the affected quarter with air just as for milk fever, and giving a thorough treatment of massage or kneading, working the air all through the quarter with the hand. It is claimed that the treatment opens up the spongy tissue, bursting and dissipating the collection of pus, and restoring the quarter to normal condition. The air should finally be forced or milked out of the udder, bringing with it most of the pus and lumpy material.

The treatment may be used once a day, or twice daily in severe cases, until a cure is effected. At the same time it is well to use some soothing ointment and hot water applications as described.

The internal medicines which should accompany the udder manipulation are sufficient purgatives of salts or oils to keep the bowels loose, followed in ordinary cases with half an ounce of saltpeter daily, dissolved in water. In cases where abscesses form, it is necessary to give internal antiseptics in addition, hyposulphite of soda, half ounce daily in a pint of water, or half an ounce of tincture or muriate of iron three times daily. If gangrene should occur, strong stimulants should be used, combinations of ammonia, ether and whiskey.

A severe case of garget results in the loss of the milking function in one or more quarters of the udder, and shrinking of the parts. If half of the udder be lost, it would be better to sell such animal to the

butcher before calving time occurs again, to prevent further trouble. In light cases the milk flow will be established naturally again, or return to its usual work at the succeeding calving time.

BLOODY OR STRINGY MILK.

When the udder has been injured by blows, or congested for any reason, the milk may become tinged with blood. When the cow is in heat and under considerable excitement, blood may flow through the teats. Other causes are, changing suddenly from poor to rich, heavy feeds, and eating of carid resinous

Stringy milk is genrally caused by the entrance into the udder of germs which collect from various sources on the end of the teats, enter the opening and gradually work their way up inside the teat, spreading through the entire mass of milk. It can be controlled by keeping the cattle away from any contamination, such as mud-holes or manure filth, and in obstinate cases by giving a drench containing one-fourth ounce Hyposulphate of Soda.

WARTS.

Warts frequently appear on the cow, and they are

Fig. 20—A round up in Florida.

weeds or plants. Some cows are more subject to this than others, being what are called "thin-skinned," the small blood vessels are liable to break inside the bladder and discharge blood in the milk canals. To cure the trouble, ascertain the cause and if necessary reduce the feed or change pastures. If injury or congestion has occurred, treat the same as for garget, by hot water bathing and greasing with lard or ointments or a weak solution of iodine. Always milk out and throw away all bloody milk. For internal treatment give a drench of one pound of salts and half an ounce of saltpeter.

especially troublesome when on the teats. Tie a silk thread around the warts. In a few days they will come off. Then apply terchloride of antimony to the affected parts, and you will have no trouble with them. If the warts are fat, or for any reason you cannot tie a string around them, take a knife and scarify them, and then apply a little nitrate of silver or terchloride of antimony every third day. After the warts have dropped off, heal the parts with two ounces tincture of catechu, two drams carbolic acid, eight ounces water.

Another remedy.—Apply nitric acid on wart daily,

til it is removed. If you should get too much nitric acid, use vaseline or some other kind of grease.

CHOKING.

This is the result of feeding roots, apples, etc. The perfect chewed particle lodges in the gullet, which is quite small in cattle, and resists all efforts of the animal to dislodge it. The symptoms are: the head is extended and stretched out; saliva flows from the mouth; the animal is restless; and shows pain; she stops chewing and making efforts to swallow. Open the mouth of the animal and place something like a wooden clevis in it to keep open, and run your hand down her throat and remove the obstruction. If you are unable to reach it, or for any reason the above fails, give the animal

One ounce sulphuric ether
One quarter pint linseed oil.

If this plan does not avail, a probe will have to be resorted to. In such case, a veterinarian should be employed, or one familiar with its use.

TUMORS.

Tumors frequently appear on the cow. Sometimes they come on the udder, sometimes on the jaw and at various places. Open the tumor, and bathe it well several times a day with hot water, and after each washing rub it well a little with the following lotion:

One half ounce acetate of lead,
One half ounce sulphate of zinc.
One quart soft water.

Shake well before using. The tumors should be distinguished from Lumpy Jaw which requires different internal treatment.

FOOT EVIL.

Foot Evil is a swelling just above the fetlock of the cow's foot. Where the foot divides, there is usually a sore. If there is a sore where the foot divides, dissolve one tablespoon blue vitriol in a pint of soft water and apply to the affected part twice a day for several days. If the place where the foot divides is not sore, apply a bag of salt to the affected part, and moisten this with vinegar.

COW TONIC.

It frequently happens that cows need tonics, just as

people do. The following tonics are recommended:

Two ounces sweet spirits of nitre,
Two ounces tincture of gentian,
Two ounces tincture of ginger,
One ounce tincture of chloride of iron.

Mix thoroughly and give as one dose in a quart of oatmeal gruel.

Another tonic.—

Four ounces sulphate of iron,
Four ounces nitrate of potassium,
Two ounces nux vomica.

Mix and divide into twenty-four doses, and give one dose morning and night in a bran mash. This tonic is especially recommended to stimulate blood circulation.

BITTER MILK.

It is often found that cows, eating some kind of weed, give bitter milk. In such cases the only thing to be done is to keep them in the lot, or change pastures so that they cannot eat the weed that causes the trouble. Feeding small amount of charcoal and salt-peter will often remove the disagreeable taste. Again bitter milk comes from uncleanness. Few people realize the importance of cleanliness in handling milk. It is frequently the case that the stable is not kept as clean as it should be. So often is this true that milk absorbs bacteria from the cow stable. If the milk is allowed to stand there for some time while the cow finishes eating or the calf is separated from its mother, it will all the time become more unfit for use. Then be certain that the milk is in a clean, cool place after bringing it into the house. The milk utensils should be kept perfectly clean. If everything is kept clean, and the cow fed proper food, the milk will always be pure and sweet.

DEHORNING.

Although dehorning has been adopted for many years, it has only recently come into such common use. Horns were evidently given to the cow as weapons of defense, but under the present feeding and stabling methods, they become a trouble and at times are dangerous to other cattle and people as well. Dehorning is considered by many as a cruel operation, but it is no more so than permitting a "boss" cow in a herd to be constantly injuring weaker animals. Dai-

ry cattle require less room when dehorned, and the operation seldom has any effect on milk flow.

There are several methods of dehorning, the oldest being by the use of a saw. This is more painful than other methods, and should be used only on adult animals over three years of age, with hard tough horns. The use of clippers in such cases may crush the horn or crack the skull bones. The head of the animal should be confined in a stanchion or tied close to a strong post, the hair clipped at base of horn, and the horn sawed off close enough to the skull to take off with the horn about a ring or a quarter of an inch of skin at its base. A fine toothed wood saw, or a regular butcher's saw may be used. The wound should be treated with pine tar or vaseline, and the openings plugged with cotton for a few days.

For animals not over two years old, it is better to use the dehorning clippers sold for the purpose, as they do the work much quicker, leaving a smooth, clean cut which readily heals. The horn at this age is soft enough to prevent any danger as mentioned in regard to adults.

When the button begins to grow, scrape with a knife till raw, and apply a little caustic potash to the spot, rubbing well on the button. The next day if there is a little dent there, the horn is dead. But if no dent appears, make a second application of caustic. This is certainly a better plan than to wait till the

Fig. 21—Method of breaking cow from sucking herself.

cow is grown, and cutting it off with clippers. In handling caustic soda, care should be observed that it be not allowed to touch the hands, as it has a corroding effect. Caustic potash can be bought at any drug-store in the form of a stick, about the size of a lead pencil.

TO BREAK A COW FROM SUCKING HERSELF.

To break a cow from sucking herself, place an ordi-

nary halter on the head, and a surcingle around her chest, just behind the front, then take a stick and tie one end to the surcingle, and the other to the halter. This plan allows the cow to eat and drink with ease but she cannot reach her udder.

Another Plan.—Make a necklace of fork or broom handles, as shown in the illustration, and string them together. Care should be observed that it is not long enough to choke or chafe the cow.

Fig. 22—Method of breaking cow from sucking herself.

TO PREVENT COWS FROM KICKING.

Tie both the cow's hind legs together tightly, and you will have no trouble about her kicking while being milked. At first she may fall down, but she will soon get accustomed to the restraint, and you will have no further trouble with her. A surcing strapped lightly around the abdomen just in front of the udder will break some cases.

BULL.

Fig. 23.—Head of the Herd. Owned by W. R. Clifton Waco, Texas.

The average farmer does not realize the importance of having the service of a good bull. It is far more important than he imagines. Let us do away with the idea of most farmers that any old bull will do. This is why we have so many poor milkers and scrub among the milk cows to-day. If there is any class

people in the world that should have first-class milk cows, it is the Southern farmer, but as a rule they have the poorest. In many places the farmers of a community co-operate and buy a first class-bull. This is an excellent idea, for they then will have something that will be a profit to them. A good bull should be pure, and the offspring of good milkers. A bull is fit for service at sixteen months old, but the first year he should not be used for more than a dozen cows. The next year the number may be doubled. Bulls are of-

Fig. 24.—Pure Bred Hereford Bull, Palmetto Stock Farm, Ocala, Fla.

troubled with the flies so much during the time when he is weak. By the time spring comes he is ready to eat the spring grass from the pasture. It is better for the man who sells milk, for, as a rule, the milk supply is not so great, and he can secure a better price for his products than in the summer. And then milk and butter can be handled much better in the cold weather than during the hot months. Jerseys should be bred when from twelve to fifteen months old, and the larger breeds six months to a year later. During pregnancy, the cow should be wisely fed. Away with the idea that the cow does not need food other than what she gets in the pasture, for now she has two lives to support. For a while before calving, the food should be slightly reduced, for the growth of the calf is complete, and the cow should not be too fat at calving time. If the cow is giving milk, let her be dried off a month or six weeks before she calves. Hay may be fed freely at any time. The birth of the

Fig. 25.—Cow Producing over 500 lbs. Butter per year. Owned by Mr. Williamson, Commerce, Ga.

ten dangerous because of lack of proper exercise. Light work will not hurt them, but it will be a help. A one horse tread power is a good machine for a bull to exercise with. His energy may be used to saw wood, pump water, shell corn, and do many other things. Allow the bull to have plenty of fresh air. Above all things, do not trust a bull, for it is the harmless bull that always kills, and be certain to de-horn him.

THE MILK COW.

One good milk cow is better than two poor ones. It takes less time and attention to have a good milk cow than it does to bother with several scrubs. Not only is this true, but a man thinks more of himself. Why some farmers persist in milking a half-dozen cows, just for the milk supply of their own family, when one good cow would give sufficient milk, is a matter I cannot explain. The period of pregnancy in cattle is slightly variable, but as a rule 280 days is an average. Service in December or January will produce calves in September or October, and this is the best time. It is best for the calf, for he will not be

calf involves no special pain or trouble to the mother cow, if all goes well. If not, a veterinarian had better be called in. The mother cow will lick her off-spring, and the calf, as a rule, begins sucking of its own accord. The first milk of a cow is of a peculiar character, and is intended by nature to act as a purgative, and to set the bowels of the calf to acting properly. The milk of the cow should not be used for human food until after the calf is four days old. A mature cow will drop a calf once a year, but in the case of a heifer, she should have more time in which to recuperate.

An old English writer has described the cow so well in verse,

"She's long in her face, she's fine in her horn,
She'll quickly get fat without cake or corn;
She's clean in her jaws, and full in her chine,
She's heavy in flank, and wide in her loin.

She's broad in her ribs, and long in her rump,
A straight and flat back, without e'er a hump;
She's wide in her hips, and calm in her eyes,
She's fine in her shoulders, and thin in her thighs.

She's light in her neck, and small in her tail,
She's wide in her breast, and good at the pail,
She's fine in her bone, and silky of skin—
She's a grazier's without, and a butcher's within."

In buying a cow, you must depend on your own judgement. Study cows, and learn to be able to tell a cow when you see one. They should have the capacity to consume and digest large amounts of feed, and be able to turn it all into milk.

THE BABY OR CALF.

Many farmer believe that the calf should suck during the milking, or the cow will not let down her milk. But not so, unless the cow has been spoiled. The proper thing to do is to take the calf away when quite young, and do not allow it to suckle its mother at all or longer than three days. But if you are bent upon allowing it to suck until weaned by the natural order of things, teach it to do its sucking, after the cow has been milked. It may be occasionally necessary to let the calf suck at first, but not as much as generally supposed.

It is not a difficult task to teach the calf to drink. It takes some patience, and at first, only a small quantity of milk. As has been suggested, the calf is an ignorant creature with only instinct to guide him. In the first place, he is a dumb brute, and naturally has not as much sense as some men, although he has more sense than the man who thinks that a calf a day old ought to know all things. Take a quart of milk, say when the calf is three days old, and put it in a eight or ten quart pail. Take the calf into a room where you can back it up in a corner, straddle it and take the lower jaw with one hand, and the milk pail with the other hand. Dip your fingers in the milk, and then let the calf suck your fingers. In this way,

he will get a taste of the milk. Naturally his points upward, but by degrees lower it into the milk. It may be that at first he will not suck, but do not give it up. Let the calf wait until he gets good hungry, and you will have little trouble with it, at it, do not give up.

There are many patented calf feeders on the market, and they may be good, but it is hard to beat the plan here outlined. In the first place, these patented feeders have an imitation of a teat which the calf sucks, and it is no unusual thing for the calf to pull this teat off. But the calf has never learned to drink without it, while you are sending hundreds of miles from another, the calf may be starving. And then again, it is next to impossible to keep rubber parts clean, and many calves die on account of the filth accumulated in the feeders. If you cannot spare new milk pails three or four days, of course you will have to change the skimmed milk, but the change should not be made suddenly as it will not work well. It is also a good idea to change from sweet to sour milk, if the calf is raised in the summer, for it is a difficult thing to change the milk sweet, unless a separator is used. The milk should be warmed to blood heat before feeding.

See to it that the calves have a good shelter in the barn in cold or wet weather. It is cheaper to shelter barns than it is to feed. If they are neglected and allowed to stand in the rain or cold, it will take that much more feed to keep them in condition. Then look at it from a humanitarian standpoint, you cannot refuse to give them shelter in bad weather. They should have some milk until three months old.

THE FARMER'S COW.

The Southern farmer as a rule, where he has only a few cows for his home use, has not thought that the dairyman has to devote to the study of feed and feedstuffs, and their chemistry. The question with him is how to get the most out of the cow for the least expense. The man who gets the most milk from his cow with the least expenditure, is the man who raises the most feed at home. If feed is low in price you may be able to even buy feed, but you cannot gain anything from a financial point, where you can get all your feed. It is far more satisfactory to raise the feed that your cow will consume. Of course, if a man has any feed at all, he should have a small pasture. A pasture is almost necessary. Many hi

and others plots of land that are now idle could be turned into money by converting them into pastures. Look about your place and see if there is not some land that could very easily be turned into a pasture, and your cow almost entirely fed there. With a good pasture in the summer, you will only have to feed your cow a little ground feed. Some of the waste from the kitchen may be fed to the cow and some to chickens and hogs. How many farmers allow this waste to be thrown away, when it could be converted into food. They enjoy eating vegetables and will eat them either cooked or raw. The skim milk can be poured over her food, and used to advantage, if there are no hogs to be fed. And then there is a great deal of waste from the garden. The cornstalks from which the roasting ears are taken should not be allowed to stand and dry up, but should be fed to the cow. And then there are the potato vines, they should be fed to

Fig. 26—Dairy House Nacoochee Valley Farm. Owned by Dr. L. G. Hardman of Commerce, Ga.

the cow. In fact, if you will only try, you can feed your cow upon many things that would otherwise be wasted. But if you cannot pasture the cow, a great deal of food can be raised, such as millet, sorghum, and such other foods, on small space and cut for feeding.

If you have to buy feed, the following ration is about the average for the American cow. Now we do

not claim that it is the proper amount, but it is an average. It may be that your cow will need more, or it may be she will not need so much:

(Northern Advice)

15 pounds good, sound hay.

10 pounds wheat bran,

5 pounds corn meal.

This ration should be divided so as to cover the entire day. Cheaper foods can be prepared than this food, but this is considered the best. A ration much used in the South is

5 pounds Cottonseed Meal.

15-20 pounds Cottonseed hulls,

5 pounds hay or fodder.

See that your cow is milked.—Milking a cow is not simply going to her and drawing the milk properly from her. He who milks successfully should study the work. The cow should be milked as quickly as possible, as she will give more milk when it is drawn from her rapidly, than when it takes a long time for her to be milked. And then a good milker will get every drop of milk. The last milk is the richest. A cow may be dried up by not taking all the milk. She produces the milk as it is taken from her. If some be left with her, then the next time she will not give quite as much.

Above all, the milker should practice cleanliness. It is not an uncommon thing for the milker to moisten his hands with milk and then proceed to fill the pail. This practice does not make the milking any easier, and it is simply inexcusable to use the milk bucket for a wash basin. Before beginning to milk, the udder and teats should be washed thoroughly clean, and then dried with a cloth. It is best to milk with the hands dry. As soon as the milk is drawn from the cow, it should be carried into the house and strained, and not allowed to stand in the barn for a half-hour, absorbing impurities. The milk should be strained immediately into shallow pans, or deep cooling cans, and allowed to cool. Do not make the mistake that many farmers' wives make in allowing the milk to sit around until after supper before it is strained.

One item in making the best butter is to churn often. Do not allow the milk to stand after the cream has ripened. It is a poor plan to wait until you get more cream. When it is ripe, then is the time to churn.

And just a word about the place where the milk is kept. Did you ever study the places that the average

family keep their milk and butter? Let us just take a peep into an ice chest. The ice chest, as a rule, does not contain over six cubic feet of space. Strawberries have a very pungent odor, but they appear first; and then there is some cheese, and then a bowl of vegetable soup that was left over, and that must be kept on ice, or it will sour. And there is beef, and the butter and the milk, and a great many other things. The milk and butter all the time are absorbing these odors. The milk should be kept by itself. It may be more expensive, but it will be more satisfactory.

The cow appreciates kindness.—Many things can be done with a cow by treating her kindly, that cannot be done in any other way. She should have plenty of salt. Do not forget to salt her at least three times a week. It is a very good plan to keep salt where she can get it all the time.

It is not necessary to feed while milking. The cow is a creature of habit, and will do as she is trained.

DAIRYING.

With butter selling at from 25 to 40 cents per pound, and milk from 18 to 25 cents per gallon the year around there is good money in dairying,—a great deal more than raising cotton at 10 cents per pound. The South is pre-eminently the place for dairy work. It is easier to raise feed here than any place in the United States. It should only be a matter of a few years when the old hills of the South that are now producing three hundreds pounds of cotton per acre will be producing feed stuff, or used as pastures for dairy cattle. The dairy business is an occupation. It requires time and patience to learn it, but there is no calling that will give better results for the amount invested than the dairy business. To the man who has been making only cotton for the past ten or fifteen years, it will take but a little reasoning for him to see how much better it would have been for him to have devoted some of his time to other work. Cotton is an easy crop to raise. As a rule, it takes only a few months to raise it, and very little exposure to cold, rainy weather. But not so in the dairy business. Cows must be milked, fed, groomed, and the milk attended to twice a day, seven days in the week, and fifty-two weeks in the year. Atlanta, Georgia, uses 500,000 pounds of butter per year, and the most of it it shipped from the North and West. This butter costs the grocers from twenty-five to thirty-five

cents a pound. Other Southern cities are the same way. They need butter, and the people of the South can supply them, and do it easily, if they will, while helping to enrich their lands.

To embark in the dairy business requires some capital, a great deal of common sense and determination. If the business is managed right, it can be made to pay from the very beginning. If you have had no experience, do not go into it too heavily, or on too large a scale. You do not know just what is best, and must learn from experience. There are many things that cannot be taught in books. The school of experience will teach you many things. The average farmer will find it a profitable business to carry on a dairy busi-

Fig. 26—Cow of Mr. Williamson, Commerce, Ga. Producing over 500 lbs. of butter each year.

ness as a side line. Every good farmer has a few good cows. Now it will not be costly for him to purchase a good pure bull, and perhaps one or two pure cows. In connection with his farm business, in the course of a few years, there is no reason why he can not have a first-class dairy herd. Of course, in breeding up a dairy herd, all the poor cows should find their way to the butcher's pen. A poor cow is a bad investment for milking purposes. Weed them out and get the very best. But if the man will look fact in the face he will be convinced that dairying pays so that the next question that comes up is, what and how must he go about the business.

THE BARN.

There can be no definite plans or rules laid down for the construction of the barn or farm buildings. If the side of a hill with a south or east exposure can be secured it will be better to build on it, as it will save time in doing the chores. And then the barn must be built according to circumstances.

The floor of the barn should be of cement. Dig out the place to a depth of six or eight inches, and make the bottom where the floor is to be laid level. Then fill in with gravel and broken stones, and thoroughly wet and trample down. Give a slant in the stable from the manger to the gutter of one or two inches. It is very important that you get the gravel and stones thoroughly packed, as this will prevent the floor from cracking. If it is not packed thoroughly the floor will be sure to crack. Then you should mark the place for the gutter, which should be from

Mix thoroughly together one part cement, and nine parts gravel, and sprinkle it, until it is damper than freshly dug earth. A box should be made, whose outside measurements are the same as the gutter, so that it can be used in making the gutter. The concrete, as mixed above, should be put on to a thickness of two and a half inches in depth. It can be smoothed over with a straight edge. Then on top of this should be placed another layer of cement and sifted sand, using one part cement and three parts sand. Care should be observed that the sand be free from dirt. After you have made the floor smooth, it is a good idea to go over the floor with a rake, letting the teeth go in the cement just a little. Go over it both lengthwise and crosswise. This will prevent the floor from being slick, and keep the cattle from slipping.

The size of the stalls depends upon the length of the animal, and should be from 3 to 3 1-2 ft. wide, and

Fig. 28—Showing bull paddock, cow lot and barn of W. R. Clifton, Waco, Texas.

six feet three inches to six feet eight inches from the manger, depending, of course, upon the size of the cows. The gutter should be dug three inches wider and deeper than wanted when finished. It should be nearly level from end to end, and should be about eight inches deep, and sixteen inches wide when finished. If you intend to use foundation posts, measure from the manger the proper distance, that is, the distance you want the foundation posts from the manger, and drive one inch pipes into the ground for eighteen inches, leaving six inches above the surface to set the posts on, holes being bored in the lower end of the posts to receive the pipe. This is better than putting the posts into cement.

from six to seven feet long. There are a great many forms of ties, stanchion and patent stalls, each having some advantages. The simplest is a rope, strap or chain to tie the cow to the front or side of the stall. If stanchions are used they should be of the swinging or chain hanging variety to give freedom to the cow. Some stalls are arranged to fit the animal exactly without tying, confining her by means of a rope or chain across the back of the stall.

The most economical and satisfactory method of watering is to have one or two large drinking troughs in protected places, where there is footing without mud, and allow the cattle to have access to this at least twice a day. Separate watering devices in each stall

have not proved satisfactory in practical use on account of being unsanitary.

The partitions between the stalls can be made of wire or boards, but should be movable, so that the barn can be more easily cleansed. The cow should have a good bed made of saw-dust, leaves or something of the kind. This will cause extra trouble, to be sure, but it will pay for itself in the saving of the manure. The bedding should be renewed at least once a day. This is much better than having the cow lying upon the cold cement. A 4 or 6 board may be fastened on edge of gutter to hold bedding in place. In planning your barn, perhaps the cheapest plan is to build a barn thirty-two feet wide. This will allow a ten-foot hall-way down the center, and two rows of stalls, one on each side. The cows can be placed with their heads towards the hallway, and this will facilitate feeding them. However, some prefer turning the cows the other way, as it is more convenient in carting off the manure. The barn should be long enough to give every cow a stall, and have two or three extra box stalls ten by ten feet to be used for hospitals, calves, etc.

Fig. 29—Cow barn which can be converted into hog barn. Erroll Farm, Plymouth, Fla.

Of course, behind the gutter there should be a walk for getting into and from the cows. A good plan has been used by some dairymen in having the outside wall of the barn made of cloth fastened at the top. By this plan, at night in the summer, and the summer in the South lasts most of the year, this canvas wall can be raised, and the cows will keep as cool as outside. Then in the winter, and cool nights it can be lowered, and the cows kept warm. If the winters are

severe it may necessitate using a blanket on each cow, but the comfort they will get in the summer will compensate for the extra trouble in keeping them warm in the winter. Then the canvas sides afford better opportunities for ventilating and letting the light in than a board wall.

Another good plan for the South is to have a small well-built stable room for milking and feeding purposes, to contain half or a third of the total number of cows, permitting them to eat the grain ration here while being milked. The remainder of the time they are kept under a large, open, covered shed, where they can secure water freely, hay or fodder from racks, and lie down at will. The floor should be kept well-bedded with leaves, pine straw or saw dust, and the manure be allowed to accumulate with the bedding and hauled out once a week to the field. This plan give the cattle freedom and comfort, produces more manure, and saves space of a tightly built barn.

FEED FOR DAIRY CATTLE.

The question of feed in the dairy business is one of the largest items. It is a question that every dairyman must study. You cannot hope to succeed in the dairy business without the proper feeding. The ration or feed of a working animal should be quite different from that of a fattening animal, and the ration of a young, growing animal should be different from that of an old, mature animal. In feeding a cow, the object is not to fatten, but to make her produce milk. Certain kinds of foods produce bone and muscle, and repair all the waste. These are called proteids. Proteids also produce the casein or cheesy part of the milk. Then there are foods that produce the heat and supply the fats to the cow. These are called carbohydrates, and are also used to produce the butter-fat of the milk.

Experiments have determined that there should be twenty-five pounds of dry vegetable matter to every thousand pounds of live weight of cows. Of this twenty-five pounds required for a 1000 pound cow, there ought to be two and a half pounds of digestible protein or flesh producing foods, twelve and a half pounds of carbohydrates, and four-tenths of a pound of fat. This ration, of course, is an average and not computed for every cow. As the cow gives milk, and the amount of protein and fat should be materially increased, while the increase in the amount of carbohydrates should be only slightly increased. Perhaps we

do no better than to give the complete tables as given in the Bulletin issued by the Georgia Experiment Station on the question of feeding cattle.

"Nutritive Ratio.—This expression means the proportion between the amount of digestible proteins in a feeding stuff, or ration, and the amount of digestible carbohydrates and fats it contains. It is found by multiplying the amount of fats by 2.25 (2 1-4), adding the product to the amount of carbohydrates and dividing this sum by the amount of proteins. This is done because the fat is considered to be two and one-fourth times the food value of the carbohydrates. The standard for an average milch cow, as given in Table No. 1, at a nutritive ratio of 1:5.4, which means that the carbohydrates and two and one-fourth times the fat (added together) are 5.4 times greater than the protein. Thus: Take field corn, the first feeding stuff in

"Feeding Standards.—Table No. 1 gives what are called the "Feeding Standards" for different kinds and conditions of animals, based on 1,000 pounds live weight. It is known as the Wolff-Lehmann standard, and is adapted from Henry's "Feeds and Feeding." The original Wolff standard ratio for the average milch cow in the table as indicated.

"This calls for a daily ration for a 1,000 pound cow of 25 pounds of organic matter, including 2.50 pounds of digestible protein, 12.50 pounds of digestible carbohydrates, and 0.40 pound of digestible fats. This standard is the basis for the suggested feeding formulas for milch cows, which will be found on this page.

"Substantially the same principles and conditions that should control in the make-up of a daily ration for a milk cow apply also to rations for fattening cattle, hogs, sheep, etc.

Table No. I. Feeding Standards.

Per day and per 1,000 pounds live weight. (Wolff-Lehmann.)

KIND OF ANIMALS	Total Dry Matter Pounds.	Digestible Nutrients.			Nutritive ratio 1 : —
		Protein Pounds.	Carbohydrates Pounds.	Fats Pounds.	
1 Oron—					
At rest in stall . .	18	0.7	8.0	0.1	11.8
At light work . .	22	1.4	10.0	0.3	7.7
At heavy work . .	28	2.8	13.0	0.8	5.3
2 Fattening Cattle—					
First period . .	30	2.5	15.0	0.5	6.5
Second period . .	30	3.0	14.5	0.7	5.4
Third period . .	26	2.7	15.0	0.7	6.2
3 Milch Cows—					
When yielding daily—					
4 quarts of milk .	24	1.6	10.0	0.3	6.7
8 quarts of milk .	27	2.0	11.0	0.4	6.0
12 quarts of milk .	29	2.5	13.0	0.5	5.7
14 quarts of milk .	32	3.3	13.0	0.8	4.5
Average Cow (Wolff)	25	2.50	12.5	0.4	5.4
4 Horses—					
At moderate work .	23	1.8	11.2	0.6	6.9
At heavy work . .	25	2.8	13.4	0.8	5.4
5 Fattening Swine—					
First period . .	36	4.5	25.0	0.7	5.9
Second period . .	32	4.0	24.0	0.5	6.3
Third period . .	25	2.7	18.0	0.4	7.0
6 Fattening Sheep—					
First period . .	26	3.0	15.2	0.5	5.4
Second period . .	25	3.0	14.4	0.6	4.5
7 Growing Cattle (Dairy Breeds)					
Age in months					
2-3 150	23	4.0	13.0	2.0	4.5
3-6 300	24	3.0	12.8	1.0	5.1
6-12 500	27	2.0	12.5	0.5	6.8
12-18 700	26	1.8	12.5	0.4	7.5
18-24 900	26	1.5	12.0	0.3	8.5

Fig. 30—Silo on U. S. Diversification farm at Talladega, Ala., weatherboarded as a house.

Table No. 2. It contains 4.3 pounds of fat in 100 pounds, which multiplied by 2.25 (2 1-4), equals 9.7. Add this 9.7 to 66.7—the amount of carbohydrates in field corn—and we 76.4 pounds. Divide this 76.4 by the 7.9—the amount of proteins in field corn and we have 9.6, which is the nutritive ratio of corn or corn meal.

KIND OF ANIMALS	Total Dry Matter Pounds.	Digestible Nutrients.			Nutri- tive ratio 1 : —
		Protein Pounds.	Carbo- hydrates Pounds.	Fats Pounds.	
<i>8 Growing Cattle— (Beef Breeds)</i>					
2-3 160	23	5.2	13.0	2.0	4.2
3-6 33	24	3.5	12.8	1.5	4.7
6-12 55	25	2.5	13.2	0.7	6.0
12-18 75	24	2.0	12.5	0.5	0.8
18-24 950	24	1.8	12.0	0.4	7.2
<i>9 Growing Swine — (Breeding Stock)</i>					
2-3 50	44	7.6	28.0	1.0	4.0
3-5 100	35	7.6	23.1	0.8	5.0
5-6 120	32	3.7	21.4	0.4	6.0
6-8 200	28	2.8	18.7	0.3	7.0
8-12 250	25	2.1	15.3	0.2	7.5
<i>10 Growing, Fattening Swine—</i>					
2-3 50	44	7.6	28.0	1.0	4.0
3-5 100	35	5.0	23.1	0.8	5.0
5-6 150	33	4.3	22.3	0.6	5.5
6-8 200	30	3.6	20.5	0.4	6.0
9-12 300	26	3.0	18.3	0.3	6.4
11 Brood Sows	22	2.5	15.5	0.4	6.6

It is not insisted that the ration for milch cows should exactly correspond either in total amount of "dry matter" or in the proportion of protein, carbohydrates and fats. The quantities and proportions given in Table No. 1 are the averages of a large number of feeding experiments. In the nature of the case, different animals, different conditions of the same animal, different outward surroundings—such as temperature, stable comfort, etc.—will call for different proportions of elements, and different quantities. It is for the intelligent dairyman to study these conditions, to note the personal peculiarities of each cow, the quality of the component foods, and the results in milk production, and to govern himself accordingly in making up the feed formulas. A careful and painstaking feeder will make changes in feed according to the observed peculiarities or conditions of the several cows. The "feeding standards" are for general guidance and not for implicit compliance in matters of detail.

It should be remembered that no ordinary change in the composition, or in the proportions of the nutritive elements of the ration will cause any change in the quality of the milk, i.e., the percentage of butter fat. It is now generally admitted that we cannot "feed fat into the milk." Each individual cow has her own opinion as to the amount of water she will put into her milk, or, in other words, how rich her milk should be, and no art or device of feeding will materially or permanently change the result. Feeding even the most

succulent and watery foods does not—as was long believed—materially affect the richness of the milk.

Quality, or richness of the milk, depends (1) on the breed, and (2) on the individual cow, and can not be changed by changing the feed. Quantity of milk may be the aim of the expectant dairyman when he is restricted to a given cow, or a herd of cows. In the quality and quantity should be the aim of the intelligent breeder.

Of course there are other qualities of milk besides richness in butter fats. Flavor, keeping qualities, color, both of the milk and of the butter, and the firmness of the latter are materially affected by the character of the food consumed.

ANALYSIS OF FEED STUFFS.

For convenience, the following table (No. 2) has been compiled, giving the proximate analyses of the stock foods in common use, including especially the most popular and available in the South. The table also includes the average amount of fertilizing constituents in one ton of each kind of feeding stuff and a column showing the commercial value of the stuffs based on the following prices of the three valuable elements: Nitrogen, fourteen cents per pound; available phosphoric acid, five cents per pound; and potash, five cents per pound. On an average, about eighty per cent. of the fertilizing elements contained in a fielding stuff will be found in the manure.

Table No. II.

Average Digestible Nutrients and Fertilizing Constituents in American Feeding Stuffs.

NAME OF FEED	Dry Matter in 100 pounds	Digestible Nutrients in 100 lbs.			Fertilizing Constituent in 2000 lbs		
		Protein	Carbo-Hydrate	Ether Extract	Nitrogen	Phosphoric Acid	value
GRAINS AND SEEDS							
Corn, Field	89.1	7.9	66.7	4.3	36.4	14.0	8.0
Corn, Sweet	91.2	8.8	63.7	7.0	37.0	11.4	12.0
Corn, Cob	89.3	0.4	52.5	0.3	10.0	1.2	12.0
Corn and Cob Meal	84.9	4.4	60.0	2.9	28.2	11.4	9.4
Gluten Meal	91.8	25.8	43.3	11.0	100.5	6.6	1.0
Wheat, Whole	89.5	10.2	69.2	1.7	47.2	15.8	15.0
Wheat Bran	88.1	12.2	39.2	2.7	53.4	57.8	32.2
Wheat Shorts	88.2	12.2	50.0	3.8	56.4	27.0	11.8
Wheat Middlings	87.9	12.8	53.0	3.4	52.6	19.0	12.6

NAME OF FEED	Dry Matter in 100 pounds	Digestible Nutrients in 100 lbs.			Fertilizing Constituents in 2000 lbs.			
		Protein	Carbo-Hydrate	Ether Extract	Nitrogen	Phosphoric Acid	Potash	Relative commercial fertilizer val.
Wheat Screenings	88.4	9.9	67.6	1.1	48.8	23.4	16.8	8.84
Barley	89.1	8.7	65.6	1.6	35.2	16.4	10.8	6.29
Malt Sprouts	89.8	18.6	37.1	1.7	71.0	28.6	32.6	13.06
Brewers' Grains, wet	24.3	3.9	9.3	1.4	17.8	6.2	1.0	2.85
Oats	89.0	9.2	47.3	4.2	41.2	16.4	12.4	7.21
Patmeal	92.1	11.5	52.1	5.9	47.0	.....	.....	.....
Rice	87.6	4.8	72.2	0.3	21.6	3.6	1.8	3.29
Rice Bran	90.3	5.3	45.1	7.3	14.2	5.8	4.8	2.52
Rice, Polish	90.0	9.0	55.4	6.5	39.4	53.4	14.2	8.90
Sorghum Seed	87.2	7.0	52.1	3.1	29.6	16.2	8.4	5.37
Room Corn Seed	85.9	7.4	48.3	2.9	32.6	.....	.....	.....
Caffir Corn Seed	84.8	7.8	57.1	2.7	.....	.....	.....	.....
Flax Seed	90.8	20.6	17.1	29.0	72.2	27.8	20.6	12.53
Linseed Meal, New Process	89.9	28.2	40.1	2.8	115.6	36.6	27.8	19.40
Cotton Seed	89.7	12.5	30.0	17.3	62.6	25.4	23.4	11.20
Cotton Seed Kernels (Meats)	90.0	29.1	26.3	24.3	99.6	34.6	22.8	15.67
Cotton Seed Meal	91.8	37.2	16.9	12.2	135.8	57.6	17.4	22.76
Cotton Seed Hulls	88.9	0.3	33.1	1.7	13.8	5.0	20.4	3.20
Sunflower Seed	92.5	12.1	20.8	20.0	45.6	24.4	11.2	8.16
Sunflower Seed Cake	91.8	31.2	19.6	12.8	111.0	43.0	23.4	18.19
Peanuts, Hulled	93.7	22.5	6.0	00.0	90.0	24.8	25.4	15.11
Peanut Cake	89.3	42.9	22.8	6.9	151.2	26.2	30.0	23.97
Soja Bean (Japan Pea)	89.2	20.6	22.3	14.4	106.0	37.4	39.8	18.70
Cow Pea, seed	85.2	18.8	54.2	1.1	66.6	.....	.....	.....
Horse Bean	85.7	22.4	49.3	1.2	81.4	24.0	25.8	13.89
Velvet Bean (clean seed) . . . . .	.....	21.4	60.7	7.1	.....	.....	.....	.....
China Berries	83.5	.....	.....	.....	23.8	8.6	46.6	6.09
GREEN FORAGE.								
Pasture Grass	20.0	2.5	10.2	0.5	18.2	4.6	15.0	3.52
Fodder Corn, green	20.7	1.0	11.6	0.4	8.2	3.0	6.6	1.63
Teosinte	25.0	2.4	13.5	0.2	.....	.....	.....	.....
Kentucky Blue Grass	24.9	3.0	19.8	0.8	10.5	3.5	13.8	2.33
Timothy Grass	33.4	1.2	19.1	0.6	9.6	5.2	15.2	2.36
Orchard Grass	27.0	1.5	11.4	0.5	8.6	3.2	15.2	2.12
Hungarian Grass	28.9	2.0	16.0	0.4	7.8	3.2	11.0	1.80
Red Top Grass	34.7	2.1	21.2	0.6	8.7	2.7	7.7	1.73
Crab Grass	33.0	1.9	14.0	0.6	9.9	5.3	11.6	2.29
Bermuda Grass	33.0	2.6	14.8	0.3	16.0	3.5	12.8	3.05
Johnson Grass	34.0	2.4	16.5	0.5	12.9	3.8	14.3	2.72
Lepedeza Striata (Jap. Clover)	30.0	2.7	14.4	0.6	14.4	2.1	9.7	2.60
Desmodium Molle (Beg'r W'd)	30.0	3.4	13.2	0.4	8.7	5.5	14.0	2.19
Oat Fodder	37.8	2.7	18.9	1.0	9.8	2.6	7.6	1.78
Rye Fodder	23.4	2.1	14.1	0.4	6.6	3.0	14.6	1.80
Barley, Green	21.0	1.9	10.2	0.4	6.6	4.0	10.2	1.63
Wheat Fodder	36.0	2.80	18.0	0.9	10.8	3.0	14.0	2.36
Sugar Cane Fodder . . . . .	.....	.....	.....	.....	.....	.....	.....	.....
Sorghum, Whole	20.6	0.6	12.2	0.4	4.6	1.8	4.6	0.96
Red Clover	29.2	2.9	14.8	0.7	10.6	2.6	9.2	2.07
Alsike Clover	25.2	2.7	13.1	0.6	8.8	2.2	4.0	1.54
Crimson Clover	19.1	2.4	9.1	0.5	8.6	2.6	9.8	1.82
Burr Clover	25.0	2.6	17.5	.....	13.0	2.2	9.6	2.46
Vetch (Vicia Sativa)	25.0	4.4	9.2	0.7	13.6	6.4	12.2	2.83
Vetch (Vicia Villosa) . . . . .	.....	.....	.....	.....	.....	.....	.....	.....
Lucerne (Alfalfa)	28.2	3.9	12.7	1.0	14.4	2.6	11.2	2.79
Cowpea	16.4	1.8	8.7	0.2	3.4	2.0	6.2	0.88
Soja Bean	21.9	3.2	22.0	1.0	5.4	3.0	10.6	1.43
Sweet Potato Vines	20.0	.....	.....	.....	8.4	1.4	14.6	1.97
SILAGE.								
Corn	20.9	0.9	11.3	0.7	5.6	2.2	7.4	1.26
NAME OF FEED	Dry Matter in 100 pounds	Digestible Nutrients in 100 lbs.			Fertilizing Constituents in 2000 lbs.			
		Protein	Carbo-Hydrate	Ether Extract	Nitrogen	Phosphoric Acid	Potash	Relative commercial fertilizer val.
Red Clover	28.0	2.0	13.5	2.0	10.2	2.4	9.0	2.00
Sorghum	23.9	0.6	14.9	0.2	4.4	1.6	4.4	0.92
Lucerne	27.5	3.0	8.5	1.9	14.2	2.5	11.0	2.66
Cowpea	20.7	1.5	8.7	0.9	3.2	2.0	6.0	0.85
Soja Bean . . . . .	.....	.....	.....	.....	5.3	2.8	10.4	1.40
HAYS, DRY FORAGE AND STRAW.								
Mixed Grass Hay	87.1	5.9	40.9	1.2	28.2	5.2	31.0	5.76
Kentucky Blue Grass Hay	78.8	4.8	37.3	2.0	23.8	8.0	31.4	5.30
Timothy Grass Hay	86.8	2.8	43.4	1.4	25.2	10.6	18.0	4.96
Orchard Grass Hay	90.1	4.9	42.3	1.4	26.2	8.2	37.6	5.96
Hungarian Grass Hay	78.8	4.8	37.3	2.0	.....	.....	.....	.....
Redtop Grass Hay	91.1	4.8	46.9	1.0	23.0	7.2	20.4	4.60
Creast (Panicum Secalinus)	86.0	3.9	45.0	1.7	.....	.....	.....	.....
Crabgrass Hay	86.0	4.3	36.4	1.5	26.8	13.8	30.0	5.94
Bermuda Grass Hay	86.0	6.9	39.0	0.8	24.0	8.7	32.2	5.40
Johnson Grass	85.7	6.0	41.4	1.2	32.4	9.6	35.7	7.79
Lepedeza Striata (Jap. Clover)	86.0	7.8	41.4	1.8	41.4	6.0	27.8	7.48
Desmodium Molle (Beg'r W'd)	86.0	9.7	37.9	1.2	26.0	16.5	42.0	6.56
Shredded Corn Stover	80.0	2.3	43.2	0.9	27.4	7.6	36.0	6.02
Corn Stalks—Butts	80.0	0.5	54.0	0.8	.....	.....	.....	.....
Corn Stalks—Tops	80.0	1.1	42.8	0.7	.....	.....	.....	.....
Corn Blades (Corn Fodder)	80.0	4.0	40.8	0.6	.....	.....	.....	.....
Corn Shucks (Husks)	80.0	1.3	49.9	0.3	.....	.....	.....	.....
Red Clover Hay	84.7	6.8	35.8	1.7	41.4	7.6	44.0	8.38
White Clover Hay	90.3	11.5	42.2	1.5	55.0	10.4	36.2	10.03
Lucerne (Alfalfa) Hay	91.6	11.0	39.6	1.2	38.8	10.2	33.6	8.32
Peanut Hay	92.4	6.7	42.1	3.4	35.2	5.8	.....	.....
Cowpea Hay	89.3	10.8	38.6	1.1	30.0	10.4	25.4	7.45
Burr Clover (Medick) Hay	83.3	8.8	36.5	.....	43.3	10.7	32.0	8.20
Alsike Clover Hay	90.3	8.4	42.5	1.5	46.8	13.4	54.6	9.45
Crimson Clover Hay	90.4	10.5	34.9	1.2	41.0	8.0	26.2	7.45
Vetch Hay (Vicia Sativa)	83.3	14.6	30.6	2.3	45.4	21.4	56.6	10.25
Cotton-seed Hulls	88.9	0.3	33.1	1.7	13.8	5.0	20.4	3.20
Wheat Straw	90.4	0.4	36.3	0.4	11.8	2.4	10.2	2.28
Oat Straw	90.8	1.2	38.6	0.8	12.4	4.0	24.8	3.18
Rye Straw	92.9	0.6	40.6	0.4	9.2	5.6	15.8	2.36
Barley Straw	85.8	0.7	41.2	0.6	11.2	6.0	41.8	3.96
Wheat Chaff	85.7	0.3	23.3	0.5	15.8	14.0	8.4	3.33
Oat Chaff	85.7	1.5	33.0	0.7	.....	.....	.....	.....
ROOTS, TUBERS, UNDERGROUND SEEDS.								
Sweet Potato	28.9	1.0	22.5	.....	.....	.....	.....	.....
Irish Potato	21.1	0.9	16.3	0.1	6.4	2.4	9.2	1.48
Artichoke (Jerusalem)	20.0	2.0	16.8	0.2	5.2	2.8	9.4	1.34
Sugar Beet	13.5	1.1	10.2	0.1	4.4	2.0	9.6	1.20
Mangel Beet	9.1	1.1	5.4	0.1	3.8	1.8	7.6	1.00
Common Garden Beet	13.0	1.9	8.8	0.1	4.8	1.8	8.8	1.20
Flat Turnip	9.5	1.0	7.2	0.2	3.6	2.0	7.8	0.99
Rutabaga	11.4	1.0	8.1	0.2	3.8	2.4	9.8	1.14
Carrot	11.4	0.8	7.8	0.2	3.0	1.8	10.2	1.02
Chufa . . . . .	.....	.....	.....	.....	.....	.....	.....	.....
Peanut (Hulled)	92.5	19.8	8.6	35.6	20.8	2.8	16.2	3.86
MISCELLANEOUS.								
Cabbage	15.3	1.8	8.2	0.4	7.6	2.2	8.6	1.60
Spurry	20.0	1.5	9.8	0.3	7.6	5.0	11.8	1.90
Sugar Beet Tops	12.0	1.7	4.6	0.2	9.2	3.0	7.2	1.77
Rutabaga Tops	11.2	2.1	6.8	0.5	5.0	1.8	5.6	1.21
Pumpkin	9.1	1.0	5.8	0.3	.....	.....	.....	.....

NAME OF FEED	Dry Matter in 100 pounds	Digestible Nutrients in 100 lbs.			Fertilizing Constituents in 2000 lbs.			
		Protein	Carbo-Hydrate	Ether Extract	Nitrogen	Phosphoric Acid	value	Relative commer- cial fertilizer val.
Rape	14.0	1.5	8.1	0.2	9.2	3.0	7.2	1.77
Acorns	44.7	2.1	34.4	1.7	.....	.....	.....	.....
Sugar Cane Bagasse . . . . .	.....	.....	.....	.....	.....	.....	.....	.....
Sorghum Bagasse	16.1	0.8	8.94	.....	.....	.....	.....	.....
Cow's Milk	12.8	3.6	4.9	3.7	10.6	3.8	3.6	1.85
Cow's Milk, Colostrum	25.4	17.6	2.7	3.6	56.4	13.2	2.2	8.67
Skim Milk, gravity	9.6	3.1	4.7	0.8	11.2	4.0	3.8	1.96
Skim Milk, Centrifugal	9.4	2.9	5.2	0.3	11.2	4.0	3.8	1.96
Butter Milk	9.9	3.9	4.0	1.1	12.8	3.4	3.2	2.12
Whey	6.6	0.8	4.7	0.3	3.0	2.8	3.6	0.75
Chees	55.0	27.2	...	...	90.6	23.0	5.0	4.08
Butter Fat	100.0	00.0	0.0	100.0	00.0	00.0	0.0	00.00

Feeding Formulas.

From Tables 1 and 2 we may now calculate a ration for a dairy cow weighing 1,000 pounds, with a view to inducing a full flow of milk. Suppose we have available the following feeding stuffs, the composition of each of which is given in Table No. 2: Cowpea hay, corn silage and wheat bran:

Table No. 2 shows that cowpea hay contains, in every 100 pounds, as follows: Dry matter, 89.3 pounds; proteins, 10.8 pounds; carbo-hydrates, 38.6 pounds; and fat 1.1 pounds. We want to know how much of these elements there are in one pound of cowpea hay; so we divide the 89.3 pounds of dry matter by 100, or 89.3 by 100 equals 893 pounds, or simply set the decimal point two places to the left. Then, as there are .893 pounds of dry matter in one pound of cowpea hay, there must be .893x15 in fifteen pounds of the hay, or 13.39 pounds. This amount is placed in the column of "Dry Matter."

Then, as Table No. 2 shows that 100 pounds of cowpea hay contain 10.8 pounds of protein, proceed as before: 10.8 by 100 equals .108, and .108 multiplied by fifteen gives 1.62 pounds of proteins in the fifteen pounds of cowpea hay, and we place the 1.62 in the column of proteins. Then proceed in like manner with the carbohydrates and fats and place the amounts of each that is contained in fifteen pounds of hay in its appropriate column.

Then proceed, in like manner, to calculate the amounts of dry matter, proteins, carbohydrates and fats that are contained in forty pounds of corn silage and three pounds of wheat bran and place each

amount in its column. Add up the columns and find that on the first trial we get: Dry matter, 24.3; protein, 235; carbohydrates, 11.48; fats, 0.52, which the ratio is 1:5.3 (1 to 5.3). The results are nearly right. It is a little short in the amounts of dry matter, and in each of the ingredients except fat. But the ratio is 1:5.4—exactly correct. It is pretty evident that if we add two pounds of wheat bran, making five pounds in all of bran, that the formula will be correct.

It may make it appear more clearly to show the different steps of the calculation, as follows:

Cowpea Hay.

	In 100 Lbs.	In 1 Lb.	In 15 Lbs.
Dry Matter	89.3 ÷ 100 = .893	.893 × 15 = 13.39	
Protein	10.8 ÷ 100 = .108	.108 × 15 = 1.62	
Carbohydrates	38.6 ÷ 100 = .386	.386 × 15 = 5.79	
Fats	1.1 ÷ 100 = .011	.011 × 15 = 0.165	

Corn Silage.

	In 100 Lbs.	In 1 Lb.	In 40 Lbs.
Dry Matter	20.9 ÷ 100 = .209	.209 × 40 = 8.36	
Proteins	0.9 ÷ 100 = .009	.009 × 40 = 0.36	
Carbohydrates	11.3 ÷ 100 = .113	.113 × 40 = 4.52	
Fats	0.7 ÷ 100 = .007	.007 × 40 = 0.28	

Wheat Bran.

	In 100 Lbs.	In 1 Lb.	In 3 Lbs.
Dry Matter	88.1 ÷ 100 = .881	.881 × 3 = 2.64	
Proteins	12.2 ÷ 100 = .122	.122 × 3 = 0.366	
Carbohydrates	39.2 ÷ 100 = .392	.392 × 3 = 1.176	
Fats	2.7 ÷ 100 = .027	.027 × 3 = 0.081	

Now arrange the above in tabular form together for comparison with the Wolff-Lehman average standard, we have:

FEEDING STUFFS		Total Dry Matter	DIGESTIBLE			
			Proteins.	Carbo-hydrates	Fats.	Ratio
A {	Required by an average cow	Lbs.	Lbs.	Lbs.	Lbs.	L
		25.00	2.50	12.50	0.40	1 : 5
B {	15 pounds cowpea hay	13.39	1.62	5.79	0.16	1 : 3
	40 pounds corn silage .	8.36	0.36	4.50	0.28	1 : 14
	3 pounds wheat bran	2.64	0.37	1.17	0.08	1 : 3
	First trial ration	24.39	2.35	11.48	0.52	1 : 5
C {	Add :					
	2 pounds wheat bran .	1.76	0.24	0.79	0.05	1 : 3
	Second trial ration	26.15	2.59	12.27	0.57	1 : 5

In the same manner feeding formulas may be co

structed of a mixture of two, three, four or more of the different feeding stuffs that may be available.

"For convenience of such as may not be ready at "figuring," a number of calculated feeding formulas are given in Table No. 3. It will be observed that these formulas vary within moderate limits in their proportions of the constituent nutritive ingredients. Some of them are "narrow," which means that they contain a larger proportion of proteins than the standard; others are "wide," which means that the proportions of proteins is less, or that of the carbohydrates is greater than the standard. A ratio of less than 1:5.4 is said to be "narrow," if greater, it is "wide."

TABLE No. III.

Daily Rations for 1,000 Pounds, Live Weight.

For Milch Cows.

U.S.		No. 8.	
No. 1.		No. 9.	
20 Hay, mixed grasses.		15 Cowpea hay.	
5 Wheat Bran.		10 Shredded corn stalks.	
2 C. S. Meal.		2 C. S. Meal.	
2 Corn Meal.		2 Corn Meal.	
Ratio 1 : 5.0		Ratio 1 : 5.5	
No. 2.		No. 10.	
20 Hay, mixed grasses.		15 Cowpea hay.	
3 C. S. Meal.		40 Corn Silage.	
4 Corn Meal.		5 Wheat bran.	
Ratio 1 : 4.0		Ratio 1 : 5.3	
No. 3.		No. 11.	
20 Corn fodder (blades).		20 Cowpea hay.	
5 C. S. Meal.		8 Corn Meal.	
20 Green fodder corn.		Ratio 1 : 5.1	
Ratio 1 : 4.0		No. 12.	
No. 4.		15 Cowpea hay.	
25 Shredded corn shucks.		10 C. S. hulls.	
5 C. S. meal.		5 Cowpea meal.	
3 Wheat Bran.		Ratio 1 : 5.0	
Ratio 1 : 5.2		No. 13.	
No. 5.		28 Bermuda hay.	
24 C. S. hulls.		8 Shelled oats.	
5 C. S. meal		1 C. S. meal.	
Ratio 1 : 5.7		Ratio 1 : 5.3	
No. 6.		No. 14.	
20 C. S. hulls.		20 Cowpea hay.	
4 C. S. Meal.		15 Sweet potatoes.	
5 Wheat bran.		4 Corn meal	
Ratio 1 : 5.3		Ratio 1 : 5.6	
No. 7.			
20 Cowpea hay.			
10 Shredded corn stalks.			
Ratio 1 : 5.7			

No. 15.		No. 18.	
12 Corn "shucks" (husks)		14 Vetch hay.	
10 Cowpea hay.		10 C. S. hulls.	
4 Corn meal.		6 Corn meal.	
3 C. S. meal.		Ratio 1 : 5.3	
Ratio 1 : 5.5		No. 19.	
No. 16.		15 Cowpea hay.	
35 Lucerne (Alfalfa) green.		8 Cotton seed.	
10 Oat straw.		6 Corn meal.	
6 Cowpea meal.		Ratio 1 : 5.4	
Ratio 1 : 5.0			
No. 17.			
18 Lucerne (green).			
6 Corn meal.			
3 Shelled oats.			
Ratio 1 : 5.1			

For Fattening Steers.

No. 21.		No. 24.	
20 C. S. hulls.		18 C. S. hulls.	
5 C. S. meal.		7 Soja bean meal.	
5 Corn meal.		6 Corn meal.	
Ratio 1 : 5.8		Ratio 1 : 6.5	
No. 22.		No. 25.	
25 C. S. hulls.		40 Sweet potatoes.	
5 C. S. meal.		10 Corn fodder (blades).	
Ratio 1 : 6.0		5 C. S. meal.	
No. 23.		2 Corn meal.	
20 Shredded corn stalks.		Ratio 1 : 6.0	
5 C. S. meal.		No. 26.	
6 Corn meal.		40 Artichokes.	
Ratio 1 : 5.7		10 Shredded corn stalks.	
		4 C. S. meal.	
		6 Corn and cob meal.	
		Ratio 1 : 6.2	

SILOS AND ENSILAGE.

The question of silos and ensilage is a new one to most of the people of the South. But if we take the testimony of those who have had experience with them, they are certainly a help to the farmer, or dairyman. Silage is canned grass, or corn, or forage of any kind. The silos are to the forage what the cans are to fruit. Ensilage was first prepared in the United States by Manly Miles, of Michigan, in 1875. The advantages claimed for silage are as follows: Succulent palatable food for the cattle may be kept all the year, maintaining a good milk supply the year round. In order for cows to keep up their milk supply, especially in the South, they must have good succulent food all the time. This is the only method by which the food can be kept in a succulent state in winter. 2nd. A larger per cent. of the food har-

vested can be kept by the silo than either by hay or fodder. There is practically no waste in the silo. 3rd. A great deal more food can be placed in a given amount of space by using a silo. The item of space on a farm, especially large stock farms and dairy farms, is no small item, for it is certainly important to have plenty of food for the stock to carry them over the winter.

Most heavy forage crops may be used for ensilage. The crops of the South that are best adapted to make silage out of are corn, millet, sorghum and cowpeas. In planting corn for ensilage it should not be broadcast, as a great many people think. In planting the corn, you want a variety that will produce a small ear.

Fig. 31—Silo on dairy farm, Selma, Ala. Built with staves.

The rows should be from three to three and a half feet apart. The corn should be planted from eight to ten inches apart in the drill, depending of course upon the fertility of the land. The corn should be cut and placed in the silo when the kernels begin to glaze, or when denting is well established. It should be cut up before placed in the silo, into pieces about half inch long. Care should be observed that the corn be packed down thoroughly, especially around the edge of the silo. The silo may be filled as rapidly as the corn can be placed in it, or by repeated fillings. When the silo is filled, it should be thoroughly packed every two or three days, for eight or ten days, and then

covered with a six-inch layer of straw well dampened with water. This will cause the first eight or ten inches to rot, and form a kind of air-tight covering.

The most modern machinery for filling silos includes a blower that elevates the cut material through a sheet iron tube over the top of the silo by air power.

Corn should be the main dependence in the South for silage. It may be mixed half and half with sorghum, or with cowpeas. Peas and sorghum do not make good silage alone, becoming too sour and slimy in the Southern climate. A good way to get peas in the silo is to let the vines run up the corn stalk in the field, and run them through the cutter together.

A few years ago there was considerable complaint from consumers of milk against the silo, stating that the use of the silo affected the milk. This matter was thoroughly tested, and it was found that the trouble was in the method of handling the ensilage. For instance, when the cows did not eat up all the ensilage, it was left in the manger, or used as bedding, and it very quickly soured. If any silage is left by any of the cows, it should not be left in the barn, nor should it be used for bedding, as it quickly sours, and the milk takes up the odor. Again, when you begin using ensilage at least two inches should be taken off every day in the winter, and three inches in the summer, for if this is not done it spoils. For milk cows, it is better than any other food we know of. But in feeding to dairy cows, it should not be fed until after the cows are milked, as it may taint the milk. From thirty to thirty-five pounds a day along with the hay and grain is considered a very good amount to feed dairy cows. Silage, so the Kansas Experiment Station says, should not be fed to bulls, as they lose their virility, and become slow and uncertain breeders. Horses, chickens, and sheep do well on certain amounts of ensilage.

The silo is a building, or can, for the preservation of the forage crops. They may be built of wood, stone, brick, cement, etc., but as the first cost of wood is less, more wood silos are built than any other kind. If possible, a silo should be twenty-five feet deep, in order that the silage may be packed down by the weight, and exclude all the air. A silo can be built which is only twenty feet high, but it is better to have one thirty than twenty feet high. The walls of the silo should be vertical, and as smooth as possible. It is far better to build a round silo, or nearly so, than a

square one, as most of the spoiling, where any takes place, occurs at the corners. The size of the silo depends, of course, upon the amount of feed that is to be preserved. A cubic foot of silage well-packed will weigh on an average between 35 and 40 pounds, which is the amount that should be fed to a cow weighing 1000 pounds. If you feed the cow silage for six months, each cow would consume about 3 1-2 tons of silage. An acre of good corn will produce anywhere from eight to fifteen tons of silage. The following table will give you the capacity of silos:

same kind of covering as you would use on a house will be sufficient, or plain board will do.

SOILING.

Soiling has long been familiar to farmers of some sections, but in the South, with so much cheap land, not many are familiar with it. Soiling is a system of raising various forage crops, which are cut and fed green, instead of pasturing them. By doing this, you can secure from two to three times as much from the same land each year, and the land is maintained in a

Depth of Silo in feet	Inside diameter of silo in feet, and capacity in tons.											
	15	16	17	18	19	20	21	22	23	24	25	26
	Tns	Tns	Tns	Tns	Tns	Tns	Tns	Tns	Tns	Tns	Tns	Tns
20.....	59	67	76	85	94	105	115	127	138	150	163	177
21.....	63	72	81	91	101	112	125	135	148	161	175	189
22.....	67	77	86	97	108	120	132	145	158	172	187	202
23.....	72	82	92	103	115	127	141	154	169	184	199	216
24.....	76	87	98	110	122	135	149	164	179	195	211	229
25.....	81	92	104	116	129	143	158	174	190	206	224	242
26.....	85	97	110	123	137	152	167	184	201	219	237	257
27.....	90	103	116	130	145	160	177	194	212	231	251	271
28.....	95	108	122	137	152	169	186	205	223	243	264	285
29.....	100	114	128	144	160	178	196	215	235	256	278	300
30.....	105	119	135	151	168	187	206	226	247	269	292	315
31.....	110	125	141	158	176	195	216	236	258	282	305	330
32.....	115	130	148	166	185	205	226	247	270	295	320	346

Of course some of the silage will be lost by spoiling, etc., and a little more than the above amount should be allowed for a cow.

The cost of building a round silo is small when compared to its advantages. As a rule, anyone that can build a barn can build a silo. The hands on the farm can be used in this work during rainy days. In building a silo, it is perhaps better to have a rock, or brick foundation, as this preserves the wood from decay. Then use 2x4 studding, placing them 12 inches apart in a circle. Then ceil this with two layers of ceiling, with tar paper in between. Linseed oil or tar should be applied to the inside, as it helps to make the silo nearer air-tight. Sometimes they are built on the fashion of a tank or tub, using staves, and being bound with hoops. Where the door is to be made, the studding should be set double, and the staves sawed out as wide and high as the door is to be. The door is made to fit over this air-tight. Some advocate not using a cover on the silo, but it is better to use a cover. The

higher state of cultivation, and the manure is better preserved. When land was plentiful, the people of the South did not need to practice soiling so much as they do now. This is especially true around our cities, for land there is too valuable to be used for pastures, when from two to three times as much can be produced by other uses. In doing this, it is necessary to have a suitable rotation of crops. With the exception of corn and sorghum soiling crops do not do well for longer periods than ten days. It is therefore best to plant a small-sized plot, just large enough to run for a week, and plant each week such a plot. This keeps your stock in fresh forage all the time, and enables them to get it while it is at its best. In the fall you may sow barley or rye, and will be ready to feed early in the spring. Winter oats or vetch make a fine combination for use in the spring. Sorghum and corn can be grown nearly all summer, also millet. Alfalfa makes an excellent soiling crop, with four or five cuttings per year, beginning in March and growing constantly till frost.

GRAINS.

The dairy herd must have some grains if the best results are to be had. For the South, corn is better than most any other grain to be fed to milk cows, unless it be cotton seed meal. But corn meal is better fed with some other food, such as bran, shorts, cottonseed meal, etc. Cottonseed meal produces a firmer butter, and raises the melting point of butter, and is therefore recommended. But care should be observed in feeding it, not to get too much. In some States it has one effect, and in some another. It should always be thoroughly mixed with cut hay or fodder or cottonseed hulls to give bulk to the mixture.

DAIRY UTENSILS.**Cream Separator.**

Every man with five or more cows selling cream or butter, should have a Separator, he stands in his own light if he refuses to buy one. Any of the standard makes of separators are good. Of course the dairy with a large number of cows will require a power separator, but for only a few cows, the hand separator will answer every purpose. To make the very best grade of butter, the time must be as short as possible after the milk is drawn from the cow, until it is made into butter. Every minute the milk is exposed to the warm air increases the danger of spoiling. By using the hand separator, the cream is taken from the milk as soon as it is drawn from the cow, and the cream can then be easily reduced in temperature. Again you can make from 10 to 50 per cent more butter by using a separator than by shallow setting. The general rule holds good that the best is cheapest, so buy a first-class machine. By a first-class machine we do not mean a large machine, but a machine that will do the work satisfactorily. When you set up the machine, be sure to read and re-read the instructions carefully. Remember that this machine has to make about five thousands revolutions per minute, and therefore must be put up right. It must be placed upon a solid foundation, and must be set perfectly level. If it is not level this will cause it to run hard, and wear out on the upper side. It is a good plan to go slow in setting up a machine. It is very important that it be washed clean every time it is used, notwithstanding what some agents may tell you. Do not believe them when they tell you that the machine

will not have to be washed each time it is used, for it is not so. Immediately after getting through with the machine, run some water through it, so that it will not dry before you can wash it.

BABCOCK TESTER.

In this day of competition, a cow that does not pay a profit cannot be kept in a herd. The same principle works in other lines as in this. A merchant does not want a clerk who does not earn a profit, nor does he want to handle a line of goods that does not pay. It is very important that we should know just what each cow produces. The milk of each cow should be weighed at every milking and a record made of it. Not only must the dairyman know the amount of milk she produces, but he should know the value of this milk so far as butter fat is concerned. One of the best testers is Babcock's Tester. Before making the test the milk should be thoroughly stirred so that an average sample can be secured. These samples are then mixed with sulphuric acid, and whirled in a centrifugal machine. The heavy parts of the milk fly to the bottom, and the butter fat, which is lighter than the other part of the milk, comes to the top, and the percentage of butter fat may be read on the graduated scale on the bottle. The principle back of it is that the sulphuric acid dissolves the other solids of the milk, leaving the fat globules free, and they, being lighter than the other solids, collect nearest the axis of the machine.

Few dairymen fully realize the importance of this matter of testing. For instance, recently two cows of similar breeding, with exactly the same milking, feed, etc., one yielded 20 pounds of butter per month, and the other 63 lbs. per month. Supposing that the butter sold for 25 cents per pound, the profit of one above the other is \$10.75 a month, which is quite an item in itself. Another illustration, two cows were fed and managed as near alike as possible for a year. One produced 252 pounds of butter fat more than the other, yet the two were under the same treatment, and received the same amount of food. You can readily see the importance of testing your cows, and seeing which one pays and which does not. And when you find a cow that does not pay, that does not produce at least 5000 pounds of milk per year, containing 200 pounds of butter, get rid of her. She may make good beef, but she is not fit for the dairy herd. •

AERATORS AND COOLERS.

As soon as milk is drawn from the cow, it should be immediately strained, and cooled down as low as 40 degrees F., if possible. Of course where you cannot get it down that low, 60 degrees will help. There are several ways to do this. There are several milk aerators and coolers that have been devised to do the work. The object of cooling the milk is to relieve it of all animal odor and animal heat. This prevents bacteria from multiplying, and enables the milk to remain sweet much longer than it would do otherwise. Secure from some dairy supply house a good milk aerator or cooler, and you will find it a profitable investment.

Fig. 23—Showing Creamery, LaGrange, Ga.

CHURNS.

Many dairymen have paid hard-earned money for churns that were utterly worthless to them. At the dairy Fairs it is no uncommon thing for the churn man to be there with his patented churn, and if you will just let him, he can show you its advantages without any trouble. But he never shows you its disadvantages.

There are two things necessary in a dairy churn. It must be practical, and it must be so simple that it can be thoroughly cleansed. The one-minute churn is not practical. Before purchasing a churn of any kind, ask yourself have you the power to run the churn as the agent has. Do not be deceived in letting him make you believe that any old power will do. And then again, is the churn offered for sale, simple enough in construction that it can be kept clean? The matter of not being able to keep them clean, is the

objection to most patented churns. It is a matter of great importance to the dairyman, for if the churn cannot be kept clean, good, pure butter cannot be made. The more parts a churn has, the harder it is to keep clean. There is the great objection to butter workers and churns combined, and it is a serious objection. See to it that the churn is simple, and that it can be thoroughly cleansed without too much effort. A barrel churn is the best and most practical.

Cream should be churned at a temperature of from 60 to 64 degrees. If the cream be in the proper condition, and churned at the correct temperature, it will not take long to bring the butter. The best butter is produced by churning from 30 to 45 minutes. It might be said that giving the cows salt regularly causes the butter to come quicker than otherwise would be. If considerable cottonseed meal is fed, it is sometimes necessary to churn as high as 70 degrees.

DAIRY THERMOMETER.

No man who wants to be up-to-date in the dairy business is going to be without a dairy thermometer, especially when they can be bought for 25 cents apiece. He simply cannot afford to do so. There is no use in guessing in a matter so important as having the correct temperature in milk, when you can be accurate by having a thermometer.

There are many other dairy utensils that must be kept at the up-to-date dairy. Mention of each one cannot be made. Of course the strainers should be thoroughly up-to-date, and easily cleansed, and above all things, they should be strainers, that is, should get every form of trash out of the milk. And then there are milk bottles, and milk cans, and many other things. Remember that the greatest questions to be asked before any utensil is bought for the dairy is, can it be cleaned? and is it simple?

THE DAIRY BREEDS.

Much depends upon the cow in the dairy. If a cow produces enough milk and butter fat, she will be pretty likely to pay. As to the breeds, a discussion of this question cannot be gone into, for the simple reason that there is no definite way to determine which is the best breed. Some very prominent dairymen like one breed, while other dairymen equally as prominent like another breed. There are four good

breeds, the purchase of one of which will be a good selection. But do not try to cross breeds, for you will make a failure. Purchase the breed that you like, and keep it pure. The Jerseys and Guernseys are remarkable for their richness of milk, and the ease with which it is converted into butter. If you are to run a butter dairy, perhaps one of these breeds will be best suited. The Holstein is a very large animal, and is remarkable for her large milk yield, but she is a low butter fat producer. When she becomes unprofitable for the dairy herd, she fattens well, and makes a good return for beef. The Ayrshire is also noted for her large yield of milk, but like the Holstein, she does not make butter. She does not suit for beef production either. It is safe to say for a butter dairy, use either Jerseys or Guernseys, and for milk producers, that is, where the milk is to be sold direct, use either Holsteins or Ayrshires. As to the appearance of the individual cow, the reader is referred to three stanzas given under the head of "THE COW," in another part of this work. In selecting a cow do not place too much importance on the size of the cow. It is true that breeders and owners of the Holsteins claim a great deal for size, but remember that to be a beef producer is one thing, and milk and butter producers another. Most people, especially those who are not posted on the subject of cows, naturally think the larger a cow, the better dairy cow she is. This rule will not hold good. And you cannot rely on the amount of milk, for you must take into consideration the amount of butter fat that is in the milk. When it comes to milk yield alone, it will be granted that the larger cow, as a rule, gives more quantity than the smaller cow, but they eat more, and the milk is not so rich in butter fat. Prof. T. L. Haecker, who is perhaps the best authority in the United States on profitable cows, in explaining why the small cows produce butter more economically than the large cow, has this to say: "The question is naturally asked, why does the small cow produce more economically than the large one? In the first place cows that give milk containing 3 per cent. butter fat, yield 2.6 pounds of milk solids not fat, to one pound of butter fat, while cows that give 5.5 per cent. butter fat, yield only 1.6 pounds solids not fat, to one of fat. So, for every pound of butter yielded by the cow that gives the lower grade of milk, she has to make an additional pound of solids not fat, and hence it takes more nutriment to produce the one pound butter fat in the thin milk. The large cow also requires three pounds more

nutriment daily for maintaining her body." There are exceptions to this rule, for no definite rule can be laid down. However, these are the facts taken as a whole.

TAKING CARE OF THE MILK ON THE FARM.

Milk when it is drawn from the cow, is practically free from germs. The germs that cause most trouble with milk get in immediately after the milk is drawn from the cow, so the important thing is to keep them out. When the calf takes milk from the cow, he closes his mouth around the teats so that no germs can get in. When man takes the milk from a cow, he takes a very wide bucket, with opportunity for getting many germs in it. You cannot keep sweet milk longer than six hours, if it is exposed to the bad atmosphere very much. It is better to spend five or ten minutes on the cow before beginning to milk. Some people are very careful to see to it that the udder is clean, when the rest of the cow is filthy. Take pains with your milk, especially in drawing it from the cow. If you use pans or crocks to cool it, strain it into these as early as possible, but do not allow these pans or crocks to remain in the kitchen, but remove them to some place where they can cool off as quickly as possible. When milk is set in shallow pans or crocks, it should be skimmed, just as soon as the milk begins to clabber at the bottom. This is a very important matter for as soon as the milk begins to clabber, the cream not only stops rising, but it begins immediately to get stale. In the winter, if the milk is liable to freeze, a blanket thrown over the milk as soon as it is strained, and it will be very apt to keep from freezing.

Tall shotgun cans are better than shallow pans for cooling and permitting cream to rise.

HOW TO START A DAIRY.

Perhaps a few suggestions, for they are only suggestions, upon the important subject of starting a dairy will not be out of place. In the first place, you must learn the trade. Dairy papers, schools, and books will be much help to you, and you should take advantage of all of these, but these are only supplementary to the great schools of experience. If you have never had experience in the actual work itself, you had better stay out of the business until you get that experience. Hire yourself to some first-class dairyman, learn the business, and learn it correctly. Learn everything about the work. Do not merely

watch others do the work, or you will prove a failure as a dairyman. And then there is another advantage in hiring to some dairyman, and that is, you have an opportunity of learning whether you like the business or not. If you do not like such business, of course you will make a failure of it. It is better to work for some one else for a while, to find out as to whether you have the "everlasting-stick-to-it-iveness" to succeed than it is to invest money, and have to sell out for fifty cents on the dollar.

Do not be in a hurry to locate.—You may make a good dairyman, but be in a location in which you cannot dispose of your products. Study the local situation thoroughly before you think of locating anywhere. Get where the people consume butter and milk, and where there is a good demand for it. If you can get between two cities that consume a great deal of butter, then you have the advantage, if you will take both markets. It makes no difference if there is a competition, for it is far better to go into a market where there are a large number of competitors, than it is to go to a place where there is neither a market nor competition. And then you must take into consideration the matter of transportation. It is expensive to keep a horse and wagon, and you will have to watch this matter. If your local market is not good, ship your butter to the cities. The express companies give a special rate upon milk products, and this will be cheaper than getting a horse and wagon. The best trade for good butter is a high-class family trade. Hotels and restaurants, as a rule, do not give the highest price for milk products, for they depend upon getting it in job lots. The grocers do not pay the best price, for they must make a commission. Go right into the fight of selling to the consumers, and take a product that will sell.

THINGS NOT TO DO IN THE DAIRY BUSINESS.

Strange to say that books and dairy papers as a rule do not pay any attention to the "don't's" that make up the dairy business. The don't's are as important as the "do's," and must be attended to, if a first-class dairy is to be kept. Let us look at a few of the "don't's."

In the first place, don't let your "know-all" neighbors, who know practically nothing about the business, convince you that it does not pay. Remember that

the dairy business does pay, when you run it as a business. Like all businesses, it will not pay if allowed to run by itself. The facts in the case are, that it does pay. Just because some man makes a failure at the business, is not a conclusive proof that it does not pay. It will pay if it is backed by a man with plenty of common sense and determination. That there will be difficulties, there is no doubt. That you will have trouble there will be no doubt. But these are sometimes necessary to the best success.

Don't believe that you know it all. Be willing to learn. Remember that there is someone else that know a few thing more about some things than you do. Be willing to learn from anyone, no matter how low in life he may be. The wise man learns from the experience of others, and the men who know it all, do not learn at all. Don't be a know-all.

Don't run after fads. There are some men who take up their business to get up new fads. Be open to conviction, but be convicted before you change your plans or ways of doing things. If you have a cow that pays, and you know she does so, do not get rid of her just because she does not come up to some other man's ideal. The thing you want is results, and be sure that you will get better results before you make a change.

Don't let some one persuade you that it does not pay to feed. Remember that you must feed to get results. Cows cannot give milk unless they are fed. Get your feed as reasonable as possible, and if the cows do not pay for it, dispose of the cows, for it is better to dispose of them than it is to keep them on half feed. If a cow will not pay for her feed, when given all she will eat, she will not pay for it when given one-fourth as much as she wants. You are in the business for money and that is what you want.

Don't let the laughs of anyone keep you from having everything as clean as it is possible for it to be. Remember that dirt causes dairymen to lose customers, and that people like to buy from dairies where everything is kept scrupulously clean.

Don't let the horns grow on cattle. Sentiment says for you to allow the horns to grow out, but common sense says take them off. This can be done easily, especially if you do so before the calf is thirty-six hours old. The calf will suffer practically no pain, and it will cause you a great deal of trouble if you allow them to grow out. Don't neglect to keep books on the cows. You must know which one is paying, and which is not, to carry on a successful dairy business.

A merchant who did not keep books would go under, and so will the dairyman. Know how much each cow pays. If you will do this, you will be surprised at the results.

Don't use any kind of preservatives in your milk and butter. It is far better to be honest, than it is to carry on this kind of practice. Be a man as a dairyman. Preservatives are the resort of the ignorant or the lazy.

Don't fail to raise all the hay you can, and other feeds. Remember that one of the greatest expenses to a dairy is the feed bill. All that you can successfully make on your dairy is that much profit. Start out to raise your feed.

Fig. 32—Showing door of silo. A is the door, b shows how it fits; should open on the inside.

Don't fail to save the manure. You need it on the fields where you propose to raise your feed.

Don't stay at the bottom of the ladder in dairying. Remember that there is a top and a bottom in the dairy business and that it is left entirely with you, as to whether you are on the top or the bottom. Be at the top.

Don't fail to study your business. You need to think and plan in the dairy business as in any other. Be a thinker and a planner. Know your business.

Don't be discouraged. Keep at it.

Don't mix beef and milk blood. If you want to make beef, do so, but don't try to mix these two bloods. You cannot do it successfully. If you have to use scrubs on your dairy farm, do so, but don't mix beef blood and dairy blood together. The beef cow takes the feed and turns it into fat, whereas the thing you want is butter and milk.

Don't abuse your cows, or allow them to be abused. Kindness will work wonders. Remember that when

you use a cow for commercial purposes you are using a mother that is giving milk for the sake of her young, and that this action is not voluntary, and any slight cause may prevent her from giving the very best returns. Remember the more regularly she is handled, the more comfortable she is kept, and the more kindness shown her, the greater will be her flow of milk. There are some very peculiar things about cows. It has been a long disputed question as to whether a cow could of her own accord hold up her milk. This is a theoretical question, for we all know she does so, whether voluntarily or involuntarily. If you take a cow's young calf away from her, or frighten her, or whip her, the milk ceases instantly to flow. If she be chilled or otherwise made uncomfortable, the same results follow. If any of these things happen to a marked degree, the stoppage of the milk is equally as marked. If a man be not blind to his own interest, he will not allow such. A cow thus treated will show it in her milk yield. Do not allow the boys to frighten the cows, for they are not race horses. The cow should look upon the farmer as her friend. Be kind to your cows. Learn to love them. Don't allow them to be abused.

LITTLE THINGS ON THE DAIRY FARM.

A man who cannot observe and take note of little things is already a failure so far as the dairy business is concerned. The little things are the ones that bring success or failure in the dairy business as well as in other business. The young man who is above all these little things cannot succeed. But let us notice some of the little things on the dairy farm.

There is cleanliness. It is not such an item to allow a little dirt or filth to accumulate, but it means the loss of customers. The supposed dairyman who is too high above such things as to give his personal attention to the matter of keeping everything clean, cannot hold customers.

The little cracks in the cow barn let in large amounts of cold wind, and this wind makes the stable uncomfortable. These cracks are but little things, but they call for feed, for the temperature of the cow must be kept up. And they frequently cause the cow to drop off in her milk and butter products. Little mice and rats spoil many dollars worth of feed. Get a lot of cats, and the little mice will seek headquarters somewhere else. To keep these cats at the cow barn, give them a little drink of milk once a day. In

passing through the stable you smell a bad odor. It is a little odor, but it must be attended to. See that there are no holes in the floor, and that the floor is even, for an uneven floor is a very uncomfortable thing for a cow to lie upon. It is not such a great thing to look at the udder of each cow once a day, but it may save you money, in that you discover a small injury, which if allowed to run on, may throw the cow out for six months. But it is a small thing. It is a small thing to watch the new milker to see if he is kind to the cows, and if he knows how to milk. Some milkers have a powerful grip in their hands, and squeeze the teats entirely too hard. This is a small matter, but it is worth looking after.

Britisher No. 145096.

After the milk vessels have been washed, rub your finger along the inside and outside of the vessels. If they are not clean, your fingers will slip along, but if they are clean, they will stick. Do not allow the buttermilk to stand in the churn after it has been churned. Keep the churn clean. Do not allow musty smells to accumulate. Be careful about these little things, and the large ones will take care of themselves.

BY-PRODUCTS.

Milk, butter, and cheese are the main products of the dairy. The products of minor importance are calves, whey, buttermilk, skim-milk, manure, pigs, poultry. In this work a long discussion of these products cannot be entered into. But many farmers allow these products to be wasted. Why men will allow such, when they can be turned into ready cash, is a hard matter to explain. Skim-milk is an excellent food for humans, and its sale should be encouraged by law. One question that has been before the wide-awake dairyman, has been how to supply milk to the trade. Skimmed milk, when allowed to be churned, does not produce buttermilk, and cannot be sold for buttermilk. This is on account of bacteria that work in the

milk on account of the cream. It has been found out that if you take a gallon of buttermilk and churn it with several gallons of skimmed milk, that you will get as good buttermilk as when produced from the cream itself. This is on account of the bacteria that is introduced into the skimmed milk through the real buttermilk itself.

And every dairyman who is alive to his own interest has a drove of hogs around, to help to use up the skimmed milk. Indeed, it is a loss not to have them. And the up-to-date dairyman can raise poultry very profitably, if he will do so, and can do it with practically no expense.

DAIRY NOTES.

Feed at the same time every day. Then the cows will not be worrying about their feed.

If you do not have the stables well ventilated, do not let another day pass until they are ventilated.

Keep the bedding well under the cow's knees. A cow can have very little comfort with her knees bruised on a hard floor.

Only the rich can afford to keep poor cows, and they don't.

It is hard to tell which is the more useful, the man behind with the milk pail, or the man in front with the feed pail.

It does not always pay to try to fatten the old cow. You had better sell her for what she will bring.

It is alright to have books, and be able to figure back, and tell who your cow's great, great grandmother was. But the great question with you is, who is your cow and what is she doing? Is she making you money, and how much?

British Blossom No. 204533.

Always be kind to your cows. Remember what Ward C. White said, "Always speak to a cow as you would to a lady."

Grow your own cows. To do so is cheaper and better, for you can then control the quality of your herd. As the calf is trained, the cow will incline.

SILVER PENCILED WYANDOTTES.

BOOK XV.

POULTRY DEPARTMENT.

Edited and revised by

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. . AND . .

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POULTRY DEPARTMENT.

INTRODUCTORY.

Before taking up the subject of "Poultry Culture," it is deemed advisable to give a brief resume of the industry in this country, to familiarize our readers with the vastness of its importance, so that the business will become fully understood, and the prospec-

the ages of two or three months it is difficult to say, but we are all aware that it is considerable. After making these deductions, we gather that the balance remaining represents quite accurately these fowls that have been kept for breeding and laying. These birds produced for market in one year poultry worth \$136,891,877.00 and eggs worth \$144,286,370.00, a

tive poultry breeder, contemplating taking up this line of work will be fully alive to his responsibilities, and the magnitude of this industry as shown by the last census report.

From the nineteenth annual report of the Bureau of Animal Industry, we gather the following facts: The valuation of fowls on the farms throughout the country in 1900 was estimated at \$85,794,996.00. How much of this amount represents fowls under

total value of \$281,178,247.00, showing that the investment yielded an income of over 400 per cent. What other legitimate business can do this?

If we consider the amount invested and compare results we find that poultry and poultry products easily stand first, and compared with the wool crops it exceeds it in money value by over one hundred and eighty-nine million dollars.

This, of course, is quite contrary to the generally

accepted view that the poultry industry is of little importance when compared with the standard crops and products of the country. When another census shall have been taken, we predict that this industry will eclipse most of the industries now ranking with it, for with improved breeds now finding their way from every farm from Maine to California it is the aggregate of the millions of small flocks which gives this business its economic importance.

The beginner who starts with poultry should have in mind that upon his foundation stock will depend his success or failure, and too much stress cannot be laid upon the importance of starting right. This refers as much to the selection of incubators, brooders, houses, etc., and the management and handling of the stock as to anything else. It does not require a learned man, in the general acceptance of the term, to run

every other business, it takes push and hustle to make anything out of it. We do not mean to say, when we say that the poultry business is a paying business, that you can make money at it without work and attention, for it is not true. A great many men have lost money at the poultry business, but this was because of non-attention, or lack of judgment on their part. Many farmers would find it profitable to raise poultry as a side line. There is a lot of food that goes to waste if there are no chickens to use it. This grain and other matter that goes to waste can be turned into profit by raising poultry. The great trouble with most farmers is in not giving their chickens enough attention and thought. Eggs sell at a good price all the year, and a part of the season they sell at very high prices. Chickens are the same. But if you decide to enter the poultry business, do not go into it on too large

Fig. 2.—Laying House with separate scratching pen attachment. A good house for the South.

a poultry plant, for we have seen men who made their reputations in the learned professions fail absolutely as poultry farmers. It does require an industrious one, however, and one who will look after every little detail.

There is no more paying business taken from a financial point of view than the poultry business. This is especially true in the South, and many farmers would find it far more profitable to raise poultry than to raise cotton. The poultry business is like

a scale. Experience can be had with a few fowls, and this experience will be worth no little to you. Start off on a small scale, and let the increase in your business graduate itself as you become capable of taking care of it. A business that does not pay expenses and a little besides is not a paying business. If you cannot make ten hens pay expenses it will be quite difficult for you to make a hundred hens do so. If you can make money out of a dozen hens, increase the number to two dozen and see what the results will be. There are several questions of vital interest

to the poultry raiser that we desire to give attention to.

LOCATION.

The location of the poultry farm is of some importance. It is better to get near a town when possible, or a city, for then your products can be put on the market in a fresh condition. You will want to be close to a railroad or steamboat landing. It will require grain for poultry, and it is a good deal of trouble to haul it over many miles of rough road. If you can produce a part or all of this food so much the better. It is not so important that you be near a city if transportation is good, as the additional expense in the value of lands near to a city will more than offset any advantages you may secure through it. Some people have the idea that any worn-out land is suitable for a poultry farm, but this is not true. In the first place it is the by-products that show the profit. The manure of poultry is quite important. With land that is untillable, this by-product cannot be used to an advantage. Select rolling, well drained land, sandy preferred, and you will be a long way towards success.

HOUSES.

The question of the house for chickens is quite important. But this questions is not so important here in the South as it is in the North. In fact, the house depends altogether upon the purpose in view and to what extent you are going into the poultry business. If you have only a few chickens on the farm, you will want a small house for them, especially to protect them from the winter rains. If you are going into the business on a more extensive scale you will want more extensive quarters for your chickens. Outside of the house should be a shed under which you can feed them, especially in bad weather. It is never advisable to feed them in the house. A puddled clay floor one-half foot higher than the ground outside, makes a very satisfactory and cheap floor for the hen house. The roosts should all be of the same height so that there will be no crowding by the fowls for the highest places. They should not be over two and a half feet from the ground. Have boxes one-half foot square on low shelves for nests and dust frequently with wood ashes to prevent insects. Always have clean straw in them. Pine straw is very

good where obtainable. Do not neglect to burn nests so soon as setting hens come off. Although more difficult to build, those who can will find those nests which project on the outside of the poultry house, with openings for hen on inside and hinged, and sloping lid cover on outside for the eggs to be gathered from and setting hens attended to, decidedly more satisfactory. These nests should be two feet above the floor and with running board in front of nests for hens to walk on. Always have enough nests to prevent crowding, or annoying setting hens. White-

Fig. 3.—Colony House, Chickadotte Farm, Rural Hall, N. C.

wash house and nests every month during summer, and do not allow fertilizer to accumulate if you do not desire insects and disease.

Many practical poultry raisers use loose nest boxes, (soap boxes,) as they are so easily removed from the house for cleaning and to be burned out inside, thus ridding them of lice and their eggs.

A house ten by fourteen feet should accommodate 30 chickens. In some sections, the houses have windows, but this is not necessary here in the middle South. Perhaps best results can be had by dividing the house into two parts, one for roosting, the other for feeding and scratching shed in the day time. If it can be so located as to front the South, have the lower two-thirds of the front covered only with wire netting. This gives sunlight and air. Balance of the house boarded tight, with roof sloped toward the north. The roosting side might be closed all around, but for most of the southern sections we say not.

The selection of a dry location, sheltered as much as possible from prevailing winds is one of the essen-

tials of an ideal house. If the soil is not naturally dry, good drainage should be the first consideration. Wet and damp soils are unsuited to successful poultry culture, and becomes a breeding place for disease germs, and is withal a most fruitful source of roup, one of the most destructive of poultry diseases. A high elevation is often warmer and more suitable for poultry than low ground, where the air is likely to be damp and cold. If the houses face the east or south they will have more sunlight and in consequence give greater comfort and cheerfulness in winter than they would through any other exposure.

for the fowls in these 16 houses, provided that the rounds were made six times a day, three times to feed; once to water, once to clean and once to gather eggs, besides in inclement weather the poultryman would be exposed when forced to go from house to house. All these matters deserve serious consideration.

Then too, separate houses entail greater expense, both in cost of erection and material necessary to their construction. One end of each house is saved by bringing the ends together, and this applies as well to yard fences. Every time a division fence is

Fig. 4.—Style of house-used at the West Virginia Experiment Station.

The form and location of poultry houses have much to do with their convenience, and steps may be saved by studying the form and location of the building. Time is money and a poultry plant should be built with a view to saving steps. If the colony house plan of keeping poultry, in which each flock has its own little house and yard, a great deal of time is spent in going from house to house. If a plat of ground 300 feet square and containing slightly more than two acres is divided into 16 square runs, and a house located in the center of each, then a man would be obliged to walk nearly 550 miles in a year to care

taken out, each flock has twice as much liberty as before. Fences increase labor. The labor of cultivating small yards is much greater than it would be if all were in one field. Large flocks can pasture in the same field. Hens know enough to return to their own roost. The biggest bump on a hen's head is her "bump of location."

The yards as a rule should be long and narrow, and double yards are desirable, allowing one to rotate crops, which practically converts the filth, which would otherwise become a source of danger, into a valuable food crop. Long and narrow yards fa-

cilitate cultivation. Making them 35 feet wide and 150 feet long would readily accommodate fifty hens, although the more room the better. Planting a row of fruit trees through the center of these yards will produce shade and give a fine yield of luscious fruit.

Now, in building houses we must remember the nearer square a house is, other things being equal, the less lumber it will require. It is twenty feet further around a house ten feet wide and forty-five feet long, than it is around a house fifteen feet wide and 30 feet long, although both houses have the same floor space.

expense of building a shed roof house as compared with the gable or combination roof house. Shingle roofs should generally be one-third pitch. Most of the roofing fabrics last longer on rather flat roofs as chickens have less tendency to creep down the roof and thus tear loose from the nails. Usually a slope of one foot in eight or ten feet will be sufficient. In sections where much snow falls, flat roofs must be substantially built to withstand the heavy burdens of snow which they may have to carry.

Each form of roof has its advantages and disadvantages. The single span roof is the easiest to build.

Fig. 5.—A good poultry house for the South. Open front at top admitting sufficient ventilation at all seasons, and can be closed during bad weather.

The shape of the roof affects the value of a poultry house. It takes the same amount of material to build a gable roof, a one pitch roof, or a combination roof, if the pitch of the roof and the ground plan are similar. If we assume that the window is six feet high in a building fifteen feet wide it would be necessary to have both sides of the house the same height, which makes more interior air space than is necessary and requires the rear wall one and a half feet higher than would be needed with a one-pitch or combination roof. A one slope roof will cost the extra lumber to build three feet higher in front than is required by the combination house.

The steeper the pitch the greater the comparative

It gives the highest vertical front exposed to the sun's rays which are reflected back, drying the ground and making a warm shelter. It throws all the rain water to the rear, lessening the length of the eave troughs one-half, and keeping the front of the house dry where no eave troughs are used. A tarred paper roof will last many years longer if not exposed to the vertical rays of the sun. The gable roof provides for a larger garret space, which can be utilized in storing away odds and ends.

Sunlight is a necessity, carries good cheer and tends to arrest and prevent disease. Too much glass makes a house too cold at night and too warm during the day, besides increases the cost of construc-

tion. Allow one square foot glass surface to sixteen square feet of floor surface, if windows are properly placed. The windows should be high and placed up and down rather than horizontally and low. In the former the sunlight passes over the entire floor during the day from west to east drying and purifying practically the whole interior. The time when sunshine is most needed is when the sun is lowest, that is, from September 21st to March 21st. Window sash with small glass seriously obstruct the light. Very large lights break too easy, and are too expensive. 8 x 10 is a good size glass to be used in a twelve light sash, making it about 3 ft. 9 in. high by 2 ft. 5 in. wide. Use two of these in a house that is about fifteen feet square. Single sash are usually

ed to touch the sides of the house. If they do the wall must be kept tight and vermin proof. Roosts should be placed in the warmest places out of drafts on same level, allowing from six to twelve inches for each fowl, according to the breed. The form of perch most desirable is a 2x4 set edgewise and the narrow edge rounded. Under the perches should be a platform for the droppings, far enough below to permit cleaning without removing the perches.

As hens prefer darkened nests they should be so arranged to exclude the light, which will tend to please them, and to mitigate the egg-eating habit. Under the dropping boards will make a good place for them, raised from the ground and so placed that the eggs can be gathered without much trouble.

Fig. 6.—A modern breeding house. Owned by the Cherry Grove Poultry Yards, Knoxville, Tenn.

less expensive than double sash of the same size and the cost for window frames is less. Single sash may swing from the side or top, or be made to shove to one side and are against the wall where least likely to be broken. With double sash this is more difficult. Whitewashing the inside of the house makes it as much lighter as an extra window.

Interior Arrangement.—While considering construction of houses, we should at the same time consider the interior arrangements, such as roosting places, nest boxes, dropping boards, etc. Movable fixtures facilitate in cleaning the house. For the most part they should be portable to facilitate in fighting mites. Generally they should not be allow-

Short cut straw makes a good nesting material, for if moss, long straw, etc., are used the fowls in scratching about preliminary to her laying operation is apt to throw out any eggs already in the nest, and tangle her feet in it and cause trouble.

As the open-front house is advised in our Southern States, a good provision against extra cold or disagreeable weather is to have a curtain of any close material which can be let down at will. If the curtain is oiled with hot linseed oil it becomes practically water proof, as well as wind proof, forming a good barrier against wind and cold, and aiding in making the open front house one much to be desired in the South.

COOPS.

The question of coops is one of importance. And yet this question is not so important here as in the North, for here the greater part of the year coops are not needed at all. But the successful poultry raiser will use coops in caring for little chicks. There are

Fig. 7.—Poultry house without scratching shed and with glass front.

many methods or plans for building coops. There are two or three things which a person must bear in mind in making a chicken coop, one of which is that it must be constructed so as to be dry and at the same time admit of plenty of sunlight, and a plenty of fresh air. If you can get a coop up that meets these requirements, that is just what is wanted. We present here direction for two kinds of coops. There are others just as good. Take a grocery box and nail three or four half hoops over the top. Over them stretch cotton cloth and secure the ends and edges. The air will now gently pass through the coop all night, though the slatted front be closed. Hinge the front in order to provide shade for the hens and chicks. The second plan is as follows: take frame like the gable roof. Slats for sides are to be made of boards five inches wide and one-half inch thick. Nail on a slant like half turned shutters in a window blind. To do this start at the bottom and nail up shingling fashion. To make coop absolutely rain proof, nail one board upon about one inch of the other. When you make a coop in this way the door is the only means of ingress and egress.

Far more important than the coop is the number of chicks in the coop. More harm is caused by crowd-

ing than any one thing. Have more coops and fewer chicks is the advice that can always be profitably followed. The older they get the more room they need, so look forward to that in planning your coop.

WATER FOR CHICKENS.

Perhaps there is more trouble in raising chickens on account of impure water than from any other cause. And nowhere is there more trouble than on the farm, where chicken raising is not made a specialty. Many farmers have an iron trough or cooking vessel, and they fill that when it is empty, usually about twice a week. The water is so hot that the chickens cannot drink it over one-half the day during the summer, and in the winter it frequently stays frozen over all the day. It never occurs to these people that chickens like fresh cool water. And still these same people complain of "hard luck" when their chickens all die. There is no excuse for the poultry not having plenty of fresh water. If you will take an ordinary jar or jug made of earthenware and fill it full of water bottom-side upwards in a plate or sau-

Fig. 8.—Colony House.

cer, it will make a splendid drinking fountain. The water will run down in the fountain as it is used out. This fount should be kept in shade in the summer, and should be filled with fresh water every day. In winter a good supply of warm water once a day will be greedily swallowed by the hens and go a long way towards inducing them to lay.

INCUBATORS AND BROODERS.

Nearly every successful poultryman now uses in-

cubators. As to how long artificial breeding has been practiced, we are unable to tell. In Egypt ovens were used. It is not claimed that incubators will hatch every fertile egg, and neither will the hen. It is claimed, however, that the incubator will hatch as many eggs in warm weather as the hen, and more in cold weather. The brooder takes care of the little chicks better than the hen, for the brooder does not drag them through the dew and dirt and neither does the brooder cover the little chicks with lice. One reason why the incubator and brooder have not been used more, is that the operator has not understood how to operate them. They have had the opinion that the incubator could be operated without attention, and as a result have failed.

Fig. 9.—A new all metal incubator, a style that is coming into use in the South.

ed. For a long time the farmers were afraid of them, and thought that they were for the fancy poultrymen, but they are fast dropping this idea and taking up with the machine that will make them dollars where they made pennies before. There are many advantages to be gained by the use of the incubator, so if you desire to be up-to-date you had better use one. As to which make is best we cannot say. There are a great many good makes on the market as well as any number of worthless ones. With the incubator you can have chicks at any time that you can get the eggs. You do not have to wait until the notion strikes the hen to set. In other words, you are independent of the notions of hens. By the use of the incubator you can have spring chickens the year

round. It is claimed by some that breeding chickens should not be hatched by the incubator, as their system is not so strong as when hatched by "Mother Hen." This theory is without foundation, and the contrary has been proven time and again. If you are raising for the market broilers, fryers, etc., it would be well to use the incubator altogether. However, you do not know all about incubators, and it will pay you to get one of the medium sized machines, rather than one of the largest ones. There are several advantages to be gained in purchasing a small incubator, for in experimental work if you lose a hatch, your loss is less than if you had run a large machine. It is true that the advertiser claims that they are so simple that a child can operate them, but when it comes to a test a child cannot operate them. It is more than some grown people can do. And even if you wanted to operate on a large scale, you could get two or three medium sized machines in preference to one large one. There are several advantages in having three or four machines over having just one large machine. One advantage is that you can use a different machine for different kinds of eggs. For instance, suppose you want a capacity of three hundred eggs. You could purchase three incubators of 100 eggs each. You can use hen, duck and turkey eggs, using a separate machine for each. Having three machines, you can fill one and start it, while you are getting eggs for the next one, and so on. It takes different amounts of moisture for different eggs, and you must learn this. If you make a mistake you will come nearer discovering it when using a few small machines than when using just one large one. After you have received your incubator, you should study it. Nine out of ten who use standard and up-to-date makes of machines are successful with them and would not part with them and go back to the hens for anything. A good machine with care and common sense methods will bring success. Remember that it takes time to learn and that you must do a little experimenting with your machine. Mr. J. A. Hunt, a very successful user of the incubator, says:

"When you receive your machine and get it set up and in running order, take a whole day if necessary to study it in its various parts. The regulating apparatus should receive particular attention; do not be satisfied in knowing that it does the work, but find out how it does it. Familiarize yourself with every part, as it may be useful knowledge to you in

future operations, for should your regulator through any accident or without accident fail to work, you will be able to discover the difficulty and remedy it without delay."

September marks the beginning of activity in poultry matters in the South, so we propose to give herewith a few hints that will be found useful by those who will take up the work for the first time, as well as those who for various reasons have been unsuccessful in previous attempts.

Cheapness in an incubator should offer no inducement for a beginner, nor for that matter, to any one else. The experienced breeders, the men who have

so in the hands of careless ones. Some are better suited to certain localities than others, although the modern up-to-date machine is guaranteed to excel in any climate, under any conditions. There are machines operated in the South that do away entirely with the moisture question, because the system of ventilation is so nearly perfect that the hatchlings will average as well as under hens, under same conditions. Others again require supplied moisture, or at least do better with it, and so it goes throughout the list. Every manufacturer claims to have the best machine, and so the beginner stands in a maze of conflicting claims of superiority, unable to decide

Fig. 10.—A Modern Incubator House.

long since passed the experimental stage, steer clear of such and buy the best. By the best we do not mean a machine in a mahogany case, for while there are such on the market, they represent nothing new in modern incubator construction, except in useless ornamentation, which appeals only to the "extravagant rich." The same machine in a pine case will give you equally good results, so when we say buy the best, we do not want to confuse the reader into believing that the best is represented by the costliest machine. What we desire to emphasize is the fact that a machine considerably below the market price of a standard make of an incubator is doubtless also below them in the hatching possibilities.

Nearly all the standard makes give good results in the hands of careful, observing operators; none do

for himself. If a manufacturer has the confidence in his machine that he claims he has, he will send you the same on trial. You can deposit the money with your postmaster, express agent or merchant, with the distinct understanding that if the machine fails to meet your expectations, you can return it, and your receipt from the railroad showing its return shall be authority on which you can secure your money from whoever you deposited it with.

Don't sign any paper obligating yourselves to go beyond this. Some concerns make sales by forcing their goods on unwilling people, and once they get your money, you have considerable trouble in getting it back.

Taking it for granted now, that your machine has

arrived and been set up, you will have to run it a day at least, may be longer, to get the heat under control. In starting it up, we would run the ventilator wide open for a few hours. When you have adjusted your regulator according to the instructions coming with your machine, and it maintains an even temperature of 102 or 103 degrees, you are ready to place your eggs in it. We will suppose that you have provided eggs that are from strong, healthy stock, and that will show good fertility, that they are as near one color and uniform size as possible, for the eggs of Brahmas, Cochins and other heavy breeds never do well when incubated with eggs from Leghorns, etc. The best results from eggs as nearly as possible of the same kind. The Asiatics are always later in hatching, and being thick shelled, require more ventilation to dry them down, or, secure the proper air-space, hence, if two lots of eggs of Brahmas and Leghorns are incubated at the same time, if you provide the correct ventilation for the former it will be to the detriment of the latter, so that point is easily explained, and even the novice will grasp the idea.

After the eggs are placed in the machine, the temperature will drop considerably, and it will take several hours before it will be back to where you started it. If your regulation has been correct, however, you will see it come back to 103 degrees and stay there. We will assume that you are operating your machine in a living-room, (seventy-five per cent. of them are), and you should see to it that there is no direct draft on the lamp, as it will cause it to smoke, and also cause the machine to become unevenly heated. After second day, you should begin to turn the eggs at a regular hour morning and night, also cooling once a day, preferably in the morning, and filling lamp too. If the filling of the lamp is done at night, you are not in a position to watch the temperature, and if you have given too much lamp light, the regulator may not be able to take care of the surplus heat, and you endanger your hatch. For this reason we prefer cooling and filling lamps every morning. When there are very marked changes in the weather, a little care should be exercised to see that a little more lamp flame is given if weather turns considerably colder, and a little less, if the reverse. You will soon get the hang of the thing and then you will wonder how you ever got so nervous and scared, and why you looked at the thermometer every 2-4 minutes. Looking at the thermometer will not

hurt, if you will quit working with the regulator, for if you start the thing right, the regulator will within reason take care of any little inside changes. Don't get frightened if it runs up a little, just turn down lamp flame a little, but let the regulator alone. If there is any adjusting to be done it should be before the eggs go in, and after that you can do the greater part of balance by controlling lamp flame.

On the seventh day you will be ready to test the eggs. If you have a good tester before a strong light, you will be able to tell fertile eggs by examining closely. It is better for you to start with thin-shelled, light eggs, as they show better the germ in the egg, which will look like a spider with little blood veins for legs. You will see it move, contract and expand, and after that it will be easy for you to pick out the strong fertile eggs, but in case of thick-shelled eggs and others, you will find it more difficult. Whenever in doubt, take a saucer and break the egg and you will soon learn. You may lose a few chicks by this process, but it is the best of all teachers.

It is generally conceded that the first week of incubation is the most critical, and we advise a careful following of the instructions going with the machine. No writer can advise you along this line, as there are certain directions which must be observed, peculiar to each incubator. If your eggs are good and strong, and your hatch a good one, you may continue the same way for the next hatch, but if the reverse, you should immediately write your incubator manufacturers, giving details, and they will doubtless set you straight. They cannot afford to have a displeased customer, and should be more than willing to help you out.

About moisture, if a no-moisture machine, follow instructions and take off hatch without supplying any, but if you find the weather exceedingly dry, it might be well to place a tub under the machine or about the room in which incubator stands. Don't sprinkle the eggs. On the seventeenth day all eggs with a hatchable chance will appear perfectly dark, except the air space. Those which are not are worthless. If the air space is too small, your ventilators must be opened wider; if too large, they must be closed some. Your operating instructions will give you correct size that air spaces should be at certain stages.

When the eighteenth day comes around, some of the eggs will probably commence pipping. Don't open machine after this until the hatch is over, not

even to help out a struggling chick. If you do, you endanger the balance of the hatch, and a chicken that can't help itself out will never amount to anything. Keep them in the machine for twenty-four hours, throwing ventilators wide open after hatch is over. Don't forget to clean out incubator thoroughly after each hatch, nor get excited if the heat runs up to 105 degrees when hatching. This is all right. All eggs that are not hatched by the twenty-first day are usually worthless.

Ventilation in Incubators.—It is the popular idea that ventilation evaporates the moisture from eggs during incubation, and so it does, to a limited extent, but the main cause is the pressure in the egg due to the growth of the chick and the shrinkage of the shell. Eggs, during incubation, get rid of the excess moisture more on account of the pressure within than on account of the ventilation. At least the ventilation can only carry off the poisonous gases.

As proof that pressure forces the moisture out of fertile eggs during incubation, we point to the infertile eggs in the same machine. Infertile eggs only perceptibly shrink in size and weight. If ventilation controlled the evaporation, then there should not be so much difference between fertile and infertile eggs under the same conditions.

I have been operating incubators for a long while, I feel sure that I can voice the opinion of nearly every operator of incubators, that getting the air cell too large is more imaginary than real. We all read about it, but few have seen it. The lack of sufficient ventilation fails to carry off the gases arising from the eggs, and the natural conditions and actions of the egg are interfered with; the chick fails to develop naturally, hence wet, weak chicks, with an unripe appearance.

It is very evident to any one who thinks (beyond what they read of) that moisture and ventilation are so mixed up that the influence of one is taken for the other. Excessive applied moisture has exactly the same effect as the lack of ventilation; it makes the air too heavy, it's the same with poor ventilation. This heavy mucky conditions of the air blocks the expelled or evaporated moisture from the egg. Another proof of the pressure within the eggs during incubation is the enlargement of the air cell as the incubation progresses.

I dispute that the air cell is for the purpose of furnishing air to the chick except just before it pips the

shell. The division between the air cell and balance of egg is air and moisture tight; if it were not tight, it would fill with moisture; the chick could not possibly use the air, even its movements and different positions would dispute the theory. Just before the chick pips the shell it usually breaks through to the air cell, but not always. I contend that the first real breathing of the chick is after it pips the shell, and from the time it pips the shell until it makes further effort it is accustoming itself to real air.

The air cell has a purpose, it helps form a pressure in the other end of the egg; it has still another purpose, it holds the contents of the egg intact; it makes a back stop and makes it possible for the chick to brace for action. If it were not for the air cell the contents of the egg would float.

Ventilation is just as important as the temperature in incubation. Ventilation does the same work in incubators as in other things. Doctors draw a line on draughts of air, but make no attempt to exclude or curtail it, and why should we in ventilating incubators?

As stated, such a thing as air cells becoming too large is more imaginary than real. We read of the

Fig. 11.—New style of brooder with outside runs for chickens. In much use throughout the South.

cautions, but the real thing is rarely in evidence. Fertile eggs, during incubation, get rid of the excess moisture through pressure more than through ventilation. In incubators, like in houses we live in, the question of ventilation is settled when we correctly draw a line between plenty of air and draughts of air. This is such a simple and well-known problem that it hardly needs mentioning. The theories about carbon, oxygen and other component parts of air serve to muddle more than to explain, and insomuch as these things are rarely mentioned in connection with air for ourselves, we cannot see the great need of using up space on the question in connection with incubators, except perhaps in some cases wherein the lamp might burn the air before it enters the egg chamber.

BROODER.

The one great difficulty with the use of the incubator was the taking care of the chicks after they were hatched. But this is now done by the brooder. The question of the brooder is one of importance. And very little is known of brooders either. The great trouble is that most poultrymen place the importance on the incubator, while they consider the brooder of secondary importance. Some one has said that it is easier to hatch healthy chicks in an incubator than to keep them healthy afterwards in a brooder. It is often the case that the beginner studies with diligence the use and work of the hatcher, while he never really considers the brooder at all. As a result his chicks are hatched out all right but they die after a few days' confinement in the brooder. There are many good brooders on the market, and most of them are good. While the brooder is not intricate or as hard to understand as the incubator, yet it is very essential that its construction should be on right lines. There are many things to be considered. How to avoid crowding, over-heating, getting too cool and chilling the chicks, either of which (too much heat or too little) will cause losses at the expiration of three or four days' time. It seems advisable to purchase a first-class brooder until you become thoroughly familiar with the methods, then if you wish to attempt to make your own well and good. The price of first-class makes would not warrant anyone in building his own machine, however.

By brooding is meant the care and nurture of little chicks. The subject of brooding may be discussed under two natural divisions, brooding by hens and brooding by artificial means.

BROODING BY MEANS OF HENS.

This is the natural way of raising chicks and when only a small flock is kept it is undoubtedly the best method to follow. The hen should be kept free from lice by the use of insect powder or other means, and it is usually a good plan to confine her for a few days until the chicks become strong enough to follow her readily. The coop for this purpose should be dry and clean, and the slats across one end should be far enough apart to allow the chicks to run in and out at will. In a few days the hen also may be allowed to run at large. If she remains unmolested by vermin at night she usually will return each evening to her own coop, which can then be closed to be opened

again the next morning after the dew has dried off the grass.

BROODING BY ARTIFICIAL MEANS.

As it is not an easy matter, especially for a beginner, to raise chicks successfully by artificial means, it is worth while to consider how an ideal hen cares for her chicks until they are weaned. In the first place, the hen remains on the nest until after the last chick has hatched, dried off, and gained strength to follow her. By this time the chicks which hatched first may be a day or so old. If the weather is warm enough the hen then wanders a short distance from the nest calling the chicks to her by chuckling, and attempts to find something for them to eat. Scratching in the earth, she now and then finds a tiny bug or worm and calling her brood to her with eager clucks she indicates with her beak the tempting morsel. If the hen is allowed to raise her brood in her own way, the chicks are on the move from morning until night, wandering a few feet away while searching for tidbits on their own account, and now running with all their might when their mother announces the discovery of a choice morsel, which if too large is broken into suitable pieces for them. If at any time the chickens become too cold and send forth their plaintive peep, then the hen answers with her motherly cluck, and the little ones run under her protecting feathers, become thoroughly warm in a few minutes, and then are ready to run away again on another foraging expedition. In other words, a chicken raised under normal and hence natural conditions is busy from morning until night searching for food which is eaten in small quantities at a time, and only when night comes is the craw full, and chick's hunger fully appeased. Not only is the food eaten slowly, but it consists of a large variety of materials, bugs and worms, the tender tips of sprouting grain, the grain itself more or less softened by its exposure to the moisture of the soil and now and then a little piece of gravel and a sip of water. Grit, green food, grain, animal matter and pure water with plenty of exercise during the day and a sufficient degree of warmth during the night are the main requisites for successful brooding.

Taking off the Hatch.—If the incubator has been handled properly, the temperature of the egg chamber will be about 95 degrees when the chicks are ready

to be removed. If the weather is cold, and it is necessary to transfer them some distance to the brooder house or to the brooders, a warm cloth-lined box should be used and the little fellows tucked up snugly, as they are very tender. A few minutes' exposure at this time may chill them sufficiently to cause inflammation of the lungs, which may destroy half or more of them in ten days. In fact, during the first two weeks of a chick's life it is of very first importance to keep the temperature just right. If the temperature of the brooder is too high or too low the results will be unsatisfactory even though all the other conditions are ideal.

Fig. 13.—The S. D. McMillan Brooder. This brooder is extensively used throughout the South.

The Proper Hover Temperature.—When the chicks are placed under the hover the temperature should be between 95 and 100 degrees. The temperature should not be allowed to fall below 95 degrees during the first week, and not below 90 degrees during the second week. From this time on the hover temperature can be lowered more rapidly, depending somewhat on the outside temperature. At no time should the chicks be uncomfortable, either on account of cold or too much heat. If they are too cold they huddle together, those inside the bunch become too warm, and pass to the outside, there becoming too cold again. Under these conditions the chicks catch cold, and soon die. On the other hand, if the hover temperature is too high, the chicks will be forced outside, where it is too cold for them. If the temperature is high enough they will not bunch together when lying down, but will scatter promiscuously over the hover floor, and a day or two later many will be found with their heads projecting from under the hover fringe. For the first few days they must be kept very

close to the hover, for if they get a short distance away, they will bunch together to get warm, instead of running under the hover. Under these circumstances, the attendant must assume to a certain extent the duties and responsibilities of the mother hen.

FEEDING.

A chick just hatched out has quite a large supply of food stored up for it in the unabsorbed contents of the yolk sac, and as a consequence feeding may be delayed for a while. Practice differs somewhat regarding the age of the chick when it should receive its first meal, but most breeders delay feeding until the chick is at least 48 hours old. By this time, the reserve material is about used up, and the digestive system has been materially strengthened.

What to Feed.—What is fed during the first few days is of less importance than how it is fed, and how much is fed. A chick when in a brooder or brooder house takes far less exercise than when following a hen, and if fed too liberally becomes sluggish and sleepy and digestive troubles soon carry it off. A brooder chick should be induced to take as much exercise as possible, and this can be accomplished but by feeding dry food scattered in short litter. Cracked wheat, corn cracked in pieces as large as one-half of a wheat grain, granulated oat meal and a small amount of millet seed will answer the purpose, admirably for the first few days. It is surprising to see how quick they learn to scratch for their grain. Hay and straw cut into inch lengths make a good litter for this purpose. Care should be exercised, however, that the material cut up for this purpose does not contain sharp beards which are apt to get in the chickens' eyes, and thus cause trouble. Ripe clover heads are especially to be avoided.

Fine chick grit should be scattered on the floor of the broods, so that they will take some grit with their first meal. Pure water should be supplied from the start, and the drinking dishes should be cleaned frequently, as they become foul in a short time.

After the chicks are a few days old a small amount of ground fresh meat and bone or beef scraps should be fed and some tender green food supplied to them. Lettuce is excellent for this purpose, but frequently cannot be secured, when recourse must be had to cabbage or the beets, the latter which may be slicked and tacked up, so that the chicks can just reach it.

I have had very good success raising chicks according to the method outlined above. While different breeders use different methods to mine, no one will fail if they follow the plan above outlined. The beginner must always remember, however, that in order to raise chickens successfully by artificial means,

Fig. 12.—McMillan's Brooders with runs for exercising the little chicks.

several things must be done just right; the chicks must be fed properly; the temperature at which they are kept must be suitable; they must be in a healthy condition when hatched; and finally the parent stock must have been vigorous and thrifty. Just as the strength of a chain depends upon its weakest length, so does the success in raising chickens depend upon that factor which is relatively the weakest.

If a considerable number of chickens are to be raised, a brooder house equipped with a hot water heater is a practical necessity. In my experience outdoor brooders cannot be used to the best advantage early in the season, when the weather is variable. Later, when the nights become warmer, and less artificial heat is required, they may be used out of doors successfully. The individual brooder whether in-door or out-door, is expensive to operate, both in respect to material and labor. The oil which must be used in the brooder lamps cost relatively much more than the coal which is used in the heater in the brooder house, and a large amount of labor is required to clean, fill and light the brooder lamps and care for the individual brooders properly. In the case of indoor brooders, there is in addition, a considerable risk from fire, which may not only destroy the brooders and their contents, but also the building in which

they are located. On the other hand, the relatively large first cost for a special brooder house prevents its adoption by a majority of people who keep fowls. Therefore, it is of importance to discuss the best way of handling individual brooders.

Location of Brooders.—Outdoor brooders should be located so as to shelter as much as possible from the prevailing winds, for in such a place a more equitable temperature can be maintained, and when the chicks begin to run on the ground they will be more comfortable in a sheltered location. An eastern or southern exposure is best, and on the east and north there should be a windbreak of some sort, either the farm buildings, a hedge or a tight board fence. The brooders should be located near the farm buildings so that the chicks can be cared for conveniently. Before placing the chicks in the brooder, the floor may be covered with sand or chaff. These are used to add to the comfort of the chicks and to facilitate the daily cleaning of the brooders. The brooders should be warm and thoroughly dry, especially if the chickens are placed in them directly from the incubator. For the first few days it will be necessary to confine the chicks to the brooder until they become accustomed to their surroundings and learn where to go

Fig. 14.—An out-door brooder, with solid top cover, much preferred to glass top brooders, formerly used.

when cold. Particular care should be taken at night to see that they are not huddled together in the outer compartment. If they have done so, they must be placed under the hover. Before allowing the chicks to run out of the brooder onto the ground, it is usually best to build a yard containing 25 to 50 square feet for them to run in for the first week or so. The yard prevents them from getting lost when small, and is also a great help when thunderstorms come up and it is necessary to get the chicks quickly under the shel-

ter. As soon as the chickens begin to roost on top of the brooders, they may be removed to colony houses, and the sexes separated.

DISEASES OF THE BROODER CHICKS.

J. A. P. WOLF.

Although the diseases of poultry will be discussed under a separate head, it seems wise here to consider the diseases of brooder chicks, for the reason that these diseases are usually due to mistakes made either in handling the parent stock, in hatching or in brooding. When the brooder chicks begin to die and the cause of the death can be discovered, then the operator can usually remedy the trouble without much difficulty, while on the other hand, if the source of trouble cannot be located, the beginner usually gives up the poultry business in disgust.

NON-ABSORPTION OF THE CONTENTS OF THE YOLK SAC.

Symptoms.—For the first three or four days the chickens may apparently be vigorous and hearty. Soon, however, many of them become drowsy during the day, and stand nodding. Bowel trouble sets in. Deaths occur most rapidly when the chicks are from six to ten days old. If the abdominal cavity of a chick be opened at this time, the yolk sac will be found to contain a large amount of semi-fluid substance which, not having been absorbed and digested, has suffered a putractive change, thus causing the death of the chick. Sometimes a chick may not die from this cause until it is two or three weeks old. In these cases the contents of the yolk sac is of a yellowish cheesy nature.

Causes.—It is quite probable that the non-absorption of the contents of the yolk sac may be brought about in more than one way. If the eggs have been laid by hens which are so fat and sluggish that the germs are weak; if the eggs have been subject to a variable temperature during incubation; if there has not been a sufficient amount of oxygen during the hatch; or if the chickens are fed too soon or too much, then they will be more liable to die from this

disorder. There is no remedy so far as we are aware. Preventative measures alone are of value.

BOWEL TROUBLE.

Symptoms.—The droppings of the chicks instead of being of a proper consistency, are soft and sticky, and frequently collect in masses about the vent. The chicks become drowsy and have a tendency to seek the heat under the hover.

Causes.—The non-absorption of the contents of the yolk sac frequently causes this trouble. It may be caused, however, by improper food or by a slight cold which settles in the bowels instead of in the lungs. There is no remedy if it be caused from non-absorption of the yolk sac. If caused by improper food, or a cold, the remedy is evident.

INFLAMMATION OF THE LUNGS.

If the temperature in the brooder or brooder house is too variable one-half or more of the chicks may die of this trouble.

Symptoms.—The chicks become drowsy and seem to require a high hover temperature. In severe cases, the chickens may even gasp for breath, appearing as though affected with gapes. If the lungs be examined in the first stage of the disease, one or more may be congested and of a darker color than usual. Later little tubercles of a lightish color may be found scattered through the tissue. Whether these tubercles contain the germs of fowl tuberculosis is unknown. It would appear, however, as though they resulted simply from the breaking down of the lung tissue due to the intense inflammation present.

DISEASE OF THE DIGESTIVE ORGANS.

If the food which the young chicks receive does not contain the elements essential to growth in right proportion, digestive disturbances may be set up which may cause the death of the chicks. At the Rhode Island Experiment Station 826 brooder chicks which died from sundry causes were examined. Of the chicks examined 75 per cent. had abnormal livers, 39 per cent. had various forms of intestinal disorders.

"In order to ascertain the cause of the mortality a feeding experiment was instituted. Two hundred and

nineteen chicks of several breeds hatched under similar conditions were placed in four pens of approximately 50 each, all conditions being identical, so far as apparent, except in the single factor of food. All pens for 30 days after hatching were fed at the same time as much as they would eat. The composition of the ration varied in each case. The following facts confirmed by these experiments show:

Fig. 15.—Brood Coops Ready for a Storm! Also shows a part of the poultry houses. Chickadotte Farm, Rural Hall, N. C.

1st. Careful external and internal examination (such as anyone can readily make) of the dead chickens will generally disclose the cause of the death. The necessary remedies are usually not difficult to find.

2nd. Death from overcrowding, suffocation and trampling can be readily corrected. It is more frequent than is generally suspected.

4th. Trouble of the liver and gall bladder are usually easily recognized from the green stain. For correcting this feed more animal food. The use of the proper proportion of animal food will pay a handsome profit through decreased mortality and increased weight of chicks. In feeding bear in mind that chicks in a state of nature spend practically all their working hours in search of food, and that they do not fill their craws in ten minutes every two hours. Feeding should be, as far as the time of the attendant renders possible, a continuous process, but by no means a continuous gorge.

5th. Diarrhoea, etc., frequently results from feed-

ing a too large proportion of animal food, and is also brought on often by cold, exposure, etc.

6th. If the yolk is present in a considerable quantity in chicks a week old, or if more than 1 or 2 per cent. of deformed chicks appears, look to the better regulation of the incubators, or to the health of the breeding pens.

LEG WEAKNESS.

This usually is an ailment of chickens which have been forced into too rapid growth by the use of rich mashes, by being kept at too high a temperature and through lack of exercise.

Symptoms.—The chick walks in an unsteady manner and frequently squats down. The hocks are generally swollen and hot to the touch.

Treatment.—Feed dry grain scattered in litter so that the chickens will be obliged to exercise. Reduce the temperature and provide plenty of green food or steamed clover, which will tend to allay the feverish condition.

GAPES.

This is a parasitic disease caused by the presence in the wind pipe of the affected chick small worms which are attached by their heads to the mucous membrane. This parasite, known scientifically by the name of *Syngamus trachealis*, when removed from the trachea has a branched appearance. The longer part which is about one-half inch long is the female, while the shorter part is the male. The female does not lay eggs during her lifetime, but after reaching maturity she is expelled from the windpipe, and the eggs escape after her death through a rent in the body wall. Other chicks take these eggs into their systems, either with their food or water, and thus the disease is propagated.

Symptoms.—The chick when badly infested, gasps for breath, coughs as though suffocating, and frequently stands with wings drooping and eyes closed.

Treatment.—In practice only preventative measures are of value. The worms can be removed by means of a gape worm extractor, if one has the necessary skill and patience, but on a large scale, this is impos-

sible, and all possible effort should be directed toward preventing further infection. All diseased chicks should be placed by themselves and the runs and houses thoroughly cleaned up and disinfected. If individual brooders are used, the simple expedient of placing them in a new location each year, often causes almost the total disappearance of the trouble. If permanent runs become infected, they may be disinfected by the frequent use of caustic lime which is spread thickly over the surface and worked into the soil. Or the run may be

hen and chicks from the nest until 25 hours after the last chick has hatched. For hen and chicken shed we use a south side wired up, with sand floor. Place the hens and chicks in a clean new nest in a nest box made of a cracker box, with a round hole sawed in one side next to one end. This makes an ideal sitting nest and nest for hen and chicks. We place near the end a pan of dry flaked oatmeal, grit and fresh, clean water and leave the hen and chicks to come out at will. The hen will call the chicks out and in this way any chicks that are not strong will remain in the

Fig. 16.—Raising Jersey Red Chickens at Sumter, La.

sprinkled thoroughly with a 2 per cent. solution of sulphuric acid in water. The lime and acid, however, should never be used in combination.

CARE OF LITTLE CHICKS.

By J. A. P. Wolf.

We do not remove chicks from incubator or take

nest, and the hen after feeding the chicks that came out, will return to the nest with the chicks and all is well. We have watched them do it many times. This nest arrangement may be placed immediately in the colony house, placing one in each end and placing two hens with chicks in each colony house, especially as the weather grows warmer. This does away with the little brood coops and is a great sav-

ing of time and labor and money, besides giving the chicks more room on a stormy day, when they should be confined to the colony house.

Our second feed is dry bread crumbs, and the third Ciphers or any other good chick feed, feeding only three or four times per day for two or three weeks, never giving the same food twice in succession. When the chicks are one week old, we give once a day, usually at noon very finely chopped onions, cabbage, salad or fine grass. When from four to six weeks old, if the weather will permit, the hen and chicks should have access to rye, grass and clover at will. The houses are thoroughly cleaned from two to four times per week, and sand sprinkled on the floor. In the use of brooders we place them in or beside the colony houses, making little runs around the brooders until the chicks learn to go into the brooders. The brooder chicks are fed and treated the same as those with the hens. When the chicks are old enough, we remove the brooders and the chicks naturally go into the colony house, and you have them where you want them.

When chicks are from 8 to 10 weeks old we feed wheat in the morning, or a small feed of chick feed, and at noon beef scraps, and at night cracked corn. Sometimes I keep beef scraps in a self-feeding bin before them at all times.

When the hens wean the chicks, you only have to place them back in the breeding pens and the chicks come home to roost, and you do not have to go night after night with a basket and remove them from the brood coops to the colony house. They know where they should roost, and will remain there until fall, when they can be removed to their winter quarters, the cockerels and pullets having been separated at the proper time.

NOTES ON LITTLE CHICKS.

One should see to it that the chicks are not chilled, while being transferred from the incubator to the brooder, and that the hover temperature at the beginning is as high as the temperature of the incubator from which the chicks are taken.

In the brooder or brooder house, the chicks must be taught where to go to get warm. It usually takes about a week for them to learn this lesson.

The hover temperature should not fall below 90 degrees during the first week, nor below 85 degrees during the second week.

Brooder chicks must not be overfed. If fed too much they droop and die.

Make the chicks exercise by scattering dry cracked grain in deep but short litter. They will go to the bottom for grain if kept a little hungry.

Grit, green food, animal matter and grain, together with plenty of exercise, pure air and fresh water are necessary for the highest degree of success in raising chickens.

Keep the brooders clean, dry and free from lice.

A brooder to be satisfactory must be simple, durable and easily cleaned. The lamp must be accessible and have ample power to keep the brooder at the right temperature.

Do not overcrowd. If a brooder is made for 50 chicks, do not place 100 in it. Fifty chicks are as many as should be together.

If some of the chicks die, cut them open and find out what the trouble is; then rectify it. If the lungs are inflamed or have whitish nodules scattered through them, then the chicks have caught cold.

If the gall bladder is enlarged, there has been a deficiency of animal food in the ration, and more should be supplied. If the contents of the yolk sac remain unabsorbed, then either the incubation was improperly performed or the chicks were fed too soon or too much or the parent stock was in an unhealthy condition.

Do not permit incubator hatched chickens to come in contact with stock hatched under hens. This is a prolific source for the spread of lice, and should be avoided.

Open water vessels are not desirable for drinking fountains. Many birds are lost by falling into such a death trap, besides such vessels accumulate filth and dirt and are unsanitary.

Watch the brooder lamps. Make your last round before retiring and see that everything is snug and safe. You will be amply rewarded both in contentment of mind and better stock for any little extra attention you give your birds.

BROODING THE CHICKS.

This subject has been worn almost threadbare, so we think, who have handled it continually season after season, but whenever we come in contact with a new beginner, full of enthusiasm and hope, and who must depend upon us for advice which will assist him on to success, we feel that we can not dwell too long

or too forcibly upon this subject, because in successful brooding it is the key to the whole situation. There are many good incubators, in fact, nearly all the old standard makes do good work in the hands of careful, observing operators, but of brooders, we have so few that we feel it a duty to warn not only beginners, but old operators as well, that here is the danger line, and this the block upon which so many stumble.

Most of the brooders are built at the North, and with a view to withstanding extremes of cold weather, while in our section we seldom have to encounter zero weather, and if we do, only for a day or two at most. Working on the lines of instructions usually sent with incubators and brooders, beginners take everything for granted. They run the heat up as instructed, paying very little attention to ventilation,

Fig. 17.—1st Prize Hen, Atlanta, Ga. Also winner of silver cup. Bred and exhibited by J. K. Ottley, Atlanta, Ga.

the very essential in our clime. So far as getting up sufficient heat is concerned, we can take a dry goods box and carry a brood through, if we have solved the question of ventilation. It is a well-known and accepted fact that less ventilation is needed in cold than in warm weather, but sufficient must be provided at all times to carry off the poisonous gases which are generated, and to enable the chick to breathe the sweet, pure, life-invigorating atmosphere which nature intended for it. If we observe the chickens under the hen, we will notice that while their bodies are snugly protrude and they breathe the pure air, while their hidden among the downy feathers, their little heads

bodies are warmed from the animal heat the hens throw off. We prefer a brooder that enables the chicks to hover, and we have seen them when a comfortable degree of heat was given to hover their little bodies under the flannel strips of cloth, their little heads protruding and an air of contentment about them, which assured us of their welfare. In many brooders, sufficient provision is not made for hovering the number of chicks at which it is rated, without crowding some beneath it, where they cannot get the necessary pure air. Chicks naturally are inclined to huddle, and in brooders not provided with hovers, we usually find them piled up in a corner, unless the chamber is overheated, which is just about as injurious. If we had to err on the side of too much or too little heat, we would choose the latter, although there is no excuse for either. Too many people rely on their thermometers as to correct temperature. A chick can stand considerable cold, if it has access to a warm place wherein to get comfortable, and we would prefer to give plenty of ventilation, even to burning twice as much oil to bring up the desired temperature, rather than economize at the expense of the health of the entire hatch. During our fine spring weather we are able to supply all the ventilation necessary, even to raising the cover, provided the chicks have a place, a hover, under which they will find comfort, as they do under a hen.

We would advise beginners and others to look carefully into this question of brooding and observe these things, as upon them will rest your success in the business. Too many buy a 300-egg incubator and but one brooder. Manufacturers are much to blame here. In the battles of fierce competition now raging, too little regard is had for truth and honesty. They know as well as we do that fifty birds to any one brooder is sufficient, no matter whether rated a 50, 100 or 200-chick size. The fact of the matter is they do not do well in larger numbers, and I would prefer a half dozen small brooders to one large one any time. Another thing to be observed is in separating the weak, stunted looking chicks from the others. They teach the others the crowding habit, and besides this never recover if left to be run over and trampled by the others. Lots of failures in brooding chicks are charged to feeding, when the whole thing is due to bad ventilation, overheating and chilling.

Another thing observable in brooder chicks incorrect their feet. Compared with the full, moist, shiny-looking brooded is the dried, shriveled appearance of

ing feet of the hen's biddies, the comparison is striking and noticeable. We prefer to have a generous amount of clean sand in the brooder—an inch deep is not too much—and it is advisable and helpful to stand in each brooder a can of water, so placed that the chicks can't get to it, which will be found very helpful to them. You all know how hard and dry the air become in a room where a stove is burning, and how placing a kettle of water on it renders the atmosphere moist and more agreeable. It is similar in a brooder, and at best can do no harm and a little experimenting along this line will soon give you an insight into its value.

With the heating and ventilating controlled, the feeding becomes easy. At the present price of all ordinary grains, we would advise the use of the well-known brands of chick-feed advertised, as with this on hand the beginner is on an even footing with the oldest breeder in the land, for besides being about as cheap, it is a well-balanced ration prepared especially for young chicks, and contains everything necessary, even to grit and meat scraps. It eliminates the danger of feeding stuff injurious to young chickens, saves time, insures raising the greatest number of chicks possible, and fed in litter, provides exercise necessary to the best development of the growing chicks.

For the first few days, in cold weather, the chicks should be confined to the brooder, and not allowed to roam. After they become active and sprightly, they may be allowed a small inclosure about three feet square to run in, and this should be increased daily until after a week's time they may run at will, they will know their home and return to it when cold, or at roosting time at night. Care should be paid to gathering in any stragglers. The heat should be gradually reduced, and in mild weather in the South, after they are several weeks old, their bodies will generate sufficient heat to maintain the necessary temperature for their comfort.

BROODER CHICKS.

Give water to drink from the start.

Remove the chicks to new runs, if confined in pens, and plant oats, rye or other green feed.

Tiny brooder chicks sometimes peck each others feet until sore. Keep them busy by feeding grain in short litter and they will forget these small vices.

Don't feed your brooder chicks like mother used to do. Mother's chicks were brooded by hens, and were quite a different proposition.

Keep out the sunlight let in the doctor.

Assafoedita in the drinking water is good for little chicks with gapes.

Remove your chicks from ground on which your chicks become infected with gape worms. Sprinkle lime freely, then spade the run and lime again.

Scrub treatment will make scrubs of thorough-breds.

Accumulated manure breeds disease.

Fresh water is worthless if poured into a filthy vessel.

Clean the brooders daily.

Fig. 18.—A fine Buff Rock Hen, winner at Atlanta, Charleston, S. C., Macon, Ga., and other shows. Owned by C. Wayne Fowler, Smyrna, Ga.

STARTING A "BROILER PLANT" ON LIMITED CAPITAL.

So long as the demand exceeds the source of supply, so long will the raising of poultry for market or for eggs remain a profitable industry, when conducted by persons who are adapted to the work. No one need attempt the undertaking with the expectation of running up against a "snap." It is work, work all the time, early morning until night with the closest

attention necessary to details, cleanliness, regularity in feeding, guarding against vermin, and supplying every want of the fowl, and looking after its comfort.

In going into this line of business, we should first determine upon the wants of the market which we aim to supply, whether it is broilers, or eggs or both, as upon this desire will depend the first steps to be taken in securing breeding stock, incubators, brooders, etc., as well as location, nearness to market being a prime essential in some cases.

We will suppose in this instance that broilers for the market is the main consideration, and take up the "egg farm" under a separate head.

during the year under contract, if the breeder can give ample assurance of his ability to supply this demand.

Two hundred hens should supply in season sufficient eggs to run two incubators of 200 egg capacity per week, and give you a surplus besides. In the off seasons more hens may be required, depending upon your ability to create the "laying habit" in your fowls. This would require six 200 egg machines with an additional smaller machine to start at the same time you do your large ones, so that at testing time you can fill in from the surplus to offset the unfertile and doubtful eggs removed from them. The first week

Fig. 19.—An ideal Buff Plymouth Rock.

For this purpose one should have sufficient means at his disposal to buy his breeding stock, his incubators and brooders, as well as feed, and look for no income the first 6 months. In the South broilers are marketed at from 10 to 12 weeks old, and bring an average of from 20 to 25 cents each in the markets where a demand has been created, and which can be regularly supplied. We have in mind several cities in the lower South that will take a large number of birds

you start two, 200 egg machines, together with the smaller one. One week later you start two more, testing out the unfertile eggs from your first lot, and refilling from your "tender" as we will call it. This will probably leave your "tender" empty, and ready to start again with your second hatch. Should it not do so, it might be well to have two small machines for "tenders," say of 100 egg size capacity, so that in event the first tender is not ready for use, the second

may be brought into play, and on 14th or 15th day of last test you will have used up all surplus eggs from first tender leaving it ready for starting with your third hatch, which will now put in use all six of your machines, the first of which is already two weeks under way, so that when the last hatch has run one week, your first machines are three weeks under way, and are hatching. Every week after the third you will have a hatch coming off, and at the lowest reasonable calculations you should get out 60 per cent. of all eggs put in, or 240 chicks every week,

this expense and further losses which one experiences when depending upon outside help.

In arranging your yards and brooding accommodations, you must figure on supplying your yard room for at least ten or twelve hatches of 250 chicks, for your first hatch will be from ten to twelve weeks old before coming to marketable age, so that you will have from ten to eleven subsequent hatches on your hands ranging in age from one week to eleven, as the case may be.

Fig. 20.—A typical Brown Leghorn.

from which you should raise to twelve weeks old at least 200, which should bring you \$50.00 in your local market. This then would be your income from a small broiler plant running 6 200-egg machines with two small "tenders" from which you would have to deduct cost of feeding, expenses, etc. Besides this profit, you would have surplus eggs from your main flock, and if you have provided ample brooding facilities and prepared to keep your different ages separated, you will with little or no outside labor avoid

To handle them to the best advantage, your brooder yards should be so arranged that they will increase in size, so that the one intended for the youngest hatches being suited to their ages, and each succeeding one being larger, to take care of the different ages, and if hawks and other vermin are troublesome, it will be necessary for you to string meshed wire, the writer having found single strand No. 14 wire or smaller well adapted for this purpose, stringing it six inches apart. No hawk will attempt to go

through, and if so, his hawkship will be unable to get out.

You will experience little trouble with skunks, opossums, etc., during the day time, but care should be observed that houses are carefully closed at night before these prowlers are on the move.

Snakes are sometimes very destructive to small chickens, and no high weeds or hiding places should be tolerated near your chicken yards. Many a promising bird has given a meal to these "thieves" and are hard to detect in their stealthy work.

In selecting the stock for the production of eggs for your incubators, birds of one variety are always preferred, and for broilers, none surpass the Plymouth Rocks or Wyandottes. The whites in both varieties are the most popular, having no dark pin feathers, and make an ideal bird for broiler purposes. The first cost for good layers may be a little more than for a lot of mongrels, but then one should not embark in this business unless sufficiently equipped with capital to start right. While the income from the broiler plant practically begins with the maturity of the first hatch at 3 months, it is always advisable for the operator to have sufficient surplus on hand to meet any disappointment that may happen to him. He must also bear in mind that while his first 200 birds are getting to marketable age, he has a large number constantly coming on that require feeding, which is a considerable item when 100 to 200 chicks are considered, to say nothing of the hens that are kept for supplying the eggs.

One should never depend on eggs purchased from outsiders to run the incubators. This has been the source of more failures in the broiler business than all the other causes combined. No matter how well you think you know the people or the flocks from which they originate, it is seldom that the results will even pay the actual cost of the eggs. If your advent in the broiler business is dependent upon this source of supply of eggs, we say emphatically "**don't.**" Many of the largest plants in this country amply capitalized have failed because of this same trouble that we are now warning our readers against.

The treatment of the chicks while in the nursery is about the same whether intended for broilers or breeders, the object being to carry the chickens safely past the many dangers which beset them during the first three or four weeks. The prepared chick feeds supplemented with grit and green feed, and

plenty of exercise is now used by the most successful broiler people in the business. The thing of greatest importance is cleanliness and this applies not alone to the brooders but to the runs as well. These should be plowed or spaded and if possible planted frequently in green feed of some kind. Foul ground is one of the causes of great mortality in chicks. If the broiler business of the past has been extremely hazardous, it has not been due to a lack of ready markets at good prices, but rather from causes entirely within the control of the operator.

Experience alone can give the desired information as to details, etc., and this must be supplemented with proper equipment of incubators, brooders and brooder houses.

EGG FARMING IN THE SOUTH.

There is no branch of poultry husbandry that carries with it less risk from losses, nor greater certainty of immediate profits with quick returns than "Egg Farming." As the greatest layers are among the Mediterranean breeds, consequently non-setters, the successful egg farmer relies almost wholly on artificial incubation and brooding for obtaining his annual supply of new stock birds which are to furnish the eggs for another year.

On the majority of the egg farms in this country the non-setting varieties are used almost exclusively, with the preference greatly in favor of the White Leghorns. There are also some very successful plants in which the American varieties are given full sway, notably the Barred, Buff, and White Plymouth Rocks, White and Buff Wyandottes, and the Rhode Island Reds. These birds become broody however, and some develop remarkable tastes for obstinate broodiness. The successful egg farmer will, however, break up this broodiness as early as possible, usually at the very first sign of it, and a method employed with much success, which eliminates any resemblance to cruelty is practiced on some of our largest egg farms.

The method is as follows:

A box such as is usually employed for the use of setting hens is procured, the bottom taken out and regular poultry netting nailed in its place, allowing it to sag down a little to form a hollow the shape of a nest. This box is nailed up from the floor, high enough to allow the air to circulate under it very freely. It seems as though the hen cannot stand this cooling off process, having nothing under her to

break the air currents, and in two or three days all signs of broodiness disappear. This method is supplemented with another which usually effects a radical cure. By placing this hen for a day with a young, vigorous male bird, all ambition for setting seems to be obliterated and she soon resumes her egg laying, to the satisfaction and profit of the owner. A notable observation where the practice has been in vogue for some years, shows that the tendency to broodiness is gradually reduced, the birds exhibiting less and less inclination to set and devoting more time to egg production, which is what the egg farmer is after.

The remarkable demand for eggs, which increases as the years roll on, makes this branch of the poultry industry an ideal one for anyone having the nec-

Fig. 21.—A typical Leghorn as grown by Jno. R. McMillan, Louisville Ky.

essary capital and love for the business to undertake it. It is conceded that the value of the laying pullet is \$1.00, also that the food and labor for the year will average \$1.25; this then would make a total of \$2.25 for one laying fowl for a year. This will be found an average cost throughout the country. While this cost may be somewhat higher than here in the South, this is balanced by the fact that we get a little less probably for our product.

Now, figuring that a laying pullet will produce her first year one hundred and fifty eggs, these at 25 cts. per dozen would bring \$3.13. At the end of her first laying year, this hen will have a market value of at least 60 cts. This makes a total of \$3.73 which may be figured as the returns of one layer kept for egg

production exclusively, and shows a profit of \$1.48 or over 60 per cent. profit on your original investment of \$2.25. These figures may be increased if pure-bred birds are used, when the farmer will have quite a demand for incubator eggs at advanced prices, which will go a long way towards swelling the profits of the year's business. Indeed, we know of one egg farmer in Georgia close to Atlanta who from 500 birds kept, uses probably 50 per cent. of his product in filling orders for incubator eggs at \$5.00 to \$6.00 per hundred and his surplus is contracted for by an Atlanta firm at 25 cts. per dozen throughout the year. During one week he sold over \$60.00 worth of stock at prices ranging from \$2.00 to \$5.00 per head, due to the fact that he culled his flock closely year by year until to-day you can find on this model "egg plant," finer specimens of Buff Wyandottes than usually grace the yards of the fancier who caters only to the "fancy trade."

Another attractive feature of an egg farm is the fact that it is an all-the-year-round branch, which caters to a constant demand, and brings in an income throughout the year in proportion to the poultryman's ability to keep his hens laying. We know of no other branch of the poultry business that offers greater inducements to a beginner, and it admits developing all other branches, as he adapts himself to the work.

If we examine into the history of most of our successful egg-farms, we find that they are the results of a small beginning, developing gradually to meet the demands of the trade, and growing steadily into a profitable business, which has scarcely any limit to its possibilities.

While it is true that the success of any egg farm depends upon the number of eggs which can be produced per head, which is influenced greatly by the method of feeding, etc., still the selection of birds from ancestors that have established an egg-record is one of the most important things that is to be taken into consideration. This selection can only be made by the use of trap nests, which subject has been treated very exhaustively under the title elsewhere in this work. A careful system of selection, continued through several years will result in giving you birds of established merit, and which as breeders, will produce stock that is as near to egg machines as human ingenuity can make them. After this, the feeding becomes a prime factor in assisting you in getting the greatest number of eggs, but if the bird itself is not a good layer by heredity, all the feeding in the

world cannot make her a "record fowl," hence our advice that you select birds by the trap nest method, which is the only sure way of knowing what you have, all others being purely guess-work.

All experiments heretofore attempted prove conclusively that pullets lay more eggs than hens, hence the farmer should use pullets exclusively. Pullet eggs are not as good to use for breeding as those from which you will produce the laying pullets another season. Use a male bird from a hen that has proven her laying qualities. Such a bird will go a long way towards fixing the strain.

We prefer the colony plan for our birds which has the advantage of furnishing large range and exercise. This, however, becomes a matter for the considera-

tion in the healthfulness of your stock, and the increased eggs produced from them.

This is no lazy man's business, yet offers to any good worker a handsome profit on his investment, an independent life, with plenty of outdoor work, and health and happiness as a consequence.

THE EGG BUSINESS.

The market price of eggs during the past seasons, more particular during the winter months, has been such as to turn the attention of many to this branch of the poultry business as offering the quickest and most profitable results, with greater chances for success. Considering the fact that it is a business from

Fig. 22.—Partial View of the Poultry Houses and Yards at West Virginia Experiment Station.

tion of each individual's environments, and if the birds are to be yarded, as large a run should be given them as possible. In this case it is necessary to feed all grain in litter to induce exercise, without which best results are not obtainable.

As regards the kind of house, this subject has been fully treated elsewhere in this book, and will convey a very good idea of the different styles of buildings adapted to the business.

All rules of cleanliness must be carefully observed, as much so in this line of poultry culture as any other. Fowls cannot do their owner justice if lice and vermin thrive; and filthy quarters are a most fruitful source of disease and vermin. Chicken houses should be cleaned regularly, the accumulated droppings removed and applied to the land used for crops, and the work necessary to do this will be greatly compensated for in the increase of the yield of grain, as well as

which a steady income is possible all the year round, it offers extra inducements to those of limited means who can not wait over-long for the income to begin.

The inexperienced often make the mistake of figuring too largely, basing their calculations too often on the misleading statements of catalogue writers and would-be poultry experts who never raised a bird in their lives. The 200-egg hen was an unheard of proposition not many years ago, but pick up a poultry journal and go through the advertisements to-day and you will find hundreds of reputable(?) breeders advertising stock and eggs of this 200 and 250-egg strain anywhere from \$1 to \$5 per setting. It is an easy matter to figure a fine profit on the basis of 200 eggs per hen per annum, and this the enthusiastic beginner is more than apt to do, and when, therefore, he realizes only 100 eggs per hen or less and his dream of fabulous wealth goes glimmering and the

reality forces itself upon him, too often when too late his little earnings have sunk with his venture.

It is more reasonable to figure on an average of 25 cents per dozen than to select layers that will yield 200 eggs per year. One hundred and twenty eggs are nearer what you will get, and this average is only possible in large flocks under systematic feeding and with care and cleanliness observed. To realize 25 cents one must have access to a good market, or have acquired a reputation for his product that will command him a premium over the regular market quotations.

One dollar per head, though being generally allowed as the cost of feeding a fowl for a year, will hardly be sufficient with feed at its present prices—\$1.50 would be nearer the mark. So we see that with a flock averaging 10 dozen eggs per annum and these

Fig. 23.—Winner 1st prizes at Winston and Raleigh, N. C., 1902. Owned by Chickadotte Farm, Rural Hall, N. C.

bringing \$2.50, from which the feeding takes \$1.50, leaves us a profit of \$1.00 per head, providing we have no other losses to take from these figures.

The novice will be content to figure on this basis, and get great consolation from it, for if 100 hens will earn him \$100 net, won't 1,000 earn him \$1,000? Here is where he strikes a snag, for no beginner, and few older breeders, can make 1,000 pay the same proportion as the smaller number. So many things enter into this arrangement to cut down the profits that it is always best to take up the business on a small scale and work up to larger proportions. If any one

thinks they have a flock of the 200-egg hens, you may dissipate this illusion by trap-nesting what you consider your best layers. Even the 200-egg hen can not be relied upon to reproduce chicks that will average this number, so that when you purchase and pay for the reputation some breeder has made on a few birds, don't feel assured of what you have bought until the trap-nest has proven the fact.

THE CARE OF BREEDING STOCK.

About the middle of December we mate our birds for eggs used for hatching. But do not send out an egg for two or four weeks after birds have been mated up, usually not until after incubating enough eggs to test their fertility.

We feed wheat, oats or cane seed in litter for morning feed, cabbage, turnips, beets or rape at noon unless there is ample green stuff in the runs, and the weather favorable to running out of doors; at night we feed one evening corn, then the next evening a mash composed of 2-3 wheat bran and 1-3 corn meal to which is added once or twice a week 10 per cent. beef scraps. Once or twice a month after February, we add to this mash 2 lbs. of sulphur, or 2 lbs. Epsom salts for every fifty or sixty hens. We find that this keeps the fowls in good condition and in the spring time when cholera is apt to make its appearance, prevents it. We keep grit, oyster shell and charcoal, or coal cinders in self-feeding bins before them all the time, also clean, fresh water. Once or twice a week we feed small quantities of green cut bone, and twice a week we feed clover hay thrown in the straw in the scratching room, or place it in little racks. We have never yet failed to get a reasonable amount of eggs, and usually a very satisfactory number.

After June when our breeding pens are broken up, we usually let our hens have their own way about the place, and are not quite so careful about our feeding, and feed much less corn until the hens begin to molt, when we begin to feed more heavily, especially on wheat and oats. We have tried the starvation molting process, but do not find that it is so satisfactory as some recommend it to be. With us the hens do better under a reasonable feed than to starve them from two to four weeks, and then increase the feed, as this method runs them down in condition, which takes longer to build up than it would if they are fed during the time and feed more heavily when

the hens show signs of molt. Take the hen that has the late brood that lives around the old garden or around the stable and is well fed, and she is the first to put on her new coat of feathers.

The above method is not so necessary with farmers whose flocks run at large and secure a great many things that yarded fowls cannot secure.

A good way to feed oats in the winter is to pour boiling water over them the night before and feed in troughs the same as a mash. With yarded fowls a great many things can be done to increase the egg production, such as throwing in sliced onions, celery scraps, apple parings, etc.

every animal should get its sustenance. It was not intended that any animal should get its food without working for it. So we can easily see the evils of lack of exercise. Allowed to remain idle and given plenty of feed will soon destroy the usefulness of any bird intended for laying purposes. And it will take longer to get the bird back to the proper condition for laying than it would to get it too fat. Exercise is as we may say life to the bird, for it is only the active bird that proves itself an egg-producer. If we fail to make them exercise they get fat and certainly will not lay. A fowl too fat is liable to get some disease, such as indigestion, etc. No need of allowing the

Fig. 24.—Single Comb White Leghorns.

EXERCISE.

I wonder how many of the poultrymen of to-day still fail to give the fowls plenty of exercise, or rather to feed them in such a way that they will be compelled to work? Of course no one who calls himself up to the times would fail in this part of the work. A few will say, "Why must exercise be given?" Look for a moment at the way which nature intended that

birds to get fat except when intended for market and at no other time should they be allowed to become fat. There is a proper condition for the laying hen to be in which can be learned by experience. To be healthy and a good egg-producer the hen must be fed well and yet be made to exercise enough to keep down surplus fat other than that which should always be present. There must be some fat, but not enough to be a detriment to egg-production.

Now, in regard to the way of giving them the exercise. In summer, on the range, they will get it in hunting for bugs, etc., but in winter it will be necessary to keep six or eight inches of straw or leaves on the floor and scatter the grain in it so they will have to scratch to find it. They should be given a small amount of grain in the litter early in the morning so they can get to work the first thing and not stand around. It is a good idea to scatter the grain in the litter at night after dark so you will have it ready for them as soon as they come off the roost in the morning before you will want to get out to feed them. The first feed should be a little grain in the

Fig. 25.—A. B. B. Red Game Brood Cock.

litter, then if a mash is fed it may be given along some time in the forenoon after the fowls have warmed themselves up working in the litter; then give a little more grain to keep them at work. Also give them green food, etc. Then at night the full feed of grain that is usually given may be scattered in the litter. Care must be taken that this last feed is given early enough that they may have time to get a full crop before dark. It will not be too early to give it to them along in the middle of the afternoon, as the days are short during the winter, and it will take them some time to dig it out of the litter.—Percy W. Shepard.

FEED FOR CHICKENS.

The question of feed for chickens is one of impor-

tance to the poultrymen, for it is by feeding that eggs and chickens are produced. The domestic fowls that receive very little attention from the farmer, that is, approach more nearly the natural conditions, lay most of their eggs in the springtime. There is a reason for this and that is the surroundings and food that are best suited for egg production. The weather is warm, the fowls have plenty of green food, some grain, a great many insects and plenty of exercise and fresh air. When all these conditions are met the fowl produces eggs. The successful poultryman will try to meet these conditions the year round, and let the fowls have a continual springtime. Many farmers and poultrymen feed entirely too much corn. By some cause many people have the idea that corn will produce eggs. Indeed, until recently corn has been considered the universal poultry food of America. Experiments have clearly demonstrated that corn should not be fed to laying hens exclusively. Corn is too fattening to be fed to fowls kept in close confinement. Wheat is perhaps a better food for laying hens than corn, but since farmers in the South raise more corn than wheat, corn will remain a standard food for poultry among farmers for a long time. Where corn is fed so constantly, green food should be supplied. Oats is better than wheat or corn, and comes nearer being an ideal food than any single grain. When browned in the oven it will be relished more and aid egg production very greatly. But there is no one grain, or no one food for that matter, that will be successful in itself. Fowls need a variety in their food just the same as any animal. Experiments have been made which show that a larger per cent. of the food is digested when a great number of foods are fed together, than where just one or two different kinds of food are used. To have a large variety of foods is more nearly natural and like the wild birds feed. So it is much cheaper in the long run and your returns larger to use a combination food. Also, most poultrymen concede that ground or soft food should be fed as well as grains. Grain should be scattered in leaves and straw, as it furnishes them exercise. They need exercise and this will come nearer furnishing it to them than anything we know of. But they should not be fed more than they will eat up clean. Fowls should always be kept active and on the lookout for another grain of corn, wheat or oats.

Most farmers do not realize the importance of green feeds. In the spring they have all the green

food that they want. And we remember that this is the time of the year that they do most of their laying. In order to make a success in raising poultry you must see to it that they have green food the year round. Rye makes an excellent food for chickens, and it comes in at a time when fowls are sadly in need of some green food. Turnips, stock beets and cabbage make a good variety and are easily produced. If you make the right kind of effort you can supply them with green food the year round.

Fowls that are confined need some meat. Fresh bone that is obtained from the butcher shop makes an excellent food, if cut finely with a good bone cutter manufactured for the purpose. You can with this cutter turn bones into the best of food. Tainted bones should never be fed to poultry. See to it that the meat you give them is fresh and not spoiled. If you cannot obtain meat, skim milk may be substituted. If you are living on the coast and can obtain fish cheaply, you will find that they make an excellent food either baked or boiled.

Cotton-seed meal is a good food. Many poultrymen do not realize the value of cotton-seed meal as an egg producer. One authority says that he considers cotton-seed meal as valuable as cut bone as an egg producer. In feeding cotton-seed meal it should be dampened, but it should not be wet. It should be fed in proportion to one teaspoonful to two fowls. Do not, however, feed it too constantly, but alternate it with other things. It should be fed mixed with some ground feed, preferably oats, corn and wheat-bran in equal parts, finely ground. These soft feeds should be seasoned with salt and a little dash of red pepper. Soft feed should be moistened with warm water. It should not be fed boiling hot even in cold weather. Do not feed moldy or spoiled grain at any time, although it may be bought for a small price. It would be dear in the end, causing bowel trouble, and all kinds of similar troubles. There are many ready mixed grains for sale, which seem to be the very thing needed for the scratching pen, and are cheaper in the end than buying separate grains.

THE MOLTING SEASON.

Mr. R. M. Drake has the following to say concerning the Molting Season:

"There is no season of the year when mature fowls need more careful attention than during the molt. At this time the fowl replaces its old coat of feathers

which has become worn and dirty with a year's use, by one that is new and clean and beautiful. The making of this new coat taxes severely the powers of the bird, usually stopping egg-production and sometimes so overtaking a weaker constitution as to bring about death.

"Time of Molt.—The time of molting varies with the age, condition and treatment of the individual. It frequently begins in June or July but may not do so until late in the fall. As a rule younger birds molt earlier than older ones, and fall-hatched pullets are usually through with their molt by the end of their first summer and are ready to get to laying again. On the other hand, pullets hatched very early in the spring are apt to shed their first mature coat toward the end of the fall and to be in molt when the cold weather sets in. Hence if eggs are wanted in the early fall months when the most of the hens are taking a vacation, it is wise to hatch fall and winter pullets. But these should be marketed when the later spring pullets come to the nest, in November or December. The first because they are not likely to come up to standard size or to be good breeders having been retarded by the winter coming in their growing season, and the latter because they will probably take a long vacation during the season when eggs are high and the cost of keeping animals is greatest.

"An early molt is considered desirable, as the warm summer months are more propitious for this change of clothes and the hens can return to their laying in the fall when eggs are especially desirable.

"It has been asserted that the period at which molting takes place can be controlled. What is called the Van Dresser system consists of penning the fowls pretty closely for two weeks about July 1st on half rations (which is thought to cause the feathers to begin dropping) and then to give them free range with abundance of food best fitted to form feathers. It is claimed that this brings about an early and quick molt, and certain experiments reported from the West Virginia Experiment Station seem to sustain the claim.

"I have been creditably informed that in a certain community in Tennessee a more vigorous method is adopted. The hens are picked and left bare to get new feathers as best they can. The results are said to be good. I should, however, be cautious in trying such a method.

"During the period of molt the hens should be at-

tended to with more than usual care. Their quarters should be kept clean and dry, and they should be kept free of lice and mites.

"In regard to feed they should have a plenty, and it should include some feather-forming elements. Sunflower seed are highly recommended at this time. Oats make a good feed. If it is practicable to turn the flock on oat stubble that ought to be of great benefit. A mash consisting of equal parts of wheat, bran and corn hearts has given good results for me. Some corn should be fed also. If on range fowls will probably provide themselves with animal food, but if they do not it should be provided for them. Clabber makes a very good feed at this time or at almost any time of the year.

"With a little attention the hens should be soon filling the egg baskets again and more than paying for their keep."

Fig. 26.—Winner of 1st prize Winston Fair. Owned by the Chickadotte Farm, Rural Hall, N. C.

SUMMER CHICKS.

There are three important essentials to the successful raising of summer chicks, viz., cleanliness, proper food, and a generous supply of clean, fresh water; and taking up the subject in the order named, we will endeavor to present a few facts from our experience, together with the methods we have used and found to give the best results.

We will presume that we have decided to get off some late hatched chicks, and that we will use hens

for incubating. Before setting the hen she should be well dusted with some good insecticide, and given a nest of clean straw in some quiet place where she will be free from intrusion from the balance of the flock. A few days before hatching she should be again well dusted with insecticide. After the hatch, grease the head of each chick with lard, and give the hen another dusting, rubbing the powder well into the feathers; then remove the hen and brood to a clean coop with slatted front, and a good close, slanting top that will shed rain; put a few handfuls of straw in coop with a generous supply of clean sand or grit; this should be renewed once or twice a week. Attach to coop a movable pen 2x4 without bottom, made of plastering laths, in which the hen can dust and exercise. We keep the hen in this coop until chicks are ready for weaning, when we remove them to their permanent quarters.

Feed.—Young chicks should be fed about five times a day, and just so much as they will eat up clean at a feeding. We find that chicks do well and grow off nicely on the following foods, which we alternate at each feeding: Corn bread, cooked until crumbly, millet seed, cracked corn, cane seed, wheat, etc. We are strong advocates of dry feeding, and seldom ever feed soft food, especially to summer-hatched chicks. And last, but by no means least, is the question of water. We believe that stale and impure water causes the death of more fowls and chicks every year than any other two causes combined, so look well to it that your chicks have before them all the time a goodly allowance of fresh water, and our word for it, that with due regard for cleanliness, proper food, and a generous supply of clean, fresh water you can raise prize-winners, even in the summer-time. Some of the finest birds in our yards to-day were late hatched.

LITERATURE THAT SHOULD BE IN THE HANDS OF ALL POULTRYMEN.

The U. S. Department of Agriculture at Washington, D. C., has just issued a pamphlet on "Incubation and Incubators," by Richard H. Wood, M.D., that will be of interest to poultrymen generally. In the summary, the following rules have been laid down:

Study your incubator.

Acquaint yourself with all of its parts.

Read the manufacturer's directions for setting it up.

Set it up carefully according to instructions.

Never try to run an incubator in a drafty place, nor near a stove, nor where the sun shines upon it.

Set fertile eggs only. Waste no effort upon those that are infertile.

Learn how to trim and clean a lamp.

Keep the lamps full and the wick and tube clean.

Avoid smoke.

See that the eggs are clean and dry before setting.

Balance the eggs, large end up, a few hours before setting them.

Do not overfill the tray.

Cool the eggs every morning.

Be sure your hands are clean when handling eggs.

Test all eggs by the 7th day.

Test again by the 11th day.

Test again by the 15th day.

If the air space is too large, supply moisture; if too small, put a saucer of dry lime in the room and run without moisture a day or too.

Do not expect to learn all about the air cell the first hatch. You will learn that later.

Do not disturb the eggs after the evening of the 18th day.

Have a regular hour for incubator work.

Do not tinker too much with the regulator.

Get the adjustment right and keep it so.

Heat your machine and make your adjustment before placing the eggs in the chamber.

Experience comes from the work itself.

Among the many publications of the Department of Agriculture that are free to all, the following are

of interest to poultrymen and can be had without charge by sending request to Secretary of Agriculture, Division of Publications, Washington, D. C.

No. 22, The Feeding of Farm Animal,

No. 37, Kaffir Corn, Culture and Uses,

No. 41, Fowls, Care and Feeding,

No. 51, Standard Varieties of Chickens,

No. 59, Bee Keeping.

No. 64, Ducks and Geese,

No. 74, Milk as a Food,

No. 85, Fish as Food,

No. 94, The Vegetable Garden,

No. 98, Suggestions to Southern Farmers,

No. 101, Millets,

No. 102, Southern Forage Crops,

No. 118, Grape Growing in the South,

No. 125, Protection of Food products from injurious temperatures.

No. 126, Practical Suggestions for Farm Buildings,

No. 128, Eggs and their uses as food,

No. 141, Poultry raising on the Farm,

No. 154, The Home Fruit Garden,

No. 156, The Home Vineyard,

No. 182, Poultry as Food,

No. 183, Meat on the Farm, Butchering, Curing, etc.,

No. 185, Beautifying the Home Grounds,

No. 200, Turkeys.

No. 234, The Guinea Fowl and its use as food,

No. 236, Incubation and Incubators.

A perusal of these works will prove of benefit to our readers, and they make a handy library for useful reference.

DISEASES OF POULTRY.

By J. A. P. WOLF.

Cleanliness is next to Godliness, so goes the old maxim. This we do know that cleanliness is necessary to healthfulness. Plenty of clean fresh water, sound wholesome food in variety and moderation are the best cures or rather preventatives for all diseases, as they keep the birds in good health and condition, thereby preventing to a great extent, and when con-

tracted give the fowl the constitution to withstand the ravages of disease.

CHOLERA.

Cholera, which is a liver trouble is attended with fever, often very high, but easily controlled if taken

in time, by separating the sick fowls and giving one-fourth teaspoonful kerosene oil to each sick bird once a day, giving water and food only once per day. We find wheat is the best food at this time, although soft food with plenty of Epsom salts is good. After you have separated your sick birds, do not neglect the rest of your flock. Cut down your feed one-fourth and add 10 drops of carbolic acid to each gallon of drinking water. Once a day feed one tablespoonful kerosene oil to each gallon of mash, made of one-third corn meal and two-thirds wheat bran, until you are satisfied that you are past danger.

COLDS AND ROUP.

Colds and roup, the most dreaded of all diseases, will first be noticed by a discharge from the nose, usually one or both nostrils being pasted over with a feather, dirt or other substance by the discharge. This is a cold, **and if** not attended to will run into roup. The eyes **and** head swell, and sometimes there is a disagreeable odor. Birds often contract colds at shows, and this will run into roup, if neglected.

Remedy.—For colds feed 2 lbs. Epsom salts in 2

Fig. 27.—An excellent specimen of the Brown Leghorn hen.

Another Remedy.—For 12 grown fowls take one quart of meal, one large tablespoonful coal oil (kerosene,) one heaping teaspoonful black pepper, one teaspoonful table salt. Mix it all together and dampen it and place it where the chickens can get to it once a week and you will seldom have cholera in your flock. However, if they do have it make them eat this prescription even if you have to force it down them.

gallons mash to every 30 or 40 fowls two or three times a week. Take equal parts sweet oil and kerosene oil and inject into the nostrils of the sick fowls a few drops of the mixture. Use 10 drops carbolic acid to each gallon drinking water as in cholera. For roup treat in the same way, first washing the fowl's head in a weak solution of carbolic acid or strong carbolic soap suds and warm water to clean the affected parts. Keep the fowls in clean, dry, warm

quarters and feed well. In very severe cases anoint the swollen or inflamed parts with carbonated vaseline or camphorated sweet oil. The above treatment will be found to be effective in the treatment of sore head, canker and chicken pox. Clean and whitewash all houses and coops and spray with water to which has been added a tablespoonful of carbolic acid to each gallon of water.

SCALY LEGS.

Scaly legs is caused by a parasite burrowing under the scales of the legs.

Treatment.—For yellow legged fowls use lard and sulphur mixed into a good paste and grease the legs two or three times per week until cured. For white legged fowls wash the feet and legs in kerosene oil. This remedy would be better for the yellow legged, except for the fact that it fades the yellow legs and runs them white.

CHICKEN POX OR SORE HEAD.

This is a disease peculiar to Southern States where the climate is warm. The disease is caused by overcrowding of the fowls in the house and yard and the lack of cleanliness. It makes its appearance as a rule on the head, a small eruption appearing near the eye, ear or on the bill. These eruptions spread until finally the eyes are covered and the whole body is infested. It sometimes appears on the legs of the fowls. As soon as the disease appears, the affected fowls should be removed and the premises disinfected by using whitewash, Bordeaux mixture or carbolic acid. For the diseased fowls take one part of carbolic acid and mix with twenty parts soft soap and apply it on the sores and unfeathered parts of the head. This should be put on until a cure is effected.

Another Remedy.—Take one part calomel and eight parts of vaseline and mix and apply to the sores and unfeathered parts of the head once a day until a cure is effected. Another remedy is to put a little pine tar on the sores each day until they get well.

LIMBERNECK.

This disease is a new one and the authorities say that it is caused by fowls eating maggots that prey on dead carcasses of fowls or animals. One author-

ity says that when a case of limberneck is reported to him he always advises that all possible sources of decayed meat be cleaned up. The chickens seem all right when they go to roost at night and on the next morning the affected ones will remain on the perch with their heads hanging down and their necks appear to be broken. The head and neck are bluish and feverish. The fowls are very sleepy and thirsty and if their skins are examined they will be found to be red. There is no sure cure for this disease. The best plan is to prevent it. All decayed meats should be burned or buried deep especially in the summer time. When the disease is developed give your birds a dose of castor oil. Allow one teaspoonful of oil to each bird, mix with corn meal to a stiff mash and feed so that each bird gets its share. But it is safer to prevent the trouble than to try to cure it after it has taken hold of your fowls. Be careful to keep everything clean and do not throw the refuse of the chickens that you kill where the live ones will get it.

GAPES.

(Treated in another part of this work under same head.)

Gapes are caused by little white worms in the throats of fowls. These worms are so numerous at times as to completely choke the fowls. This disease, like most others with poultry, is not so easily cured, but can be prevented without much trouble. The pens and yards should be kept clean and dry, and the chickens kept in as healthy condition as possible. For treatment of, say, 25 chickens, take one teaspoonful of flowers of sulphur, mix in wet corn meal, and give one feed once a day for three days, then omit this medicine for three days, and then give it to them again, once a day for three days.

Another Remedy.—Moisten a feather in turpentine or kerosene oil and insert in the windpipe of fowls, and turn it around until the worms are removed. This is a popular remedy.

PNEUMONIA.

Pneumonia is a disease brought on by shipping fowls in very cold weather, keeping fowls in houses that are not ventilated, and exposure to the winds. The fowls make a noise in the throat, droop and sit around with their head back in their feathers and finally they die. The comb turns light and not dark.

The disease as a rule kills the fowls before you realize that they are sick. There is little that you can do in treating this disease. The fowls should have plenty of fresh air, but they should not be in a draft. The house should be sunny and kept as near the same temperature day and night.

HOW TO KEEP RID OF HEN'S LICE.

There is a tendency on the part of fowls to be infested with lice. They do a great deal of harm, covering the body of the hen to such an extent that sometimes you are unable to tell the natural color of their feathers. But by a little attention you can rid your poultry of lice and it will pay you to do so.

Remedy.—Sprinkle the nests and the brooders with Scotch snuff or flower of sulphur at intervals of two or three days. Keep the hen-house and all houses connected with the poultry business white-washed.

Another Remedy.—Close the house up tightly and burn sulphur in it. The sulphur fumes will go into every crack and destroy the lice.

CHICKEN MITES.

The chicken mite is one of the worst enemies to the chicken and it is very important that your poultry yard be kept free from them. It is a very easy matter to keep the house and yards free from mites if you will only start in time. Dusting the house inside by throwing the ashes so the house will be filled with dust and keeping dry ashes where the fowls can dust in them will keep the chickens free from mites. However, if they should get the start of you, you can rid your place of them by smoking the house out with tobacco. First stop the cracks and then burn tobacco or tobacco stems in it, keeping as much of the smoke in the house as possible.

Another Treatment.—It is quite important that all old nests and straw be removed from the house and burned. Then white-wash house, roosts and everything connected with the house with a mixture of lime and kerosene. Then make a mixture of ashes, Scotch snuff and air-slacked lime, using equal parts of each, and take the chickens by their legs and while suspended in the air thoroughly dust their feathers. Get this dust thoroughly in them and you should have no more trouble with mites.

Another Remedy. Take an empty quart bottle and fill two-thirds full of kerosene and add four table-spoonsful of spirits turpentine, also four spoonsful of camphor gum dissolved in whiskey or alcohol. Shake well together and sprinkle the roosts, nests and all places infested with this mixture. This is said to be an excellent remedy.

INDIGESTION.

Liver disease or, more properly speaking, indigestion; is the result, direct or indirect, of improperly feeding fowls.

It may be that the food is not wholesome, or perhaps the fowls are permitted to eat decaying animal or vegetable matter, or oftener still the food given the fowls is not of the kind that they need, and is not given at the proper time and way.

Fig. 28.—First Prize White Plymouth Rock at Atlanta, Ga.

By degrees the digestion of the fowls is impaired, and by degrees the system gives way, until the final breakdown, and then it is that we begin to search for the cause and the cure.

During the warm months fowls need but little food other than that which they gather.

Bugs, worms and insects swarm over the fields, and the fowls enjoy them.

During their pursuit they not only get exercise, but they obtain the very kind of food that gives them health and vigor.

Fowls that show symptoms of indigestion, that droop or decline to eat, should be driven to a shaded field or pasture and left to seek their food as best

they may. A few weeks of such outdoor living will restore them to health.

STIFF JOINTS.

Mr. H. B. Greer, of Nashville, Tenn., has the following to say concerning stiff joints:

It is a little singular that there should at this time be so much complaint about chickens developing stiff joints and lameness, with a tendency to sit about during the daytime, and gradually weaken and finally die.

In my past experience, I have noticed the symptoms most prominently, in inbred stock; that is, stock that has been bred for a number of years without changing cocks, so as to infuse new blood, which latter is always invigorating and valuable in stimulating more active or rapid growth, and earlier and more prolific laying on the part of the pullets from such matings. This is one way in which to forestall, or prevent stiffness and swollen joints; but it does not help us any with fowls that are already affected with it.

There is one remedy, however, which is very simple, and which costs nothing, and that remedy is to be found in the scratch pile. Let a chicken scratch for it's living as nature intended it should, and it will soon limber up and be healthful and vigorous. I would suggest this remedy to our friends who have fowls with stiff joints: Fix up a place where the rain can not get to the litter, and scatter it to the depth of 4 or 5 inches, boarding up the sides three feet high, and then scatter the grain for the chickens in the enclosure—raking the litter about so as to cover the feed up completely, and leave it to the fowls to find. They will work with a hearty good-will and be the most active and happy lot you ever saw. Do this daily, and all stiff joints will become normal, the combs will redden, and in a short time there will

be music and eggs. Indeed, it is advisable to adopt the scratch pen now, at the beginning of the winter laying season, as a means of stimulating the hens in this latter respect.

POULTRY AILMENTS.

When a fowl has difficulty in breathing look out for pneumonia.

When the crop is hard and unyielding there is danger of the bird becoming crop-bound.

When the discharges are streaked with blood it is time to give preventives for diarrhoea.

When the hen seems giddy and turns round and round, she is probably suffering from apoplexy.

When the joints are hot and swollen and the fowl is disinclined to stand, rheumatism has taken hold.

When the excrement secreted by the kidneys, which is normally pure white, appears yellow, look out for bowel trouble.

When the bird has leg weakness, with no disorder of the liver, feed lighter and give plenty of bone-forming material.

When a bird is "going light," has good appetite, but passes food from the bowels undigested, it is the early stage of consumption and treatment is useless.

When the nostrils are clogged with dirt and the eyes water, ward off a possible case of roup by timely treatment. If the case is bad apply the hatchet and bury the carcass.

When a hen seems to drown down behind and goes repeatedly to the nest without laying, she is usually suffering from a disorder of the oviduct, and might as well be killed and eaten.

When the bird seems lame and has a small swelling on its foot, remove to a house with no perches and oblige it to roost on a bed of straw. Rumble-foot is easily cured in the early stages if the cause is at once removed.

DUCK RAISING.

It has been but a few years since it was thought that ducks were fit for but little else than to swim the ponds and streams and furnish their owners once or twice a year with a poor crop of feathers. Along with the progress of the age, however, the insignificant art of duck-raising has kept steady pace. As the country was first inhabited along the seacoast, duck-raising was principally carried on along the shore, and the ducks were fed and fattened upon the refuse fish which the fishermen couldn't use. Then, like all

tory prices. Now, with a ranch capacity of 10,000 ducks yearly, I cannot fill my orders."

The reason for his success was proper food and care. Thus, if they are fed upon about the same kind of food other fowls of the better grades are fed, there will be no trouble about there always being a ready market for them.

But some ask, is it profitable to raise ducks? A pertinent question. Is it profitable to raise anything the people demand? The demand for a thing is

Fig. 29.—Pair of Muscovy Ducks.

the scrub stock of years ago, the ducks were brought through on as clean, scanty fare as possible, rendering their flesh coarse and fishy and wholly unpalatable to most people. But later years and proper care and feeding have made the duck more delicious food than either turkey, chicken or goose, while the demand is constantly increasing for this splendid bird. A noted duck-raiser's experience fully proves this statement. He says:

"About twelve years ago, when I was growing less than 1,500 ducks a year, I was obliged to visit the city markets personally and tease the dealers to purchase my birds in order to get anything like satisfac-

bound to make its production profitable. But that crop which is the most largely produced is not always the most profitable. Crowding the market is one of the most dangerous calamities to producers. If a man raises nothing but cattle and corn, he is sure to go under with all he has if every other man does the same. The same with cotton-growing or any other crop. Now, it is very seldom the market is over-crowded with poultry of any kind, much less with ducks.

Occasionally the market is full up with chickens; sometimes turkeys are a little slow selling, but this is seldom, if ever, true of ducks. Why is this? Is it

because there is not sufficient profit in raising ducks? Not at all. I have personally made the rounds of the markets lately, and to my utter astonishment could find but very few ducks on sale. I asked dealers why they had so few of them on their counters with other dressed poultry, and if they were not salable. Without an exception I was told there was a ready sale for ducks, but they could not get them except in small lots, for there were few to be had, and that they would gladly pay 15 cents per pound and possibly more.

It is estimated that it costs 5 cents per pound to raise a duck. Early ducks sell readily at from 20 to 40 cents per pound, but taking the minimum price, 15 cents, will give a profit of 200 per cent. Ducks will lay 130 eggs each, annually. The eggs can be successfully hatched by an incubator at small cost. Ducks are less liable to disease than other fowls, are

They are hardy, the young are easily raised, and the cost of their feed is so insignificant, compared to the many uses to which they may be put, that it is a wonder more of them are not seen throughout our section of the country.

They live to a good old age, and as breeders continue to be profitable, one in Scotland said to have reached the clearly ascertained age of eighty-one years, and killed by a sow whilst setting over her eggs. The goose sets from twenty-eight to thirty days, usually covering from thirteen to fifteen eggs. A nest should be prepared for her as soon as she begins to carry straw in her mouth, declaring her readiness to lay. A goose on range will gather the largest portion of its food, and where there are fields that have streams, branches, or unused springs on them, they may be turned to good advantage by making them into goose pastures. The care and attention

Fig. 30.—Ducks raised without water.

less trouble to care for, and can be raised at a cost allowing the grower a profit of 200 per cent.

Now, we are ready to ask the question: Is there any other industry that will return a profit of 200 per cent. on the capital invested, or that can be made out of so small a capital as it requires in the industry of raising ducks for market?

THE GOOSE ON THE FARM.

We call the attention of our readers to the advantages of having geese on the farm, for there are very few farms that have no waste places, where they can roam and almost pick up a living for themselves.

necessary for raising geese is small when compared with the returns, and compared with the cost of food used for other birds bred for market, is insignificant.

They require only the simplest kind of shelters, in fact, in the lower South they thrive as well sheltered under trees, although any open shed will be a suitable place for them. We prefer not to keep ganders for breeders that are over three years old, the younger birds being more vigorous and active, which insures greater fertility of the eggs, and young ganders are less pugnacious than older ones.

An important source of revenue are goose-feathers, which find a ready sale at profitable prices. One

pound of feathers per annum is about the average yield. They should be plucked when there is no blood in the ends of the quills, which is easily ascertained, as they will leave the flesh without hard pulling. As a rule, they are good setters and attentive mothers, and make their own nests, if not disturbed, and hatch a good percentage of eggs. The eggs may be taken from them and placed under hens, and by breaking them from setting, they will soon lay another clutch of eggs, when they may be permitted to set and bring off a hatch. The gander will stand sentinel at the chamber door of his wives, and woe betide the unfortunate who ventures near, to disturb their quiet.

In purchasing stock, one thing should be borne in

breaking them of setting they may be forced to lay three settings, upon the last of which they should be permitted to set. After hatching the goslings should be left in nest for twenty-four hours, and when they are four days old they will be able to take care of themselves, but if allowed to roam see that they are cooped at night.

Breeds.—There are several standard breeds of geese, among which are Toulouse, White Embden, African, Brown and White Chinese, and Colored Egyptian. The latter are strictly an ornamental breed of beautiful plumage, but very vicious, and not to be kept with other geese.

In feeding and dressing young geese for market, it

Fig. 31.—Pair of Cayuga (black) Ducks. These are good layers, and grow off quickly.

mind, that is, to buy in the fall, so that they will become accustomed to their surroundings, and be ready for business in early spring. Of the many varieties, perhaps none excel the African goose, being the most prolific, quickest to mature, and easiest to handle.

If African geese are used, mate two geese to one gander, and you will have strong, fertile eggs. We prefer birds fully two years old, and they may be fed grain through the winter months, and will then be in good breeding condition when spring arrives. In our section geese frequently begin laying in January. By

is admissible to place them in a pen, not large enough for them to exercise, and feed them all they will eat up clean of the following ration: corn-meal, mixed to a dry crumbly state, with beef scraps added to amount of about twenty per cent. of the bulk of corn-meal.

In killing and dressing for market, cut them in the roof of the mouth, or hit them a quick, sharp blow on the head. Pick the feathers carefully, dampening the hands at the finish to remove all the down. Some feathers should be left on the neck, and on the first joint of the wings.

In fattening old geese, they should be so penned

that but little if any exercise is attainable, and in this way they lose much of their toughness, and if properly fed are even better than the famed "green goose," and different from the hard, strong things fresh from the stubble fields.

Best Markets.—In marketing geese, ship to markets having a large foreign element, particularly Jews and Germans. The former will use only live geese, but dressed stock will be taken by other buyers at profitable prices.

GOSLINGS.

The Epitomist has the following on goslings:

"If one has the large range necessary for geese to roam about on, it generally pays to grow them, the more so in that there is a fair market for the fowls when their usefulness as feather producers is over with. Not only do the feathers command good prices, but the live birds, also, and especially if they be the white China or Toulouse variety. These, on a large range, will so pick up their living as to make the cost of otherwise maintaining them very small. The point in raising geese is to get them rightly started. Rather than giving an exclusive grain diet, composed for the most part of corn, they should have at the beginning vegetables and short clover hay in abundance, that they may not become too fat. Goslings hatched early in the season must also be kept from the severe cold, for a while. On emerging from the shell they should be brought, one by one, into a warm room and wrapped in flannel until all are hatched, with no food given them for twenty-four hours after hatching; in which case the mother and her brood should be confined in a big box in a sunny shed for two or three days, the wraps being removed from the young when they are returned to the hen. The best time to do this is in the evening.

Their First Feathers.—Until they get their first feathers goslings should be furnished with no more water than they need to drink, and never should they be allowed to go into cold spring water, as swimming in that will cause them to contract cramp, whereupon they are liable to turn over suddenly on their backs and die. Of course, it is not so essential to keep them away from water if the weather is warm and when the later hatches come off they may be allowed to run with the mother goose, which, as a matter

of truth, supplies more oil to the down of goslings than a hen and if used for a mother will thus enable them to shed water better. Nevertheless, it is advisable in any case to shield the little things from showers, including wet grass and damp floors at night and not let them go near ponds or streams until they have shed their down. They should be fed at first on bread and milk, corn-meal, mush and milk, or corn-meal and bran, half and half, moistened with milk and water. Dry cracked corn may be given later, also wheat, cabbage, chopped onions, and apples and boiled vegetables may be omitted, however, if they have a run on short new grass. Provided they are kept in yards, grit must be supplied."

DUCKS AND GEESE.

There are few farms that have not sufficient spare land to devote to ducks and geese, more particularly to the latter, which from now on 'till winter will get the greater part of their living from the range, and as they make a toothsome morsel when properly prepared, they make that variety in the diet which is the spice of life. Considering the excellence of the flesh, and the ease with which they are reared, it is strange that more of them are not found on our farms. A mistaken idea prevails that ducks and geese can not live without a pond of water to swim in, but this is a mistake, as thousands are raised annually that never have water to swim in. While we admit there are some advantages where swimming-pools abound, it is not of such importance as to make its absence a barrier to breeding them with profit.

Some few breeders find it profitable to raise the different breeds in their purity, of which there are the White Pekin, White Aylesbury, Colored Rouen, Black Cayuga, Colored Muscovy, White Muscovy, Gray Call, White Call, Black East Indian and Crested White, all standard varieties. The demand for most of these is not sufficient to justify any extensive production.

When it comes to geese, the cost of raising is so insignificant as to make them a desirable addition to any farm where a pasture or waste land is to be had. The principal demand for them is in the large trade centers with a foreign element, although any native of our country readily becomes their admirer when once a prime, fat green goose is served in the proper style.

Among the breeds of standard geese most in demand we have the Toulouse, White Embden, African, Brown China, White China, Gray Wild and Colored Egyptian. Of these, the Embden are most in demand for market purposes, the adult gander weighing about 20 pounds, the young gander 18 pounds, and the adult goose 18 and the young goose 16 pounds. They are not as prolific as the China geese, laying about 20 eggs in a season.

As an ornamental bird, the most beautiful of geese are the Colored Egyptian, being bred almost exclusively for show-room purposes. Because of their quarrelsome nature, they are not to be raised with other breeds, and males of the same species have to be confined to separate enclosures, or they will fight until they are killed.

TURKEYS.

CARE AND MANAGEMENT.

The constantly increasing demand for turkeys as a holiday feast, more especially around Thanksgiving, and Christmas, has been an important factor in keeping prices up, and making this line of poultry culture a profitable one for those adapted to the work. We say adapted to the work, for experience has shown that there are little details to be taken into consideration, which all breeders of turkeys do not care to bother with, and in consequence we find many people who get along very well with poultry conspicuous failures as successful breeders of our national bird.

The failures of many with turkeys in the past have been through inbreeding, and this applies particularly to our section, where the same male birds have been used for years, without any attempt at introducing new blood. While it has been stated by some authorities that the wild turkey of this country would not breed with our domestic birds, many of our Southern breeders know better, having introduced them to their flocks, always with the best results, and through so doing succeeded in increasing their vigor, supplying rich, new, vigorous blood and building up stock that had deteriorated through carelessness and inattention, thereby benefiting the turkey-raising industry of our country.

In many sections of the country the people have become so disheartened, that no attempt is now made to breed turkeys, ascribing the causes of failure to anything but the right one, not realizing that it was due to undermining the breeding of stock through inbreeding that caused disaster and loss. If there is

anything necessary to emphasize the necessity for the introduction of new blood, we need only to look to the successful breeders, and wherever you find one you will find him or her working carefully after the little details and bringing new blood into the flock either through the purchase regularly of male birds not related, or using birds from eggs of wild stock that have been found and incubated. With the many advantages the South offers for successful turkey-raising, we see little reason why the average breeder of poultry should not succeed with them, if they will follow along the line of advice we shall give. The idea is to raise the best, and with a good demand the past season in the big markets with prices ranging up to thirty cents a pound, you have some idea of the public's willingness to pay a good price for the best.

As regards the profits that can be made per head on turkeys, if we can eliminate the great losses that have hitherto been such a drain upon the industry, you will find that your flocks will average you greater profit than other poultry. They will, after six weeks of age, gain the greater part of their living in the fields and woods, eating bugs, grasshoppers, and waste grain that they pick up in their wanderings over the range, with little or no cost to the grower. If sufficient range is provided they become almost self-sustaining.

The greater and more general the use of the flesh, the greater the chances for profit in raising them. There are few up-to-date restaurants, hotels, etc., that do not use them constantly as cold cuts for sandwiches and for salads, to say nothing of the great demand for roasters, and late hatched poults for broilers.

The preferred weights for market are from fourteen to twenty pounds. An extra large bird is not as much in demand as those averaging as stated. The idea is to mature your birds within the shortest possible time, which can be done readily if proper care and attention be given.

In the selection and treatment of breeding stock there are rules that must be followed if one hopes to succeed, and the one that must be observed above all others, is the introduction of new blood. Without

The male should be a yearling or over. The large, overgrown birds are not the best. An eye should be had to strength, health and vigor, with well proportioned, medium size.

In introducing new blood, it would be well to send a long distance off for your new blood, rather than risk the chances of getting a bird already akin, and inbreeding. The bird should be secured in the fall, so that he will be acquainted with his surroundings, and his health and condition assured.

Fig. 33.—A typical Mammoth Bronze Gobler.

observing this, you may give every care and attention to a flock without results, while with this precaution observed you will have overcome the greatest obstacle in turkey-raising next to that which comes from lice.

In selecting breeding stock T. F. McGrew, one of our best authorities, advises the use of turkey hens over one year old, strong, healthy and vigorous, and of good medium size. Small ones must never be selected, neither should they be unnaturally large.

We would have from four to five hens to one gobler, and when we consider that the male is one-half of the flock in the matter of breeding, we do not overestimate the necessity of careful selection. Plenty of bone, a full round breast and long body are the requisites. No matter of what stock or breeding the hen may be, the male should be selected of some standard variety. If the hens are all of one variety, procure a male likewise to maintain their purity. Nothing is gained by crossbreeding, but rather a ten-

dency to bring to the surface the weak points of both sides of the cross.

If **your intentions** are to yard your birds, this is feasible, but the larger the pens the better. Range is preferable and the best results can only be obtained in this way. Care should be taken that the breeding stock is not too fat, nor should they be allowed to go hungry and underfed. If they have the run of the farm where any other stock is fed, there will be little danger of their lacking food. They are untiring foragers, and there is little danger of them becoming overfat, if they range freely. They must

in the trees, and we prefer to have them there, in preference to a closed house. If the latter becomes necessary, perfect cleanliness should be observed, the quarters should be airy and roomy. The roosting-poles should be placed well up from the floor, and special care should be taken to keep the place free of vermin. Some of the most successful Rhode Island breeders keep their turkeys roosting the year round in trees, and in our section we think it advisable at all times. At any rate, no closed houses need be provided, any kind of a shelter providing comfort and increasing the hardiness of the flock.

Fig. 32.—Mammoth Bronze Turkeys. The-kind that they breed in Sunny Tennessee.

have plenty of fresh water, also grit and shell-forming material.

In **mating**, it is quite unusual for the male to pair with the female more than once for a clutch of eggs, and hens will wander miles, if necessary, for this purpose.

It is through this habit that destructive inbreeding is caused, for if breeders who keep only a few turkey hens depend upon one gobbler in a neighborhood to serve, he often pairs with his own descendants, which accounts for the lack of vitality in the pullets, and the failures which too often result.

Turkeys are in their natural element when roosting

The limited number of eggs which a turkey hen produces makes artificial hatching unnecessary, and we prefer to give them to a hen to hatch (turkey hen.) They make the best mothers and are required to brood the poults. While hens do very well to brood poults to a certain age, best results are had with turkeys. The eggs from hens over two years of age are considered best for hatching, producing stronger and more vigorous poults.

In **selecting a nest**, a dirt foundation covered with some slaked lime is good. Place some straw or hay upon it. Lice are most destructive to young poults and every precaution should be observed to keep

them in check. Eternal vigilance is the price of success here.

The turkey hen sits twenty-seven to twenty-nine days, and their eggs are usually found very fertile, but we would be careful to give only so many eggs as a hen will cover readily, which will insure better results. She should be supplied regularly with food and water and should be placed where they can be had at will. Wheat and corn are best for this food.

In growing poults, nothing in the way of advice can take the place of actual experience. They should not be pampered and fed unnaturally, and should have light, room and air. Exercise is essential, but the hen should be cooped to prevent her wandering away with her young before they are able to stand it. They should not be allowed to run out on wet days, nor while the grass is wet, 'till old enough to wander with the mother and roost out on fences or trees.

For the first feed nothing is better than very fine oatmeal or finely cracked wheat or corn, supplemented with a little granulated meat scraps and fine grit of some kind. Some of the commercial brands of chick feed are very good. Fresh water should be provided. Gravel makes good grit. Be careful and not over-feed, feed sparingly, yet often. Give them what they will speedily clean up and no more. Bowel trouble means improper feeding.

We say again then, feed the young poults at the start oatmeal, broken wheat and finely cracked corn; as they grow older whole wheat, hulled oats and coarser cracked corn, and still later whole corn.

This course of treatment, carefully followed out, will place the beginner on a good footing and enable him to overcome a great many obstacles he would otherwise meet with, if he was compelled to do all his work along experimental lines. As to varieties, there are several, which are treated elsewhere in these columns, and in their selection, attention should be paid to their chief characteristics, so as to secure such as are best adapted to your surroundings. It is claimed by some that the White Hollands are less inclined to roam and wander off, and because of having no black pin-feathers are preferred as market birds.

TURKEY BRIEFS.

The American Bronze Turkey originated from the union of the wild turkey of North America with the domestic turkey of this country.

One fecundation is sufficient to render fertile all the eggs of one laying.

Inbreeding is the source of most failures in turkey-raising.

Texas leads as a turkey-raising State, followed by Missouri, Illinois, Iowa and Ohio.

Rhode Island leads in the quality and reputation of her product.

The demand for turkeys is constantly increasing.

The medium-sized, plump carcass has the preference.

Over-large males to pair with small, weakly hens is not desirable.

It is quite as easy to grow the Rhode Island quality as the other kind, but it takes brains to do it.

Of all domestic fowls, none show the harm of inbreeding as soon as turkeys.

Size and constitutional vigor come largely through the female.

Discard the undersized birds at all times.

Length of shank and thigh, if out of proportion, should not be mistaken for size.

Full, rounded body and breast indicate value; size and strength of bone indicate constitutional vigor. All these characteristics are of no avail if inbreeding is permitted.

Variegated turkeys are of black ground color, each feather ending with a band of steel gray, edged with black. The males of this variety run from 20 to 30 pounds; the females 12 to 18 pounds.

True buff color is seldom found in the Buff Variety.

Use hens over one year old for breeders.

Unnatural size is not desirable or profitable.

Large over-grown males are not best. Year-old birds or older are preferable for breeders.

Annual introduction of new blood is necessary.

Health and vigor in the foundation stock count for most.

In all fowls, size is influenced largely by the female, and color and finish by the male.

The wise farmer always selects the very best corn or grain for seed. Equal care should be given for selecting breeding turkeys.

The best raised on the farm should be reserved for producers, and the fact should be kept in mind that turkey hens in their second and third year of laying make the best producers.

Trees make good roosting places, and are preferred to close houses, barns, etc.

The Bronze holds the place of honor, both for mammoth size and beautiful rich plumage.

In inbreeding, much of the richness of color, which the Bronze secured through its wild progenitor, is lost.

As the market preference is given to the best grown, and best finished specimens, any variety raised to the desired perfection will command ready sale.

When young turkeys are suitably housed, properly fed and kept free from lice, they are quite as easy to grow as young chickens.

Varieties.—There are six standard varieties of turkeys grown in the United States, viz.: The Bronze, Narragansett, Buff, Slate, White and Black. The differences are mainly in size and color of plumage. Among the largest we find the Bronze and Narragansett, while the Buff and Slate are medium and the Black and White the smallest of all. The latter have been bred up recently to almost third position of size and the Blacks also show great improvement.

Turkeys begin laying in the South from February, and in Florida even as early as January.

Where hens are unrestrained and no attention paid to protecting their nests, results are not usually profitable.

To insure fertile eggs a vigorous male bird must be used, as after pairing once the hen devotes her entire time in locating her nest, etc. Never allow but one male to run with a group of breeding hens, as they are apt to disturb each other at the time of pairing, and ruin an entire hatch.

Wide range is essential for the best results.

Watch the hens in their wanderings, until their nests are located. If it is advisable to remove all the eggs, large sized nest eggs should be substituted, oth-

erwise they may become dissatisfied and wander and locate elsewhere to the detriment of the hatch.

The hens naturally select their nests in the most concealed places, and if you find that it is not well protected, provide a box or coop with a suitable opening to protect her from the weather, and also against "varments."

There are several varieties, all having their admirers, but the White Holland and Mammoth Bronze are the prime favorites. It is claimed for the White Holland that they are more domestic, and less inclined to wander away from home, and like all white birds, are easily picked, having no dark pin-feathers, which is some advantage.

Trees are the natural roosting-places for turkeys, and are preferred to close houses at any time.

Inbreeding, or using birds too closely related in breeding, is one cause of failure with turkeys.

The markets prefer a medium-sized plump carcass, and over-grown birds are not much in demand except for show specimens.

The Buff varieties are seldom seen in our section, and the true buff color is seldom found in this variety.

When young turkeys are suitably housed, properly fed and kept free from lice, they are quite as easily raised as young chicks, provided the foundation stock are healthy, vigorous birds.

Turkeys lay from fifteen to twenty eggs before becoming broody; if desired they can be broken-up from sitting the first time, when they will commence laying again, and may be allowed to bring off the second lot of eggs.

While turkey-eggs can be hatched successfully in incubators, the question of brooding them makes us prefer to use the natural methods.

LINE BREEDING.

So much stress is being laid nowadays on line-bred birds that many who have not given this subject careful study are asking "What is a truly line-bred fowl?" and when we speak of "cockerel" and "pullet strains," our meaning is not at all clearly understood. Now, this question of line-breeding is of such importance and real value, that even the amateur should stop long enough to master enough of its principles to be

able to put it into practical operation in his own yard, for whatever success he may happen to have the first year or so that he mates up his birds in "any old way," there is for him only one end—degenerate stock. Then, when he discovers his error he goes out after fresh blood to restore the vitality of his impoverished flock, but alas! after he has gone down into his pocket for a choice bird or so—birds bred in line

for generations, he finds that they do not "nick" with his run-down strain, and with disgust he either quits the business altogether or goes after another breed—perhaps for a like experience.

The accompanying charts may prove of benefit to some—some who are seeking a safe route to success, and by way of explanation—the circles represent the male line, the squares the female line, while the diamonds show the blend of the two—our breeding base: The unbroken arrows are males, the dotted arrows are females—this explanation enables one to follow the charts easily.

washed-out barring, notwithstanding other excellent traits; exercise a good deal of hard common sense, and yet the best. Number the male 1—the female 2—(see chart No. 1)—blend the two and we have in group 3 chicks with half blood of each (1st season.) Take a female from group 3 and mate to her sire and we have in group 4—chicks with three-fourths of the blood of the male. A cockerel from group 3 is mated to his dam, and in group 5 we have chicks with three-fourths the blood of the female (2d season.)

Take a female from group 4 and mate to original male No. 1 and in 6 we have chicks seven-eighths blood of original sire, while a cockerel from group 5,

Fig. 34.—Showing the effect of line breeding as shown in the matter referring to this cut.

Now, then, for a start, select a male and female with great care, seeing to it that no same serious defect appears in both, but let them offset each other in weak points, bearing in mind that we are aiming at the "standard of perfection;" therefore, if you are breeding Cornish Indians and the standard calls for "broad heads with over-hanging brows," don't let both of your selections have heads inclined to narrow, or if your breed is Barred Rocks, you are wasting your time if you select two birds with faded or

mated to original female, gives us in group 7 chicks with seven-eighths blood of original female No. 2 (3d season.) Now a male from group 6 and female from group 7 gives us in group 8 chicks once more with half blood of each original sire and dam (4th season.) but if we have been careful in our selection of breeders the chicks should show a marked improvement over those that came in group 3, for by the fusion of blood we ought to have eliminated some of the defects of the original pair.

Now for our new strains, cockerel and pullet lines. Up to this time we have closely watched the product of the different matings, and have carefully noted where the finest cockerels came from, as well as the choicest females, say, for illustration, that we have seen that our best cockerels came from matings where there was a predominance of male blood, i. e., groups 4 and 6, and the most desirable females from the other side of the line, where the original female blood was in excess, i. e., groups 5 and 7, why the way is clear. Preserve those dominant forces by two ways. Take a choice male from group 6 and number him 20 in chart 3; select a female from group 8 and number her 21 in same chart. A fusion of these two will form a base for our cockerel line in group 22, which, though not mathematically correct, is to all practical purposes three-fourths the original blood of the male (No. 1,) and one-fourth that of the original dam (No. 2.) A female from group 22, mated to male No. 20 maintains the supremacy of the male line in group 23. From this number on down we get our cockerels and cockerel-breeding females. Please note that in every mating here (except one) in both sides and center the male blood predominates; only once was it allowed to become one-half. In this line all the birds, male and female, should be selected with traits decidedly after the original male, except defects.

To establish a pullet line, the same course is pursued, except that here (chart 3) we select the female from group 7 and the male from group 8, the fusion in 42 forming the base of this line, while the line-bred pullets and pullet breeding cockerels came from 43 and on down. Here the inverse of chart 2 is seen, for in all these matings, with one exception, the female blood is dominant. All the selections in this line should resemble the original female. Now, look at our charts once more. Take a male from 27 and a female from 47, mate them together and what do we get in group 48? Why, as to blood just what we had in 3, 3-8 and 48, being mathematically the same ratings; but after eight seasons' breeding, if we have used good judgment in our matings, our stock is not only not deteriorated but actually improved, for in groups 25 and 45 we should have better individual specimens, higher scoring birds (weight not excepted) than we had in Nos. 1 and 2, while the chicks in fusion 48 should outclass those we had in 3. Why? Because we have fused the best traits, of two high-grade birds into one, thus attaining nearer the stand-

ard. This process should be carried on in single matings and in no case should more than two females be used and they full sisters and as much alike as "peas in the same pod."

But, says the thrifty, practical breeder, "Am I to lose the revenue from my flock while all this is going on?" By no means; you can have choice birds even from the first matings, and after that as many as you want to make up your large pens and to sell to the man who wants first-class, line-bred stock; but the birds in the chart-pens constitute your vital forces, your cream, your "royal blood," if you please. Band all of these last with their group numbers and carefully keep your charts or you'll get all in a muddle, and watch your diamond groups; it is fitting that they should be so designated, for if you get any "gems" for the breeding-pen or show-room it will be through these fountains of blood.

THE TRAP NEST AND ITS VALUE TO POULTRY-KEEPERS.

F. O. Wellcome, of Yarmouth, Maine, inventor of "The Ideal Trap Nest," wrote the following article on the Trap Nest:

For various reasons which need not be discussed here, the great majority of poultry keepers everywhere know nothing whatever of the trap nest system in its best and most practical form. So my Southern readers need not feel that they are in this respect to any great extent behind the poultry keepers of New England or elsewhere.

The practical trap nest system is as yet a brand new proposition to the majority of the poultry keepers, although it has been completely and thoroughly tested for years by many in various parts of the country—especially in California—and they value it so highly that they would hardly know how to get along without it.

The best patented trap nest and also the best "free plan" trap are both products of the State of Maine.

The most common type of the trap nest is merely a nest box so constructed that any hen that wants to can enter it, but can not get out until released. If she lays an egg while in the box, it necessarily follows that the attendant when visiting the pen will find the eggs in the nests in company with the hens that laid them. If each hen wears a leg band with a number stamped upon it—a different number for each hen, of course—it will be seen at once that the poul-

try-keeper can keep a record of the product of each hen, just as the practical dairyman keeps account of the product of each one of his cows.

Now that I have described in a general way what a trap nest is, I can understand how some ingenious reader with a mechanical trend will set about devising a nest box fitted with a trap door which will allow a hen to go in but will close after her and prevent her escape. He will very naturally do what hundreds of others have done; that is, he will adopt some familiar type of hinged or sliding door to a box of some sort and arrange a string, a spring, or some other contrivance that will cause the trap to admit the hen and close after her. That will be alright enough for a more or less costly experiment; a great many have tried it and learned things that they did not know before.

I believe that I am familiar with the results of some two score or more of such experiments and most of them were failures. Although exploited more or less—often gratuitously in the interest of the something-for-nothing schemer—very few if any of them have ever been installed in adequate numbers by practical people and used continuously for business purposes in business blocks; which is the final and true test of merit.

Something like twenty patents have been granted for trap nest devices and among these patented traps are to be found the very best trap nests as well as the worst, the least expensive (worthy of note) as well as the most costly.

One of the hardest problems that has confronted the trap nest inventor has been to devise a trap that in practical and general use would allow but one hen to occupy the nest at one time and would surely keep her there until her number and egg were taken.

That problem has been satisfactorily solved. Another problem, that few have considered, has been to so design the trap that a hen would not enter the nest unless she wanted to use it. That also has been thoroughly solved.

Another has been to so construct the trap that the hen could lay and remain in the same small nest without too much danger of breaking her egg. Some seem to think that impossible. It has been done.

Another problem that some poultry novices seem to be working at quite persistently is to devise a nest that will automatically record the work of each layer without labor or attention on the part of the poultryman. Those who are honest in that effort have per-

haps been deceived by "gold brick" advertising that has occasionally appeared in very interesting places. Unfortunately, poultry journalism has not yet become courageous enough to bar those humbugs that do so much to injure legitimate advertising, and the novices who alone invest in "gold bricks."

Such a nest is inherently impossible, so far as practical results are concerned. Any nest that will mark the hen that occupies it and then passes out will require much more of the time and attention of the caretaker—even if the desired record could be obtained in that manner—than would any trap nest properly installed.

A little knowledge of hen nature and habits, and the details of practical poultry keeping would prevent much self-delusion in this connection. But I must

Fig. 35.—Winner 1st prize Winston, N. C. and Raleigh, N. C.
Owned by Chickadotte Farm, Rural Hall, N. C.

not weary the reader with details. Suffice it to say, we have some practical trap nests that are designed for and are used by practical poultry keepers for business purposes.

In trap nest installation there should be about two-thirds as many nests as the average number of eggs laid daily; or about one nest for each three hens that are actually laying well. The total number of hens has no bearing aside from that.

It is by no means necessary to watch the nests, neither is it desirable, and it is not important that the hens should be released soon after having laid.

The trap nest user who is a practical person and has a practical installation of nests, will so arrange his work with his flock that he will visit them at least four times a day during the time that abundant laying is in progress. With the "Ideal" system he can collect and record from four to eight eggs per minute after he has gained practical experience in attending to them.

Mr. Davis Lawton, of Winstead, Conn., a market poultryman who has kept careful account of the matter, says that it requires about twelve minutes extra time per day to attend the traps for each hundred hens in the flock. M. K. Boyer, whom every "old timer" knows, says that it does not take five minutes to look after fifty hens.

Those who only keep a few hens and have no one to visit the pens during the day, can only use the nests as traps at intervals when they can be attended to, using them at other times as self-releasing nests, the hens going and coming at will. In such circumstances individual egg records that will be continuous and accurate are impossible to obtain by any means, unless it be an extremely small flock of hens that are much mixed in blood and lay eggs that differ much in appearance.

The office of the trap nest is to identify each layer and her egg at any time or all of the time at the option or convenience of the user. It shows which hen laid the egg. That knowledge enables the poultry keeper to learn which hens pay profitably for him, and which do not, which lay good eggs and which do not. He can convert the non-layers, the poor layers and the layers of imperfect eggs into ready money, retaining only those which produce good goods in profitable quantity. He can breed from good layers only, discarding those, which, in his opinion, would not be likely to transmit a persistent laying tendency and other desired qualities to their offspring. He can pedigree his stock if he likes, just as other animals are pedigreed, for he can keep a record of the sire and dam of each and every chick. I would rather know the dam of the 200-egg pullets than to know how many eggs that dam laid.

In short, the trap nest assists the poultryman to learn all about each individual hen, her good and her bad qualities for stock purposes, and also her breeding value if desired.

The domestic hen when compared with other domestic animals, is a fearfully mixed up proposition. There seems to be no stable system of breeding, or

feeding or culling for hens and no such thing as uniformity in production than can be depended upon year after year.

A practically universal lack of knowledge of the individual bird and failure to build upon known individual productive ability, combined with the practice of mixing blood without guide or reason, is sufficient to account for the condition as it is.

The trap nest system is practical. Those who are fortunate enough to own a suitable equipment of good traps, and are practically interested in poultry work, give it their unqualified endorsement.

Some widely exploited trap nests have limitations which make them expensive to install and also make excessive demands upon the time of the user, but those specific faults should not be charged against the trap-nesting system as a system.

HOW SOON AND LONG ARE EGGS FERTILE?

The question, How soon are eggs fertile is often asked during the hatching season and very few can answer it or come anywhere near doing so. We give below an experiment which certainly throws considerable light upon the subject. A number of experiments have been made, but one of the most thorough of those experiments was that made some years ago by M. C. E. Spires, of Ohio, says the Farmer's Voice. It was directed to the solutions of the two related questions, how soon after the introduction of the cock in the pen can fertile eggs be expected, and for how long after the removal of the male will the eggs continue fertile? In carrying out the experiment forty Leghorns were divided into three pens, with suitable runs, and males of the same variety were placed in the pens on February 18. They were the first males that had been on the place, so that there had been no opportunity for any previous fertilization. Twenty-one eggs were secured on the first day, none of which were fertile; eighteen on the second day, with two fertile; twenty-four were laid on the third day and twenty on the fourth and of these twelve were fertile in each lot; twenty were laid on the fifth day, of which fifteen were fertile; twenty-four on the sixth day, of which nineteen were fertile; fifteen were obtained on the seventh day, of which twelve were fertile; nineteen on the eighth day, of which seventeen were fertile, and nineteen on the ninth day, of which eighteen were fertile.

The males were removed on July 1, on that day

nine eggs were obtained, of which six were fertile; on the second day thirteen eggs were laid, all of which were fertile; on the fifth day twelve were laid, of which ten were fertile; on the seventh nine were laid, all being fertile; on the eighth thirteen eggs gave twelve fertile; on the ninth day eleven eggs gave nine that were fertile; on the tenth day twelve eggs gave nine that were fertile; on the eleventh day nine eggs gave six that were fertile; on the twelfth day nine eggs gave three that were fertile; on the thirteenth day nine eggs gave three that were fertile; on the fourteenth day eight eggs were laid, of which but one was fertile, and on the fifteenth day ten eggs gave two that were fertile.

From this experiment it would seem that with breeding stock in good health and vigor eggs may be expected to be fertile after the birds have been mated for a week, and that they will continue to be fertile for about ten days after the male has been removed from the pen.

KEEPING POULTRY IN HEALTH.

There is no reason why we should not have strains of strictly hardy stock, and yet it seems to be a fact that contagion and a multitude of ailments continue to be the "besetting sins" of poultry in the hands of the farmer.

A glance at the "query departments" of the leading poultry journals shows that now, as of yore, there are cases of cholera, roup, liver complaint, vertigo, apoplexy, scaly legs, bronchitis, canker, swelled head, diarrhoea, crop bound, indigestion, catarrh, egg bound, soft eggs, bumble foot, scurvey and scrofulous troubles, and so on. We mention them as they come to mind.

Now, from past experience, we know that at least two-thirds of these "besetting sins" can be avoided. And we further know that it is possible to have a strain of strictly hardy stock. In the first place, lice cause more trouble than anything else. These miserable pests sap the life out of the stock, both old and young. They weaken the body, and any other disease has, in consequence, easy prey.

Dyspepsia or indigestion can be avoided by the use of sharp grit. But it must be sharp, or it is not worth anything. Oyster shells will not do for grit, neither will coal ashes. Something harder is required. Neglected indigestion will lead on to liver troubles. Keep the fowls free from indigestion, and liver

complaint will be more scarce. The combination of life and indigestion is what makes up the average case of so-called "cholera." Genuine cholera is a very rare article in this country.

Over-feeding is the direct cause of vertigo and apoplexy. The blood rushes to the heads of the fowls, the body becomes sort of paralyzed—death suddenly winds up the case.

This getting hens too fat ends in cases of egg-bound and soft-shelled eggs, where it does not reach the vertigo or apoplexy stage.

Bronchitis comes from exposure to damp or wet weather, and when neglected results in consumption.

Roup, canker, distemper and swelled head have their origin in some neglect by which fowls catch cold.

Diarrhoea, too, follows exposure to damp, cold and wet weather; and filthy houses and runs, or too much green food and not enough grain, are also guilty.

Sleeping in draught, or confinement in damp places, not only gives swelled head, but also shows itself in dyphtheria or ulcerated throat.

Costiveness and constipation are due to continual feeding on dry food, without sufficient green stuff. Also to a want of sufficient supply of pure drinking water, or too close confinement.

Rheumatism and cramp come from exposure to cold or wet weather, or roosting in damp and cool houses.

Leg weakness is another penalty for over-feeding. Bumble foot comes from flying from high roosts.

Too close confinement, damp and muddy runs, and not sufficient meat or green food, are the prime causes for scaly leg.

When fowls are sick they should at once be placed in warm, dry quarters. Colds, roup, dyphtheria, diarrhoea, cholera and scaly legs are contagious, and should never be allowed in well flocks. No matter how slight the ailment may seem, the bird should be isolated.

Over-crowding is a common evil, and should be avoided. Nothing is gained. It is false economy of space. Lice more rapidly accumulate in crowded quarters. Filth is more sure to present itself only to introduce sickness and death. The vice of feather pulling owes its origin to this condition.

Inbreeding.—Need we say anything concerning inbreeding? Some fanciers are endeavoring to stretch a point by saying "No harm is done." Can any wise

person be of such an opinion? Can any one who has bred stock of any kind show that new blood is not highly essential to good health? Wara says consumption is the disease most carefully to be guarded against. A consumptive strain will be a constant source of care and disappointment. Squirrel tail is sure to be reproduced in many of the young birds. Wry tail is also hereditary. Crooked breasts, thumb marks on combs, or any peculiarity in the spikes of the comb, white face where red is the proper color, is dangerously hereditary; ear-lobes splashed or marked with red where pure white is a point, vultured hock—all these defects will be reproduced. Birds with malformations or anything missing, such as being short a toe, or having any peculiarities, should not be used for breeding.

So, in short, to have a good and sound strain of fowls, all deformities and evils in breeding fowls must be noted; the stock must be kept free from lice, have clean, warm, dry and roomy quarters; must be compelled to exercise to gain a good appetite—and sharp grit to masticate the food. During cold, wet weather, the birds must not be exposed, and must be equally protected from the hot suns of summer.

Prevention is an art, and if we know the cause of disease, how easy it is to check it before it starts, and how hard to cure it after it has begun to root itself.

STICK TO ONE BREED.

It is a hard matter to convince the beginner that his chances of success are multiplied when he confines himself to one breed, but this fact is admitted by experienced breeders in every section of the country. The uninitiated will put forth what to him appears very good argument against sticking to one variety, but we have noticed that those who began with many breeds, if they succeeded at all, dropped them, one by one, until finally the one breed which paid them best, received their entire time and attention.

The selection of the breeds depends a great deal upon the end in view. An egg farm would undoubtedly get best results from the Leghorns, while a combination broiler and egg plant would prefer the Wyandottes, Plymouth Rocks, or some other similar variety.

For the farmer there are few breeds that can beat

the Plymouth Rocks and Wyandottes, and no one will make a mistake in selecting either of these varieties for their foundation stock, whether buff, barred or white, this being merely a matter of preference. The advantages of one breed over several are many. A man who starts with several breeds, must confine each separately, and to do this requires time and money. It also means denying them the free use of the range, and although confined birds have produced as well as any others, the free range birds always show the greater stamina and vitality.

The best breeders may tell you that their birds do equally well penned, but it is more expensive, and as breeders, their eggs are not usually as fertile, nor are the offspring as vigorous and healthy. However, the fancy breeder handling several varieties, has usually no other recourse, but why should the farmer want more than one breed?

Mixing them don't get him better results, that is sure. If he thinks so, let him select two coops of birds, one to be all of one color, the other the usual coop of farm-yard mongrels. Take them to town, offer them for sale, and we venture it will not take him long to decide which is the most profitable.

It is not alone the farmer, however, whom we would pin down to one variety. The beginner, whether he is going in for fancy or utility, should decide on one breed. Look over your poultry journals to-day, select the names of the foremost breeders in the land, and invariably you find them concentrating all their time and energy perfecting one breed, and reaping a golden harvest in consequence.

If you think otherwise, write to any breeder who through his success is entitled to speak with authority, and we think he will bear us out in our advice, stick to one breed.

THE VARIOUS STANDARD BREEDS OF FOWLS.

American Class.

Plymouth Rocks—Barred, White, Buff, Black, Partridge, Silver Penciled.

Javas—Black and Mottled.

Domineques—Rose Comb.

Rhode Island—Reds, Single Comb.

Buckeyes—Pea Comb.

Asiatic Class.

Brahmas—Light and Dark.

Cochins—Buff, Black, White and Partridge.
Langhams—Black and White.

MEDITERRANEAN.

Leghorns—Single Comb Brown, Rose Comb Brown, Single Comb White, Rose Comb White, Single Comb Buff, Double Comb Buff, Silver Duckning.
Minorcas—Single Comb Black, Rose Comb Black, Single Comb White.
Spanish—White-faced Black.
Andalusians—Blue.
Anconas—Mottled.

ENGLISH.

Dorkings—White, Silver Gray, Colored.
Red Caps—Rose Comb.
Orpingtons—Single Comb Buff, Single Comb White.

POLISH.

Polish—White Crested Black, Bearded Golden, Bearded Silver, Bearded White, Buff Laced, Non-Bearded Golden, Non-Bearded Silver, Non-Bearded White.

DUTCH.

Hamburgs—Golden Spangled, Silver Spangled, Golden Penciled, Silver Penciled, White, Black.

FRENCH.

Hondams—Mottled.
Cuvecoeus—Black.
La Fleche—Black.

GAMES AND GAME BANTAMS.

Games—Black Breasted Red, Brown Red, Golden Duckning, Birchen, Red Pyle, White, Black.
Game Bantams—Black Breasted Red, Brown Red, Golden Duckning, Silver Duckning, Birchen, Red Pyle, White, Black.

ORIENTAL GAMES AND BANTAMS.

Indians—Cornish, White.
Sumatras—Black.
Malays—Black Breasted Red.
Malay Bantams—Black Breasted Red.

ORNAMENTAL BANTAMS.

Seabrights—Golden, Silver.
Rose Comb—White Black.
Booted—White.
Brahma—Light, Dark.

Cochin—Buff, Partridge, White, Black.
Japanese—Black Tailed, White, Black.
Polish—Bearded White, Buff Laced, Non-Bearded.

MISCELLANEOUS.

Silkers—White.
Sultans—White.
Frizzles—Any Color.

TURKEYS.

Bronze, Narragansett, Buff, Slate, White, Black.

DUCKS.

Pekin—White.
Aylesbury—White.
Rowen—Colored.
Cayuga—Black.
Call—Gray, White.
East India—Black.
Crested—White.
Muscovey—Colored, White.
Indian Runner—
Swedish—Blue.

GEESE.

Tonlouse—Gray.
Embsen—White.
African—Gray.
Chinese—Brown, White.
Wild or Canadian—Gray.
Egyptian—Colored.

WHAT BREED TO SELECT.

Many mistakes are made by the beginner in selecting breeds that are not suited for the purposes which they are needed. In selecting breeds that are wanted for egg production we should not make mistake in securing those breeds that are needed for this characteristic. The same will apply if in want of breeds for the amount of meat we should not secure the smaller breeds. What is wanted is heavy-bodied fowls. Before purchasing fowls to make a start, we should decide what we want and what is expected of the breeds we are going to keep. If we want fowls for egg production we have a large variety to select from, any variety of which will pay a good profit if properly cared for. The Mediterranean class produce large quantities of eggs. These fowls are so strong physically that they will stand much pushing for egg production. They are regular egg machines. They

do not stand confinement as well as most other breeds; if given free range their egg production will be doubled. The leading varieties of this class are Black and White Minorcas, White and Brown Leghorns. The Minorca resembles the Leghorn in shape and style, but is much larger. This breed can be safely recommended to lay as many or more eggs than other breed of fowls. They lay large, white eggs. Both as chicks and fowls are very hardy, mature early, and are non-setters. Leghorns, both white and brown, are the most popular of the Leghorn class, and are wonderful egg producers. They are much smaller than the Minorca. Leghorns are considered to be non-setters, but I have had the Brown to set and make good mothers. If fowls for meat are wanted, select some variety of the Asiatic class. The most popular are Black and White Langshans, Light Brahma and Buff Cochins. Langshans should be placed in the middle class; our personal experience has taught us to prize them very highly as a general purpose fowl. For eggs and broilers they are not surpassed by any breed. They are smaller than other Asiatic varieties, and mature much quicker; they produce more eggs during the winter than any other breed. Light Brahmas stand at the head of all breeds as meat producers, they are the largest of all other fowls; they are good winter layers and stand confinement better than other breeds. Buff Cochins are not quite as large as Brahmas, but look much heavier on account of their being more fluffy; they are fair layers of large, brown eggs; make good setters and first-class mothers. If you wish to raise fowls for general purposes, that is, meat and eggs, select some variety of the American class. The most popular are White and Barred Plymouth Rock, White and Silver Wyandotte. As a utility fowl any of these varieties cannot be surpassed. Barred Plymouth Rocks are great favorites; they are adapted to both farmer and fancier; they do well on free range or small runs. They are good egg producers, good setters and good mothers; chicks are hardy and mature rapidly. Silver and White Wyandottes are the ideal farmers' fowl—have the same qualities as Plymouth Rock, but their chicks mature two to three weeks earlier than any other breed.

BREEDS OF FOWLS.

There are many popular breeds of fowls. As to

which breed you should select, that depends upon several matters. A great many poultrymen advise that you select the breed that suits your individual taste or fancy the best. But to advise thus is wrong. If you are breeding fancy fowls, that advice may do, but if you are raising eggs or poultry for the market that advice will not do. For instance, if you are raising eggs for the market, you do not want to select a breed that will not produce eggs. For egg producers, you want not the large fowls that are noted for the meat production. Should you want a meat producer, you will not want a small, nervous, active egg producer. And there are other questions that will affect this matter. We give here the characteristics of the different breeds and you should study this matter with a great deal of care, for many mistakes are made regarding the breed that is selected. There is a medium class that is good for both meat and egg producers. These are not as large as the Asiatic breed, and are not so good for meat producers, but still they grow large enough to be profitably raised. And they are good when it comes to egg producers. The Wyandottes and Plymouth Rocks are good specimens of the American class of fowls, and the Leghorns of the Mediterranean.

It will not be out of place here to insist upon your selecting a pure breed. Many poultrymen make the mistake of selecting anything in the shape of a chicken. You will find it more profitable to have a pure breed and stick to it. Scrubs do not pay. If you are going to raise poultry for your family use, you can select a pure breed just as well as you can a mixed breed, or a scrub. If you have not the money to start out on a large scale in the pure breed, select just a few and get rid of your scrub stock. You do not need mongrels if you are going to make money out of the poultry business. If you have a pure breed you will take much more pride in them, and secure better results than if you had a mixed stock.

WHITE GEORGIAN GAMES.

This Southern Fowl makes one of the prettiest sights that you can see on a lawn. They are pure white in color, have an elegant carriage, have great courage and intelligence. They are now pure bred in the South, and are popular wherever known. As a farm fowl, they are excellent, producing a goodly number of eggs. They should be pure white all over, with no shade on the neck, breast, hock or tail. The

legs have to be white or yellow and the beak should harmonize with the legs.

GAME BANTAMS.

The Game Bantams are wonderful birds, being but little larger than pigeons, but having wonderful courage, brilliant plumage, and carrying themselves erect. They can be kept in the yard with large breeds without any danger of intermixture, but at the same time they will be found masters of the yard. They will be found quite profitable in protecting the fowls from intruders, as they will give due warning of approach of danger.

There are other varieties of Bantams, such as the Black, the Cochins, the White, the Brahma, the Seabright, and the Japanese. The Seabright is also divided into two classes, the Golden and the Silver. The cocks of the Seabright should not weight more than twenty ounces, and the hen more than sixteen ounces. The Japanese variety is the most striking of any variety of Bantams. The variety cannot stand cold weather, and for that reason are very suitable for the South.

COCHINS.

This is one of the largest of the many breeds of birds, and is quite popular. There are several varieties of this breed, and the characteristics for several of these varieties are as follows: The comb of the cock is single, rather fine, upright and straight, stout at the base and tapering to a point; the eye is bright and mild in expression; hackles of the neck full and abundant, reaching well to the shoulders and cape; the back broad with a gentle rise to the middle of the tail, with a great many saddle feathers; the wings small; the tail small, curved feathers numerous, the tail being carried horizontally rather than upright; the breast deep, broad and full; thighs large and strong, covered with soft feathers. This variety still continues to hold a high place in the estimation of the public, the Buff variety being the most popular. Like the Brahma, they are good winter layers and being of good size make excellent roasters. There are four varieties, the Buff, Partridge, White and Black, the two former having the preference in the estimation of the public.

LANGHANS.

Another deserving breed, of which there are less

shown every year, although one of the best winter layers of all the large varieties; very hardy, easily kept thriving in confinement, and layers of dark shell-ed-eggs of medium size. The Black is the most popular color, the surface of the plumage throughout being close and smooth, very brilliant with greenish reflections. The standard weights are as follows: Cock 10 pounds, cockerels 8 pounds, hens 7 pounds and pullets 6 pounds.

WYANDOTTES.

The Wyandottes are another American breed that have sprung into public favor by virtue of their good qualities. They are a fine combination breed, being good layers and a fine table fowl. Under strong specialty club work the Wyandottes have been rapidly placed in the front ranks, which position they will maintain.

Hamburg and Dark Brahma blood runs in their veins, and in breeding the white variety it is found to be a hard matter to get them free from creaminess. Their standard weights are: Cock 8 1-2 pounds, Cockerel 7 1-2 pounds, Hens 6 1-2 pounds, Pullets 5 1-2 pounds.

BRAHMAS.

This grand breed of birds deserves a place in the houses of more breeders than are at present handling them, but they are not found at the shows in numbers like in former days. They are among the most beautiful of all birds, hardy, fine winter layers and largest of all the breeds, standard weight of the male being 12 pounds, hen 9 1-2 pounds. There are two varieties, the Light and Dark Brahmas, the former being the most popular.

PLYMOUTH ROCKS.

The Plymouth Rock is an ideal fowl, and probably one of the most popular of all the breeds, being found on nearly all the farms of the country, making a good combination egg and meat bird. It is somewhat larger than the Wyandotte, not so blocky, and different in all sections.

The three varieties of this breed, the Barred, White and Buff are all identical except in color, that of the Barred Rock being extremely hard to describe, and can only be learned by observation. Good specimens are extremely hard to raise, and in the Barred varie-

ty the same shade of color should prevail in all sections, and should be barred to the skin.

The White Plymouth Rock is fast eclipsing all others, plumage should be clear and white and free from all business, as well as creaminess.

The Buff Plymouth Rock plumage should be a rich golden Buff, very light and very dark, being two extremes that are undesirable. The same shade should prevail throughout every section. The cock should weight 9 1-2 pounds, cockerel 8 pounds, hen 7 1-2 pounds, pullet 6 1-2 pounds.

LEGHORNS.

A breed so well and favorably known as to require very little introduction. They originated in Italy, are somewhat small in size, with yellow legs, white ear lobes and active and sprightly in disposition. They are hardy and prolific, non-setters, few of them ever showing a tendency to broodiness. As producers of good sized eggs in great numbers, they stand unrivaled and on the egg farm are readily the preferred fowl.

Fig. 37.—Nomenclature Diagram of Fowl.

0. Beak,	6. Breast,	12. Tail Coverts,	18. Flight Coverts,
1. Comb,	7. Back,	13. Main Tail Feathers,	19. Point of Breast Bone,
2. Face,	8. Saddle,	14. Wing bow,	19-20. Body and Fluff,
3. Wattles,	9. Saddle Feathers,	15. Wing Coverts,	21. Thigh,
4. Ear Lobe,	10. Sickles,	16. Secondaries, wing-bay;	22. Knee Joints,
5. Hackle,	11. Lesser Sickles,	17. Primaries or Flight feathers,	23. Shanks,
	24. Spur.		25. Toes or Claws.

There are seven distinct varieties, but the White and Brown are the ones that hold the favor of the breeders everywhere.

They are too small to hold a place as broilers, but are the ideal fowl for the man who wishes to produce eggs for the market.

MINORCAS.

The largest of the Mediterranean class, formerly known as Red Faced, Black Spanish. Like the Leghorns, they are non-setters, layers of the largest white shelled eggs of any breed and one of the prettiest fowls in the entire list. In the Black variety purple shade in surface color is a distinct detriment, a green brilliant black being the desired color. The single comb variety is the most popular, the Rose Combs not being popular in the South. For cold climates, the latter are preferred, the single comb variety being susceptible to cold, owing to their large comb and wattles, which are easily frozen. Their general appearance is graceful, aggressive and commanding, and as layers they excel many of the other breeds.

The White Minorcas resemble the White Leghorn to a considerable extent, and are not very popular here.

ORPINGTONS.

We now come to one of the English classes that has gained marked popularity throughout the country by virtue of their many meritorious qualities. They are the latest importation from England, are large and stately in appearance, very full in the breast and in the development of the back. They are docile, easily kept in confinement, and a fine combination fowl for their stately appearance and they are rapidly becoming a general favorite with all who breed them. Good specimens are high, but the demand is such that these are readily obtained.

HAMBURGS.

In the Dutch class, we have the Hamburgs among the prettiest of the entire feathered tribe. There are six varieties, the Golden, Silver Spangled, and Golden and Silver penciled leading in popularity. The White and Black are not seen much at the shows. They are excellent layers of medium sized eggs, and good foragers. They have been bred to that degree which makes them a general favorite wherever introduced.

CORNISH AND WHITE INDIAN GAMES.

In the Oriental games we have two that excel and

have earned their popularity in the estimation of breeders everywhere, these are the Cornish and the White Indian. They are of English origin and produced by crossing a low Derby Black Breasted Red Game with a Red Aseel imported from India, the blood of the Sumatra Game having also been later introduced. They have short thick legs, large thighs and deep and broad breast, great width of back at shoulders, with comparatively short neck. Their plumage is beautiful, that of the Cornish having great lustre, and as layers they rank with the best.

JUDGING.

In judging any of the Standard Breeds of land and water fowls, the judges either use the Score-card or judge by comparison. The latter system is used almost entirely at all the large shows, and is gaining advocates even among those who formerly stood fast for the Score-Card system. We append herewith a copy of the Score-Card as now used, which will give the reader an idea as to what sections are considered by the judge in cutting for defects.

OFFICIAL SCORE-CARD OF THE ATLANTA (Georgia) POULTRY ASSOCIATION.

There are two ways of judging a chicken, by score card and by comparison, the latter is principally used at early shows and fall fairs, when birds are not in full feather, and is not near so satisfactory as the score card, for under the comparison system if you do not accompany your birds to the fairs, if you are fortunate enough to win a ribbon or two, you have no means of knowing which bird or birds won, as there is no record kept of the particular bird winning, and you are only notified of your success without telling you which bird was the successful competitor, and a breeder, especially if he is just starting out, would like to know his best bird, so that he may be able to compare it with others of his flock, and see how many are like it. The score card system is much more exacting, and where a class is well fitted as the Rocks, Wyandottes, Leghorns and Minorcas are at most shows to win in these classes is an honor, especially is this true when the judge is an experienced man and knows his business. The ideal bird should score 100 points, but the ideal has never been attained, 96 points is as near a top notch as competent judges go, and a 94 or 95 point bird is a "thing

of beauty" in the show room (even if it is not much of a breeder or egg-layer.) The score is divided into sections, and run as follows: weight, symmetry, condition, head shape and color, comb, shape and color, wattles and lobes, shape and color, neck shape and color, back shape and color, breast shape and color, body and fluff shape and color, wings shape and color, tail shape and color, legs and feet shape and color, so you can see that it would be almost impossible for a bird to be perfect in all these points, and it takes long and hard study for one to be able to pick from a flock of pen or trio to exhibit, in fact, it is almost an impossibility to do so without one has a copy of the Standard at hand, and then to go over each bird section by section. And at shows where the score card

are a yellowish flesh color. A pair of Plymouth Rocks with clean, bright, yellow legs is a rarity, and not often seen.

In the above I have briefly related one or two of the Standard requirements of the B. P. Rock, another great point is color, which should be grayish white with blue bars across each feather, which should be even on all parts of the plumage, and the male and female should be exactly alike in color, and those who are breeding Rocks know how hard it is to do this, as nine times out of ten the cockerels are light and the pullets dark and, in fact, are sometimes almost black. Such birds would stand no chance in the show room, and the only way to produce such birds is to go "agin" nature, and double mate; that is, all

Fig. 38.—Part of poultry farm of G. B. Thrasher, Dallas, Tex.

is used you receive the score card from the secretary of the show, showing wherein your bird or birds were defective. The heaviest cut is for weight, for instance the Standard weight of a B. P. Rock cock is 9 1-2 pounds and the specimen shown only weighs 8 1-2 pounds, he is cut two points, one point of every one-half pound he is short; that would bring his score down to 98 points on the start, and with such handicap, the bird could not score over 90 or 91, if that. The comb on any breed is hard to get true, and on most scores a cut of 3-4 to 1 1-2 will generally be found. The comb of a Rock should be medium sized, single and straight, with regular serrations or points five in number. Then again, the Standard says Rocks should have yellow legs and bill, and it is almost impossible to produce them, a little brown or black will crop out on bill, and the shanks are more or less cloudy with blue black scales, and instead of the legs of either sex being yellow, the larger number of them

the dark hens and dark males to produce cockerels, and all the very lightest hens and light males to produce pullets; the cockerels from the pullet yard are worthless and the pullets from the cockerel yard are only fit for table.

THE AMERICAN STANDARD OF PERFECTION

No one who raises poultry can expect to do so intelligently unless he is familiar with the rules which govern the judgment of fowls, as laid down by the American Poultry Association in their work known as the American Standard of Perfection.

This work is absolutely necessary, and should be in the hands of every breeder of thoroughbred or rather standard-bred fowls. It is a valuable aid to the beginner and an essential to the older breeder, and so far the new edition has already passed the 10,000 mark in copies sold.

It fully covers the ground which every breeder has to know, in order to breed fowls intelligently, gives a full description of all the breeds recognized in the Standard, and defines and illustrates the various sections of the bird, gives a glossary of technical terms, general disqualifications, etc.

A full description, with illustrations of all the breeds are given and with this work in hand any one can soon familiarize himself with the rules, so that he can score his birds with a certainty and satisfaction.

A STUDY OF THE POINTS OF FOWLS NECESSARY.

If you are going to raise poultry, especially fancy poultry, you must make a close study of the makeup of fowls. You must not only know the physical characteristics of fowls, but you must have a close discrimination for the various feathers, markings and characteristics, for these are quite important especially with fancy breeders.

SEASONABLE HINTS.

Do not permit the old fowls to have access to the same inclosure in which your brooder chicks are kept, nor mix the chicks reared under hens with those that come from the incubator, as lice and mites are often thus communicated to the detriment of the entire flock.

Chicks hatched in incubators are free from vermin, provided you have kept the machine clean, but all this is of no avail if the chicks from a lousy hen have access to these quarters.

The beginner having a lot of breeding stock to purchase in getting his foundation stock, is bound to get some birds inferior to others, birds that it would pay him to cull out entirely. It is imperative to start with young stock, preferably pullets headed by vigorous matured males, and by doing so you will have less occasion for losses, and with care and attention your profit will commence the first season.

The old notion that old hens would produce better and stronger chicks than a young hen, has long since been exploded. Pullets with a vigorous cock bird is the way to mate for strong healthy offspring.

Culling is one of the most important requisites in successful poultry breeding. It takes more to weed

out everything in the flock that should go, but it pays in the end.

An egg-eating or feather-pulling hen; no matter how fine a bird or how excellent a layer; should be killed and marketed at once. Besides teaching the vice to others she will in a short while eat up more than her worth in eggs.

The hen that develops a mania for broodiness is all right in that particular line, but in no other, and should be promptly disposed of. Likewise, the lazy hen that lingers on the roost late in the day, cull out and replace with others or fewer hens, but have them good, which means profit. Any other means loss and disappointment.

One of the great secrets of success in profitable poultry keeping is the prompt isolation of droopy or sick fowls from the flock, and the killing and burning of diseased fowls, as soon as discovered where the case seems beyond cure.

The bird must indeed be a valuable one to warrant the breeder in risking the balance of his flock in the attempt to cure. Every well-regulated poultry establishment should have its quarantine and it will many times repay the cost of construction, and insure against spread of contagion from diseased birds.

The man who succeeds with poultry is usually a close observer and critically examines his birds on every occasion. A visit to the hen house at night will eventually impress you with its importance.

If you hear any wheezing or sneezing or see any shaking of head, take these birds in hand at once. Few who make a practice of visiting the houses at night have occasion to complain of spread of contagion, as by this process we are enabled to nip in the bud any disease with which the birds became affected.

Avoid damaged and musty grain, and feed no carrion or tainted meats. The meat scrap should be sweet and fresh, and the grain good and sound. Have the water fresh and clean, cool in summer and not frozen in winter. Supply grit, also lime in some shape, such as crushed oyster shells, plaster, rubbish or its equivalent, and granulated or broken charcoal continuously.

Of equal importance are comfortable and clean quarters. You may observe all other rules and still fail if you neglect to protect your fowls against lice and mites, tainted ground and draughty houses. One of the villainous practices which are still observed by unscrupulous breeders, is the killing, dressing, and

marketing of diseased poultry. It is a good rule never to sell a fowl that you cannot leave the head on, nor buy one with the head off. The offering of dressed poultry so presented that evidence of disease is not discernable, gives opportunity to rascally dealers and hucksters which they eagerly grasp. Just as some eggs look best "scrambled" so some birds look best "heads off."

One needs only to look into the dealers' coops throughout the country to appreciate the luxury of a farm-raised, healthy fowl. The servants entrusted with the buying of the table fowl are often careless of his or her responsibility, and many an unhealthy bird finds its way to the table that one would spurn to eat, were the facts known.

The trap nest, while not much in use in our section, has everything to recommend it to our people. Those who use them become their firm advocates and they should be used by every breeder in the land.

Fattening broilers is an art worthy of greater study on the part of those engaged in supplying market demands. Free range is neither essential nor desirable. The young chicks put on better growth and develop a larger frame when given the range, but fully two weeks before marketing they can be fattened quicker and to greater advantage by confining, which causes relaxation of any of the muscles that have developed on the range, and makes the fattening process surer and quicker at less expense than otherwise. Forcing food will do very well for broilers, where the profitable age is short, but it is a mistake to force chicks intended for breeders. For these nothing is better than free range, sound, hard grain, freedom from crowding on the roost, and clean, well-ventilated quarters.

The practice of feeding chicks under four weeks of age mash feed has its ardent advocates, but we advise our readers to stick to the successful tried methods of hard grain, which eliminates or at least minimizes the chances of bowel trouble, and a hundred other ills which follow the other method when used by inexperienced people.

The number of excellent brooders now on the market are the result of a demand for less death-traps and more chicken-raisers. Buy the best, regardless of first cost, as it will save you loss of time, worry and expense. In the South much attention must be paid to ventilation in the brooders. Disregard operating instructions when your own judgment prompts you to

do so. It is safe to give plenty ventilation at all times, provided the temperature is kept right. As long as the chicks crowd they are not comfortable and more heat should be given.

The brooder should be kept clean by using sand or earth on the floor. Dusty sand is not best, coarse sand is what is needed. By using a coarse comb as a rake, the droppings are easily removable without changing the sand often. As soon as the chicks show an inclination to roost, get them out of the brooders into conveniently arranged chick houses, with low roosting poles, and if necessary place them on these a time or two, when they will take to them naturally and teach any of those otherwise inclined to do likewise.

DUCK RAISING FOR PROFIT.

This branch of the poultry business holds special inducements for those whose yarding space is limited or circumscribed, for the reason that ducks are quiet creatures. An inclosure twelve inches high suffices for duckling harbors, and a two, and at the most, a three-foot-high fence for large ducks.

The fence does not require to be so firmly built, especially at the base, as for other birds, ducks having no "scratchers," but if properly fed and watered are "contented in their lot."

More pounds of ducks may be raised to the square foot than of any other fowl. In three months twenty-five ducks will market between 125 and 150 pounds and produce five pounds of fine feathers and down.

Ducks mature more quickly and get out from under the mother wing sooner than our other standard varieties of poultry. The ducklings are independent little creatures. After the first month or six weeks they require very little attention from the parent bird.

I have tried ducks and found them very satisfactory. On a quarter of an acre we annually raise between one and two thousand birds. The rest of the place except along the river, is left at peace.

I used hens for incubating the eggs, at first having five female ducks, and a drake and about a dozen good, motherly hens. About four hens were set at a time, nine eggs under each hen. In about ten days the eggs were tested out, the nests doubled up so each still held nine eggs. In this way we secured a good sized flock of the same age, that at about six weeks of age were separated from the hens, yarded and fed together.

Ducks need little exercise on an extended range, especially where preparing for market. But they need clean, dry bedding at night and shade from the sun during the day, and they must not be exposed to long, cold rain-storms. They do well in feeding from a V-shaped trough and the same for drinking. There may be a slat running lengthwise through the center, so as to keep the birds, all but their bills out of the trough. They need a pan or box of warm sand or fine grit in the yards, near the feeding troughs.

Regarding their housing or shelter. When it is possible, a good roof is a great comfort to the care taker, and a floor space protected from the rains, but they can be raised out-doors in roomy packing boxes quite successfully.

Mortality among ducklings is mostly due to over and improper feeding and the chilling of young birds. They can be fed to good advantage four times a day, all that they will eat up clean and quick in about ten minutes. The troughs should be sufficiently roomy to give each bird an equal chance at the food and no danger of the weaker being crowded away and losing the nourishment that it specially stands in need of. It is better to water the birds after, not before they are fed. The drinking vessels should be sufficiently deep to submerge the entire bill so the little fellows can squirt the water through (and thus cleanse out the nostrils). Otherwise the nostrils become clogged and the birds are liable to smother. When in this condition they throw back their heads, tumble over on their backs, a few kicks and they are among the yesterdays. The same symptoms accompany indigestion and sunstroke.

Indigestion is due to a forcing diet and overfeeding. Also a sudden chill—the change from a hot brooder to a cold outer atmosphere, especially at feeding time. Ducks require more fresh air, and will stand more cold than chicks. It is the sudden changes and the fetid brooder atmosphere that is injurious.

A good diet for the first week is one-third wheat bran, one-third brown middlings, one-third corn, to which is added a tenth of coarse sand or fine grit all mixed into a creamy mash. For the balance of the first month to the above add 5 per cent. or one-twentieth of fine beef scrap or blood meal. During the second month increase the beef to one-tenth (in weight nine parts of grain and one part beef) and add about one-fourth in bulk green stuff, cut clover,

lettuce, grass, etc. During the last two weeks of the third month give one part bran, one part middlings, two parts coarse meal and one-seventh of beef with same proportion of green stuff till within a week of marketing, when green must be discontinued.

Ducks will only stand this last high-forcing diet about two weeks and must be then promptly marketed, else they fall back in flesh and it is never possible to get them up to as good weight again, besides the extra expense. During the high-forcing it is very important to watch their feed and keep them a little hungry all the time.

THE BEST HATCHING SEASON.

Spring is the season of the most rapid growth and quickest development of all the year. It is the wild fowls' and the birds' hatching time—nature's own time. The March winds have ceased, the cold, blowing rains are over, the April showers are giving way to the more settled and calm period that comes with May. Indeed, all things are now favorable to the hatching of the chicks and their rapid development. Nearly every egg set now means a chicken at hatching time, for the highest per cent. of fertility is now.

There is a certain aggressiveness in human nature that makes us try to do things out of season, and to accomplish that which ordinarily is quite impossible. That is why we study the methods that will make hens lay in winter; and the same natural bent produces the artificial hatcher and brooder. We all love to overcome the seemingly impossible, and to be ahead of the seasons—to circumvent nature, as it were.

And so we rush through the hatching process prematurely, and then, when nature has just settled down to it, we are through. At least, the man with the incubator is well supplied with young chicks when the trees are in full leaf. And yet it is then—the present time, that things have just gotten in good shape for natural hatching, as we have cited in the case of the wild fowl and the songsters of the groves and the fields.

In the spring is really the best time for hatching and brooding chickens with hens, because the conditions are so favorable for foraging. The chickens that are hatched now will soon take to the range with their mothers and earn the greater part of their own living. And that which is true in this respect now will hold good for the next six weeks following, for the latter

part of April and the first half of May comprise the ideal hatching period; and if kerosene oil should be used freely about the nests and coops the young chickens will suffer no setback whatever in growth and development.

Let no one who has not yet taken action in regard to getting out some chickens this year hesitate under the impression that it is now too late, for such a conclusion would be erroneous, for better results and quicker returns could not be obtained at any season for one's work and money in the hatching line than in the spring. This is particularly true of the smaller varieties of thoroughbreds and of Pit Games which are rapid growers, and which also develop early. Neither is it too late to hatch the larger breeds successfully. Only to-day we saw a fine young Barred Plymouth Rock cockerel in a breeding yard—a cockerel which was hatched as late as July, and yet he is now well developed and a very fine bird. Pullets of the same mating with him are now laying; and yet they are good sized young hens, too. But it is not July yet, nor June—not even May, but mid-April, the zenith of the laying and hatching season, and we should utilize it fully by unusual activity among our fowls.

PINFOLD'S PIN FEATHERS.

Sometimes the hens get tired of raw vegetables, no matter whether given to them whole or chopped. Try them with some that have been cooked, drained and mashed with a little meal. A little salt in the food will render it more appetizing and healthful.

Do not forget to put some charcoal in the box with the shell. The hens like it in pieces as fine as cracked corn.

If the hens show any disposition to "sour crop," put a little cooking soda in their drinking water.

The best layers should be noted and their eggs reserved for settings. Keep some of them on hand ready for the first old biddy that will set well.

It does not hurt a hen—if she has been properly cared for—to hatch out two settings in succession. I have done this a number of times when the hen has proved to be a good, quiet setter, and broody hens have been scarce. The hen has set the six weeks and then has come out in fairly good condition because she had come off the nest every day for food, water and exercise. Freedom from lice as insured by allowing her to dust and by keeping the nest clean. It is

never advisable to set two hatches in succession unless it is absolutely necessary.

When hens steal their nests it is a pretty good sign that the proper nests need investigating. Look them over and see if the biddies have any real excuse for deserting them.

Allow ten hens 100 square feet of space.

The cheap "rolled oats" is the best food for little chicks.

CHICKENS AND THEIR CARE.

Keep a record of each hatch.

Never set a hen with scaly legs.

Pullets are unreliable as setters.

A wild hen will have wild chickens.

Neglected chickens will be stunted.

Set each hen in an apartment alone.

When the chick droops look for lice.

Dust the hen well before setting her.

Make this the banner year for chicks.

Keep the coops and nests clean.

Be sure and set the hen in a warm place.

Keep small grit constantly within reach.

The fresher the eggs the better the hatch.

There are not positive non-setting breeds.

Sprinkle insect powder in the nests every week.

Leave the hen with her young so long as she clucks.

It is not always the fat hen that becomes broody.

Covered runs are a protection from hawks, cats or dogs. They should be moved to fresh plots every week.

PREPARATORY TREATMENT OF SHOW BIRDS.

As it takes some time to prepare a bird for show purposes, and as we hope all our readers who have anything worth exhibiting intend to prove their faith by sending it along to their agricultural fairs, we have captured a few hints for their benefit. These methods are practiced by most experienced exhibitors, and there is no reason why they are not legitimate for the amateur's use, provided he desires to benefit by the experience of others.

It is needless to say select your very finest and most perfect bird to put in trim. The healthiest birds will always win, so it is needless to waste time trying to prepare any other. As your exhibition cock and hen are apt to be moulting now, and as their new

feathers will very largely determine their success or defeat, great care must be taken to have them moult correctly, as well as looking to their new feathers. The following tonic fed to those intended for exhibition is highly recommended by one of the most successful exhibitors in America: One ounce carbonate of iron, pulverized gentian root, black antimony, mandrake, ginger and flowers of sulphur; one ounce bi-carbonate of soda; fourteen ounces flaxseed meal. Mix level teaspoonful in each quart of soft feed. The tonic is to be fed every other morning regularly, from the beginning of the moulting until the bird is completely clothed in its new feathers. Here is the treatment followed by the above mentioned fancier:

The birds intended for exhibition are placed to themselves in clean, comfortable quarters, where there is shade enough to prevent the burning of their plumage. (Rain and dampness are likewise bad for the new feathers, which should certainly receive as much attention as a delicately tinted dress). A little ammonia added to the drinking water is recommended to help remove the straw color from plumage, but it is much easier to prevent by judicious shading, than to remove after the mischief is done. The above tonic is mixed with ground oats, bran and shorts, which is thoroughly cooked and fed mornings, the tonic being added only every other morning. (Of course the cocks are kept by themselves). They are on grass runs, but where this is not possible, are fed chopped vegetables, besides receiving regular feeds of hulled oats, wheat, barley, millet, etc., liberally. A month before the date for their exhibition the birds are placed in fitting pens where the weight-forcing is begun. The tonic is then discontinued, after having given them appetites like hunters. Great care is now exercised in keeping a variety of feeds before the birds, not to get them "off feed." They still receive the soft food mornings, a moderate supply of raw vegetables are fed often, a liberal supply of cracked corn every night, and a small feed of lean beef every other night. Once or twice a week they must be dusted with insect powder, and each pen is kept bedded in clean, soft, cut straw.

In putting on the finishing touches, the legs are washed several times a week in warm, soft water, to which a little alcohol is added. They are then dried carefully and greased with a little sweet oil, after which they are thoroughly rubbed with a flannel rag. As redness of the leg is to be avoided, a little oxide of

zinc is applied to remove the redness. To give a handsome red face, ten drops of calchicum wine in one teaspoonful of water is administered daily, for ten days before exhibition. For comb and wattles, apply a little glycerine daily, working it in gently, with the fingers and thumb. Towards the end of treatment add a little alcohol to the glycerine.

Whites lobes should be handled carefully to avoid reddening. To such as need whitening, bathe in warm milk twice a day, and after drying apply a little oxide of zinc.

The following instructions should be strictly observed in shipping: On each coop securely fasten a card on which is plainly written, first, the breed of fowl it contains; second, name and address of exhibitor; third, cock, hen, etc.; fourth, "By Express." This will insure safe delivery, and avert confusion and mistakes on the part of the show management.

ROOSTER TALK.

There is more in this subject than may appear on the surface to the casual reader. There is much in it, because the subject of roosters has much to do with the prosperity of pullets, and the pullets have a direct bearing on the profits of the poultry yard.

The truth is, there are about eleven more young roosters in every dozen hatched than we need. Because they are consumers and non-producers. And, in addition, they soon become a nuisance in the poultry yard, and tend to run down the whole flock of young stock by the crowding, quarreling, etc.

It certainly does not pay to keep a number of them on the place until they reach maturity. They should be disposed of early in the season. We have had this subject up before, but, as it is a seasonable topic, it may not be amiss to consider it again.

If we will only stop to think—think what a difference it would make in the appearance of the flock of young chickens, to have none but pullets, and how much easier it would be to force their growth then, and bring them to early development and laying, we would think more then of clearing the yard of the unprofitable half of the flock.

Let the rascals be bundled up and marketed just as soon as they are large enough to eat. There is some profit in them then, and the advantage of their absence in the advancement of the pullets will add an additional profit to the season's work.

The exception to this plan is where one has purchased some fine eggs, with a view of starting a yard or mating of thoroughbreds. Then, of course, it is best to retain all of the roosters until grown, in order to select the best for mating the following season, and for the double purpose of selling the surplus ones to other poultrymen for breeding purposes. The worst specimens in a flock of thoroughbreds may be utilized to advantage in cross-mating with common hens. For, if of the great laying strains, they carry the characteristics of their breed with them; and if of the large heavy-weight kind they will produce chicks, when mated with the ordinary stock, that will be superior in size and usually of quicker growth and earlier maturity than the common run.

Indeed, it is worth our while to consider the rooster question from several different standpoints.

POULTRY POINTERS.

Lice cause more trouble to the poultryman than all else.

A little oil meal will help your poultry as well as other stock.

Keep the lice down, or down goes the profits of the poultryman.

Season the mash you feed your hens with a little pepper, or ginger, or both.

Many so-called poultry powders have but little value except to the seller.

Don't allow your fowls to go thirsty. They need water, especially the laying hens.

We advocate pure breeds, because experience has taught us that scrubs and crosses are not profitable.

Lime is a very good product about the poultry house. Liberal use of whitewash cannot be too highly recommended.

Lime is essential in the formation of the shell. See that your layers are provided with a little lime, but not unslaked lime.

If fowls have a good range, feeding will be light, as they will gather most of their living and destroy millions of insects.

A good mash is made of ground wheat, oats and corn and buckwheat, to which add a little meat scrap, bone meal and pepper.

Hens must have exercise. If they have not free range, give their feed in pens littered with straw when

they will have to scratch to find it. Scratching is according to their nature and makes them healthy.

The best whitewash for a poultry house is made by slacking the lime with hot water. It should be about the consistency of soft soap, then thin it with coal oil to the proper consistency for applying and your white wash will stick where applied and you will find it "death to lice."

The infusion of new blood into the flock is of much importance, but be sure that the new blood introduced be of a high grade.

The perches should be removed and cleaned frequently. Treated with a good coating of coal oil at each cleaning will be found the best and quickest way of exterminating lice.

It is best to remove the old nest immediately upon taking the brood off, and so prevent the spread of any insects which might have incubated with the hen.

Thoroughly grease with melted lard the heads of both hen and chicks on taking off: The hen may need greasing along the under side of the roots of large wing feathers, also.

A little pepper in the morning feed will stimulate, and correct bowel trouble in little chicks.

Never feed sloppy foods to young chickens nor other poultry. Most foods can be crumpled with corn meal.

Be sure rain cannot make their sleeping places damp. Dampness ranks next to insects in its death-reaping power.

Always keep dry wood ashes or dry dust and lime where the flock can dust at liberty. They are sure to take frequent advantage of this opportunity to bathe.

Don't let the little chicks get damp or chilled. A little care for the first few weeks will save much loss and worry.

Don't be in a hurry to feed the little chicks. Nature has provided them with sufficient food for twenty-four hours.

Don't crowd too many little chicks in one brooder or give too many to one hen. Twelve now and twenty later are sufficient for a brood.

Don't grease the little chicks, especially in cold weather. Insect powder will destroy mites and do no injury.

Don't put too many eggs under the setting hen. One too many will often cause half or more not to hatch.

Don't let the young chicks roost in filthy boxes.

Move them around every few days and sprinkle lime where they stood.

Don't let brooder chicks become lazy. Scatter grain in litter and make them scratch.

Goose, duck, guinea, turkey and chicken eggs that are shipped a great distance will hatch well if they are turned upside down in the basket and left to stand for twenty-four hours and then put under a good hen or in an incubator.

The hens prefer good nests, and when they refuse to lay in the poultry house and begin to deposit their eggs in the hay loft, the chances are that lice have taken possession of the nests.

Let turkeys roost on trees until it gets real cold, as they do better that way than if confined to close quarters. Whitewash and clean up your poultry-houses in the fall and have everything in first-class shape and see to it that your house is warm and then feed right and you can get eggs when they are bringing good prices. Laying hens need extra good care through winter.

Do not feed too much pepper to make hens lay. Pepper is a stimulant, not a food, and should be used with great caution.

If you do your part by your chickens, your chickens will do their part by you. The poultry business is one of give and take: if you give fair treatment to your fowls, they will reciprocate with gold dollars and plenty of them.

Fresh ground bone is a splendid animal food for both egg production and growth.

Select hens that lay the greatest number of eggs, for your breeding stock, if you want to increase egg production.

Feeding good, healthy feed together with good care, will require less running to the drugstores for chicken medicine.

In selecting a male for breeding purposes you will make no mistake in choosing the cock that carries his head highest, is so full of nervous energy that he dances on his tiptoes in strutting around, and who is most gallant and gentlemanly with his hens.

Always select your incubator or setting eggs with care. Pick out the largest, roundest and least chalky eggs. Nor should a "shiny" egg ever be set. They are very apt to prove unsatisfactory, and you will find them unhatched when your hen comes off. Really fresh eggs are seldom glossy, you will find.

No food is better for young ducks than cornmeal

and bran in equal parts, made into a mush with milk.

Before being fed to young chickens corn should be crushed or cracked. The whole grains are unmanageable.

In arranging perches it is best to place them on the same level and not, as is often done, with some higher than others.

The average farmer will find it the best plan to keep only one breed of poultry, but of course he should see that it is a good one.

When ducks get to be two weeks old they must have some green food, or they will begin to pine away and, if they do not die, will not thrive.

An ill-ventilated poultry house is sure to become a breeder of disease and debility. Fowls must have plenty of fresh air or they won't thrive.

Two-year-old hens produce the best eggs for hatching purposes. They possess the necessary fertility and all the elements for vigorous offspring.

Good cornmeal has been found to be one of the best of fatteners. Give the fowls all they will eat up clean, and rapid putting on of flesh will be noticed as a result.

In arranging nests, it is important that they should be so placed that the hens in getting in and out, will not break the eggs. Allow plenty of room, avoid crowding.

While whole wheat is an excellent food for hens it must not be made an exclusive diet. Variety is demanded to produce the best results, just as in the case of all animals.

Every business requires attention to bring success and poultry raising is no exception to the rule. Fowls, especially the young ones, are silly and helpless things and need constant care.

If chickens show loss of appetite, and do not eat their food with relish, it is a sign that they need more exercise and a change in the bill of fare. It is the business of the owner to look after these things.

To keep both the fowls and their house clean, is the whole law and the prophets in poultry raising. Other things are essential, but without cleanliness as a basis there will be no permanent success in the business.

The dust bath is where the hen rids herself of vermin.

The roosting perches should be so arranged as to be movable.

Chickens and "chinck" are certain results of good care of the flocks.

A good dusting place for chickens is as necessary as anything about the poultry yard.

Keep on good terms with your hens, for wild hens that are afraid of you are not desirable.

Early hatched chicks are the best. Select breeders from early hatches as they are more vigorous.

Always aim to make your poultry better. There is much room for improvement in the poultry flocks yet.

Good shape, graceful carriage and general symmetry should be well considered in selecting your breeding stock.

Remember that overfat hens will not lay, and are liable to leg weakness and sudden death. If your hens are overfat, shorten the feed, especially corn, force exercise and you'll see a change for the better.

Do not cease to guard against insects in your flock. Kerosene and crude carbolic acid are cheap, and time is money where poultry are concerned.

We are told on good authority, that perfectly healthy, properly fed poultry are never troubled by insects. The poison thrown out of the fowl's system breeds the parasites as scavengers.

Never try rushing the hens with patent "egg stimulants," whose eggs you expect to set. Egg-producing "foods" are very apt to weaken the vitality of the eggs, if they stimulate the production. Where they do not they are evidently useless.

A flock of hens are disturbed by moving from one locality to another and will quit laying for a few days upon such a change.

Ill shaped eggs should never be set. They are often infertile and those which do hatch never bring forth the best of chicks.

Poultry raising is not an experiment. It has been proven to be profitable either as an exclusive business, or as a side line.

Cheap food and cheap remedies should be given the go-by. Better be sure you are right, than to feed something unreliable.

Poultry raising on the farm requires but little capital and less attention because of the free range. Where the fowls have free range, less feed is required because they gather so much food stuff and what they gather is best.

Poultry culture, if properly conducted is a source of revenue every day in the year. A poultry plant that is properly managed should afford eggs all the year

round, and if broilers are wanted they too, can be had at any season if the poultryman desires to have them.

Build poultry houses in the South with curtain front made of burlaps. Our winters, unlike those in the North, are never so severe as to require artificially heated poultry houses. Do not coddle your fowls to death.

Cleanliness and watchfulness are the secrets of success in poultry raising. Keep the houses, roosts, watertroughs, and nests in clean and sanitary condition and you will not be bothered by diseases among your fowls. Watch out for unfavorable symptoms and remember that prompt action has saved many a fine chicken's life.

See that your poultry has a regular feed of ground bone and a plentiful supply of green vegetation, and you will materially increase the number and fertility of eggs.

Feed plenty of green food to your fowl and they will pay you with full egg baskets.

Clean water, clean, wholesome food and judiciously administered insures healthy, vigorous, active and profitable poultry.

Many Poultry Associations in the Eastern and Western States hold experience meetings at stated intervals, to which the general public is invited. A timely lecture on the proper methods of poultry raising for profit is also provided. These meetings are not only popular, but educational and profitable, and Southern Poultry Associations could do no better than follow the practice of their contemporary associations.

Milk, whether sweet or sour, skimmed or not, and even buttermilk, all make excellent food for chickens.

Keep down the lice and mites in your chicken houses. This can be done by cleaning the house thoroughly every week and spraying with any of the advertised lice-killers, or you may use kerosene oil mixed with a small quantity of crude carbolic acid. Whitewash everything in sight, and do it at least four times a year.

Keep incubators at work—there's where the profit lies. Early hatched chicks produce gold dollars in a few weeks. Don't neglect your incubator.

Women make most successful poultry raisers, because they are satisfied to start with a small business and increase as profits and knowledge are acquired. They are painstaking, cleanly and energetic, hence are

admirably adapted by nature to reap success.

Drinking water in winter if tepid, not cold, will increase the health and egg-laying propensities of the hens. Water must be both fresh and clean at all seasons of the year.

A writer in the American Poultry Journal tells of feeding Spanish peanuts to show poultry, with the result that the fowls' plumage "fairly shone." He also claims it to be an excellent egg-producer.

No amateur should begin poultry raising on a large scale, unless he can afford to throw away his investment. One year's actual experience in rearing poultry will be worth more to such a person than his investment would amount to.

It is simply wonderful how much finer poultry will thrive for those who really like them, than for only the mercenary owner.

If you haven't bought an incubator, we would advise you to begin investigating the merits of the various makes at once.

Poultry can stand extremes of cold weather as well as human beings, but they cannot live in close, damp houses winter or summer without getting the roup.

Hens that lack the energy to hustle might as well be killed at once to save the expense of food they will consume if allowed to continue their useless lives.

There are only three real essentials for the breeder to labor for, and they all add to the value and utility of the fowl; they are egg production, size and early development.

It is possible to breed up a flock of fowls to a better egg production and a larger size just the same as it is to take a dairy herd and breed it to an increased flow of milk.

One hen always comes off the perch before any of the others in the morning, and retires last at night. She is the best layer in your flock. Better save her eggs for hatching.

Setting hens like a dark place in which to cuddle their brood. A piece of old burlap hung up around the nest boxes where they sit will make them more contented during the last few days of their sitting.

Have your miller crack two bushels of corn, one bushel of wheat, one bushel of oats, and a half bushel of peas, sift out the fine meal to avoid waste, and screen out the oat and pea hulls for safety, and add twenty pounds of ground beef scraps. Use this as a dry feed for all young chicks.

The careful selecting of the better layers year after

year, and the use of them only mated to males as carefully selected from the largest egg producers, has increased the egg yield, until to-day many flocks of hens average over 150 eggs each, and individual flocks or pens have gone as high as 180 per year.

The nest box of a sitting hen should be large enough for her to move about easily when turning her eggs. It is claimed that a sod of grass cut to fit the bottom of the box and slightly hollowed in the middle, makes the most comfortable nest, and keeps the eggs at a more uniform temperature, while it neither encourages or harbors vermin.

Formerly the average egg production of 100 hens was about 12 doz. per week; to-day it is about 20 doz. per week or a little better, and those that do not average so many or its proportion from their hens can feel assured they are not getting what they should, while those who use the most approved methods get as many as 25 dozen per week from each 100 hens. This is only three eggs per week from each hen, or 156 eggs per year from each hen, not an unusual number at the present time.

With cool nights and heavy dew prepare to prevent roup and other fall diseases. Furnish decently comfortable and cleanly quarters—if you have fine breeds, especially—keep clean drinking water, and a good supply, where they can get it. Be sure there are no insects tormenting your fowls if you are expecting them to be healthy and profitable.

The following is highly recommended as an egg preservative: A solution of ten parts water to one part water glass. Put mixture in stone jar and keep in cool, dark place. Put your clean, fresh eggs in this solution and keep immersed. An inverted saucer can be used to keep eggs under water, for it is necessary that they do not come in contact with the air. The water glass will cost from 40 to 60 cents per gallon at your druggist's, and the solution can be used repeatedly.

We are assured by distinguished poultrymen that the color of the meat of poultry can be regulated by the food. When we wish yellow meat, confine the fowl, and fatten principally, or exclusively on corn. When we desire white meat—which he claims is firmer and of a more delicate flavor,—we have only to confine the diets to cereals and milk.

Remember corn is a heat producer and cold weather food. Vegetables and green foods are good at all seasons.

Whole wheat placed twice a day in the little chicks' feed coop, will pay.

Beware of air-tight poultry houses here in the South, if you do not wish to encourage roup. In extremely cold weather, the danger of coming from such an artificial atmosphere out into the frosty air, where the greater part of their lives is lived, is much greater than from even leaving them to find their own lodgings under sheds and in cedars.

Neither compel them to roost in strong draughts or damp places. To have them roost between two openings is bad. If one, or two adjoining sides of the house are of lattice-work that is another matter. In the latter case they will have the benefit of fresh air—which seems to keep them hearty—without direct draughts; and there will be no great change of temperature to chill them when they run out in the morning. If they are kept warm on the inside, by plenty of good food, you need not fear our winters for the majority of poultry.

If the comb and wattles of poultry are not of a healthy color is a sure sign that something is wrong; either in feeding, or insects.

Dust nests, roosts and house well with wood ashes, by throwing it about with a short-handled shovel. Also sprinkle a liberal quantity in their dusting places. It is death to mites and is so powdery that it will penetrate everything. Where this treatment is not convenient coal tar thinned with kerosene and applied with paint brush to roosts and crevices, once or twice a year, has proven very satisfactory.

A small piece of logwood—procurable at drug stores—placed in their drinking vessels, is said to prevent cholera in chickens. A little turpentine in corn meal dough has always cured it, for the writer. Where an individual fowl only is affected, catch it, and after putting a drop or two on a breadcrumb, open its bill and place far down the throat. Repeat this every day until cured. The flock affected should have two or three feeds a week.

Place all newly purchased fowls in coops by themselves until sure they have neither disease or insects.

Never force your poultry to fly from high roosts unless you court bumblefoot or other leg or foot ailments. This is especially trying on heavy breeds.

Remember oats are muscle and bone feed, and is fine for growing chicks. Do not feed with the husks on, however, if procurable in any other form.

Select your best two-year-old hens for eggs to set.

Never set pullet eggs if you desire fine, large, healthy chicks. Where one has no incubator, the older hen makes the most sensible mother, and is more easily handled and managed during incubation.

Gather eggs every evening, and take a pencil—if you have no stamp—marking the day and month, on each one as you gather it. Be careful to keep these setting eggs where they will not become chilled during freezing weather. Where children or servants are allowed to collect the eggs, see that they do not shake or jolt them, as many an embryo prize fowl never materializes from just such causes.

We find it best to feed setters on their nests in winter. They do not remain off so long, thus allowing the eggs to chill.

Cotton seed hulls make draft-proof foundations on which to place straw for winter setting. We find a liberal sprinkling of ashes in the nest before setting very objectionable to all insects.

Keep an eye on the nest when a hen begins to hatch. Twice a day is not too often to investigate operations and keep the nest clear of old shells. Many a chick has had its life crushed out by another chick's shell.

Remember it is your spring hatched pullets that are your profitable winter layers.

Amateurs should be sure the floor on which their incubator rests is non-shakable and solid.

Careful people succeed with incubators where careless persons do not.

Very often mature incubator chicks die in the shell for lack of moisture.

Looseness of bowels in chicks is a sure sign of lack of heat in the brooder. Weak legs may be caused by either insects, dampness, or lack of well-balanced food.

A successful poultryman feeds his incubator chicks the following: Bread made of flour, meal, ground meat, milk and soda, baked until cooked thoroughly. To this he adds some green food, and always keeps fresh, clean water for them.

That reminds me, in winter be sure to melt the ice and dump it from the fowl's drinking vessels early every morning and refill with fresh water from the well. Early in the morning and late in the afternoon is when they drink most.

If your hens are not laying well, an open corn-crib or hog-pen is apt to be the cause. Too fat. Nail up the cracks and keep fowls shut in until after hogs have eaten their breakfast.

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