ELEMENTARY AGRICULTURE

WILLIAM LEWIS NIDA

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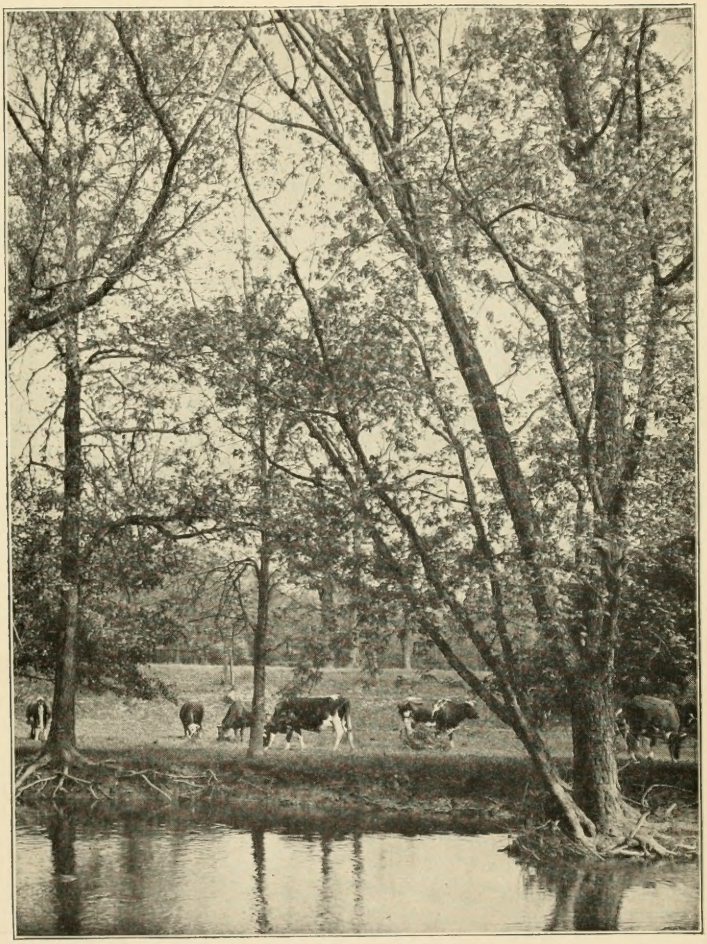

FIG. 1. *Every stock farm needs its shade and water easily accessible.*

Elementary Agriculture

By

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PREFACE

If country boys and girls are to be kept on the farm, it is incumbent on parents and school authorities to enlist their interest in scientific farming and stock raising at the earliest possible age. A text on Agriculture for grade or rural schools should, therefore, begin with a discussion of farm animals, because it is vastly easier to stir up enthusiasm among children over the raising of fine stock than it is over soil elements or even fine crops.

Many texts have reversed this order, because certain farmers' organizations have so recommended. However, if education is our object, the child mind should receive first consideration in presenting any subject.

The author was born and reared on an Ohio farm and taught in rural schools for several winters. He was later a supervisor of township schools. His knowledge of actual farm life and rural schools on the one hand, and of the child on the other, is offered in explanation of this attempt to place before the children of the common schools a simple and stimulating introduction to scientific farming.

Grateful acknowledgments are due to the U. S. Department of Agriculture for a number of fine photographs and for much valuable material from which the author has drawn freely. The author and publishers also desire to express thanks to the Agricultural Extension Department of the International Harvester Company for a number of fine plates and half tones chiefly of animals and farm scenes, selected by the author, and for valuable suggestions. To others who have kindly aided us with photographs, credit has been given in the body of the book.

WILLIAM L. NIDA.

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ELEMENTARY AGRICULTURE

PART I. FARM ANIMALS

CHAPTER I

THE HORSE

Taming the Wild Horse. Who tamed and rode the first wild horse and how he did it, we shall never know; but it was an important event for mankind. It happened long ages ago, before men began to write their doings in books. We know that horses lived in the time of the cave men, for we find remains of horses and rude pictures of them scratched on stone in caves and sand drifts. The cave men hunted these wild horses for meat and for their skins.

Variety in Size. The horse was then much smaller than he is now. He was about the size of a wild pony. The wild horses that came to live in mild climates where food was plentiful began to grow larger, with heavier limbs and stronger muscles; but those that passed into cold, bleak lands where food was scarce, grew small like the ponies of the Shetland Islands.

The Horse's Foot. The bones and fossils of the ancient horse show that he was once less than twenty-four inches in height. He had a spreading

foot with five toes. At that time he lived in low, marshy lands, and toes were needed to help him get about. As the earth became harder he lost one toe after another and so was able to travel faster to escape from his enemies. The horse's hoof is the nail of the one remaining toe.

Riding Horseback. The Greeks first drove the horse hitched to rude chariots, but later, it is said, they learned to ride him without saddle or bridle. They invented the first bridle bit, which is called the snaffle. Neither Greeks nor Romans shod their horses. At first only kings, nobles, and warriors could afford horses. They were used chiefly in war and for riding and driving in war chariots. But everybody who was able rode horseback; even kings looked upon this as the most dignified way to travel.

The First Work Animal. All this time the farmer had only the plow ox or the stubborn ass to help him raise his crops. When at last the farmer began to use the horse, he did his work much faster, for the horse has not only better speed and greater strength than the ox, but he can hold out longer.

The Horse and the Indian. Horses were not found in America when the white men first came. The Indians were greatly frightened when they saw the horses which the Spaniards brought over. They thought these animals were terrible monsters. But the Indians soon learned to use the horse, and, after a time, great herds of horses appeared wild on the western plains.

The Big Draft Horse. The time came when men began to breed horses for different uses. When they wished work horses that could draw very heavy loads at a slow pace, they selected the heavy, stout-limbed animals that had strong muscles; and by using these as parents they reared more like them. Gradually the colts of these horses grew stronger and larger, and so the draft horse was developed.

FIG. 2. *A coach horse.*

Coach and Roadsters. Other men wanted horses that could pull heavy coaches with good speed.

FIG. 3. *Percheron stallion.*

They wanted high knee action and fine style. So they kept this kind to breed from and developed the coach horse (Fig. 2). Still other men wanted speedy horses for light loads, and they reared saddle and race horses.

Kinds of Draft Horses. The draft horse is blocky, heavy, and powerful. He may weigh from fifteen hundred to two thousand pounds and is in much

demand for pulling great loads on city streets. He has a round body and rather short legs. His hind legs are the stronger, yet he uses his front legs so much in pulling that the front quarters are heavy and powerful. His breast is broad and his front legs far apart. From France we get the Percheron (Figs. 3 and 4) draft horse, with a gray, chestnut, or black color; from Belgium comes the bay Belgian; the Shire of bay brown or chestnut color comes from England and the smaller but more active Clydesdale (Fig. 5) from Scotland.

How to Hitch a Horse. When a team cannot pull a heavy load, it is often because the feet slip. The heavier the horse is, the better he can hold with his toes. A horse can really pull more on hard or slippery roads if he has a man on his back. This gives him more weight and a better foothold. One way to

FIG. 4. *Prize six-horse Percheron team.*

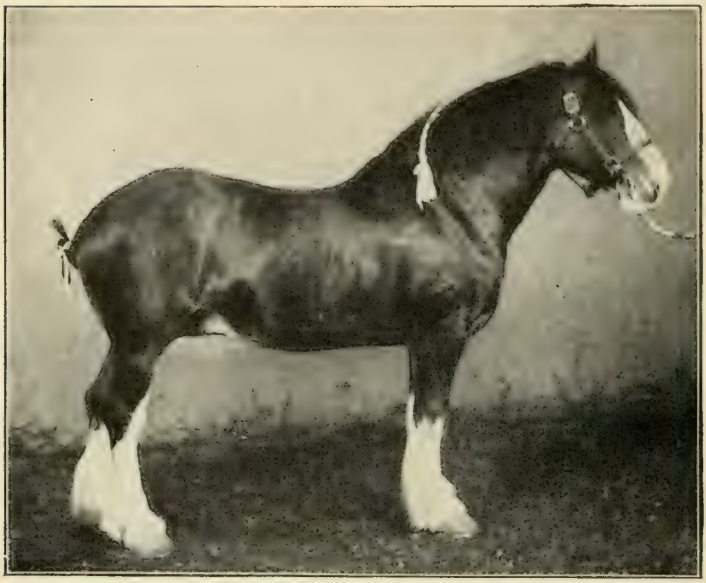


FIG. 5. *A Clydesdale.*

help a horse pull heavy loads is to put the whiffletree low down. It is better to have the doubletree under the tongue for heavy pulling. A farmer once tested this by hitching a horse to a post with a spring balance which would show how many pounds he pulled. When the whiffletree was tied six inches from the ground he pulled six hundred pounds more than when it was three feet from the ground.

Driving Fast. When a horse has a light load and is driven for speed, the whiffletree should be high. This makes the weight on the horse lighter so there is less strain on his legs and feet. Sometimes you

see in the city a two-wheeled carriage with the driver sitting high behind. This is called a hansom cab. The driver's weight makes the thills pull up on the horse and so carries part of the horse's weight. This saves his feet greatly in driving upon hard pavements.

Race Horses. The American trotter (Fig. 6) and the American saddle horse are the best of their kind in the world. Trotters have powerful hind legs and good lungs. They have small heads and large nostrils so they can breathe abundance of air (Fig. 7).

FIG. 6. *American trotting horse (Morgan type).*

Other Uses of the Horse. Among the Tartar tribes of northern and central Asia, mare's milk and horseflesh are still used for the food of man. Old horses are always fattened for the meat markets of France and other countries of Europe.

Most Horses in America. To-day in Great Britain there is one horse to every twenty people; in France, one to every ten people; and in the United States, one to every five people. So we have more horses in America than there are in any other country, and we make them do more of our work.

Horse Power Cheap. Human labor costs more than any other kind of labor, so the farmer has learned to use his horses for many purposes. Years ago, when harnesses were poor and tools crude, many things were done by human hands that are now done by horse power. To-day one good horse can do as much work as ten men, while his board and keep costs about half as much as that of one man.

Doing Forty Men's Work. A farmer boy who drives a four-horse team hitched to a gang-plow is doing as much work as forty men working with hand tools. Four-horse plows and four-horse harrows are very common on the large farms in the West. Some of the great harvesting machines employ as many as twenty or thirty horses and mules on a single machine.

Feeding the Horse. A horse's stomach is small, so he cannot use as much bulky food as a cow. He

ought to have at least three good meals every day. When a horse is making long trips on the road he should not have too much hay, but a richer food, like corn or oats. The work horse should have his largest meal at night, when he has plenty of time to eat and digest it. If a horse is not warm, it is better to water before feeding him. The water passes on through the stomach and leaves room for the food. If an animal is very warm, it should

FIG. 7. *Thoroughbred trotting mares and colts.*

not be given either food or water until it has cooled off. Clover hay is not so good for a horse as timothy, because it is more dusty; and dusty hay is liable to give horses the heaves. If dusty hay must be used, it should be sprinkled before feeding.

A Good Variety. It is cruel to feed the horse on nothing but oats and hay all the year round, when

he would so much like some barley, beans, peas, corn, or turnips for a change. In the United States Army a horse is allowed ten quarts of oats a day. It is better to feed corn on the cob, as this makes the animal eat more slowly and it also improves his teeth. When carrots are given, they should be sliced to prevent the horse from choking. It is important to keep a little salt in his trough.

Cleaning the Horse. When a horse comes to the barn with muddy legs, they should be rubbed down or washed, especially in cold weather, to prevent rheumatism. Time spent in cleaning and rubbing the horse in the evening after the day's work is done, is much better for the animal than the same time spent in the morning, because the horse will rest so much better.

His Care. When a horse is warm upon stopping work in cold weather, he should be blanketed to keep him from catching cold. On very cold mornings the bits should be warmed by dipping them in water before bridling the horse. Even cold water will keep a frosty bit from freezing to the tongue and tearing the skin. Have you ever tried touching your tongue to frosty iron?

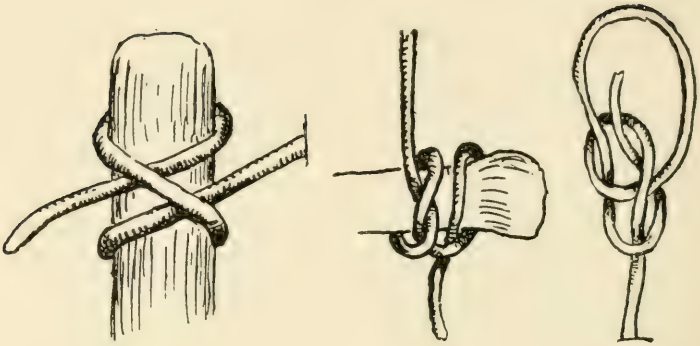
Healthy Shoulders. Many farm horses suffer from sore shoulders. This need not be so. The collar should fit and be kept clean. If there is danger of sore shoulders, they should be washed in salt water at noon and in the evening. Salt water is healing, and it makes the shoulders tough. When

the team is working hard, the harness ought to be removed at the noon hour. The horse should be well cleaned every day with a good brush. The curry-comb is harsh and painful, especially when used by rough hands.

A Pleasant Home. The horse's home or stable should be kept clean. It needs to be light, but the windows must not be where the horse will look into them, for this will injure his eyes, as it does yours when you sit facing a window. The horse barn should also have good air. If the barn is made very warm, a window should always be open where the draft will not strike the animals.

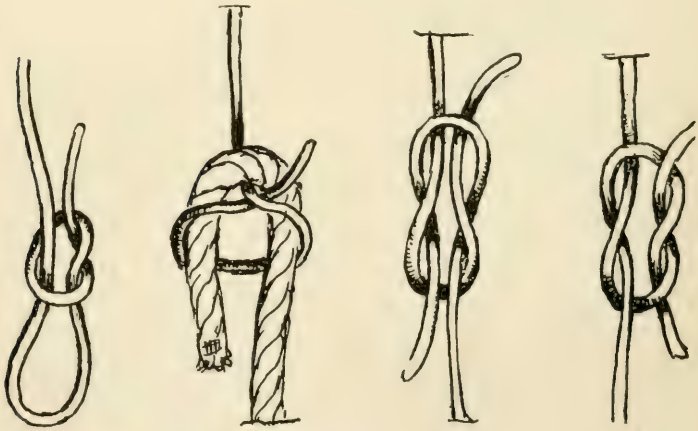
Shoeing the Horse. Many horseshoers do not understand their trade, and so they injure the feet of the horse. Sometimes they put on shoes that are too big, and this stretches the hoof too much. A very small shoe pinches and makes corns. Some pare the sole too much, and others even use the knife on the frog, which is a great injury to the foot. As the hoof is growing all the time, just as a man's finger-nails grow, the shoes need to be changed often, so they will not pinch the foot.

One Lesson at a Time. In breaking colts it is better not to try to teach them too much at one time. One of the first lessons is to "halter-break" the young colt. This should be done while he is still a suckling. A strong, well-fitting halter is placed on him, and he is tied short to a post near to his mother. A colt should always be tied firmly, for if



1 2 3

1. Clove hitch.
2. Picket rope with a half-granny and a half-hitch.
3. Bowline: a noose that never slips; is easily untied.



4 5 6 7

4. A slip knot, running noose, or halter knot.
5. Becket hitch for joining a cord and a rope.
6. Reef knot or square knot; never slips; easily untied.
7. False reef or granny; difficult to untie; a bad knot.

FIG. 8. *Knots that every*

8

9

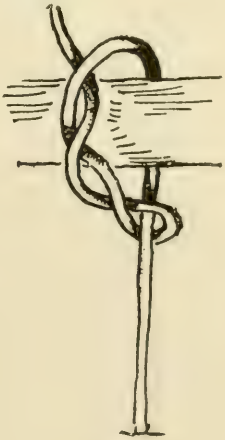
10

11

8. Anchor bend.
9. Fixed loop in middle of a cord.
10. Weavers' knot or sheet bend, for joining small cords.
11. Two half-hitches.

12

13



14

12. Blackwall hitch.
13. Carrick bend for joining large ropes.
14. Timber hitch; cannot slip or jamb; easily untied.

farmer should know.

he once breaks loose he has learned a very bad trick (Fig. 8).

His First Bridle. After the colt is halter-broken so he can be tied or led, it is a good plan to tie his halter to his mother's hame or collar. In this way he gets used to trotting beside another horse. The next lesson is to put on a bridle with a smooth bit. An open bridle is better than a "blind" one, for the horse ought to see everything about him so he will the more quickly get used to the new experience.

Driving the Colt. A saddle may now be put on, or a single harness with crupper and back strap. It is a good plan to drive the horse at first without a cart. The driver passes the lines through the tug or the loop made for the shafts, and in this way keeps the animal from whirling suddenly and getting tangled up in the lines. It is well to have a helper lead the colt at first, until he understands what is expected of him.

Driving Double. The colt may now be hitched to a cart with long shafts and a kick strap, or he may be hitched up with another horse. When this is done it is a good plan to keep a pair of single lines on the colt's bridle and have these in the hands of a helper. In hitching up double, it is well to use a heavy wagon with a brake and to put the colt on the "off" side. He can now be taught to stop, to back, and to start at the proper signal.

Not Too Many Signals. A horse should be trained early to stand still while he is being harnessed and

hitched up. Very few words or signals should be used, for a horse has far less brains than a dog. "Whoa" should always mean to stop. "Steady" is the word when we wish the team to go more slowly. "Back" should be used only when we wish the team to move backwards.

Kindness Pays. "The merciful man is merciful to his beast," and the well-treated horse repays his master's patience and good care. Horses, like all farm animals, should be kindly and gently handled. Jerking and whipping do harm to the horse, and this means a money loss to the farmer.

QUESTIONS

(1) How do we know that the horse lived in the cave man's time? (2) What were horses first used for? (3) What difference did the horse make in the life of the Indian? (4) Why did men want a draft horse? (5) What is taking his place in the cities? (6) Do you think that machinery will ever entirely take the place of the horse? (7) Why or why not? (8) Are coach horses increasing in the city streets or decreasing? (9) Why? (10) Why should the horse be hitched low to a heavy load? (11) What types of horses have been developed in America? (12) Why does a horse need different kinds of food? (13) How do you break a colt? (14) In what ways is machinery relieving the horse on the farm? (15) Make questions of your own on each chapter. (16) Have the class answer them.

For exercises, problems and experiments on each chapter, refer to the Appendix.

CHAPTER II

CATTLE

More Useful Than Horses. Horses are a great help to man, but we could get along without them better than without cattle. Cattle supply us with meat, leather, and milk; and they may also be yoked up for work.

Where Cattle Came From. Cattle have come down to us from a queer animal of the cave man's time, called the urus. In those far-off days there was also a kind of wild cattle. Some say the herds of wild cattle mixed with herds of the urus, and this mixture formed the cattle that we have. But nobody is very sure about this. We know that the cave man hunted and killed wild cattle for meat.

Taming the Wild Cattle. A long time after the cave man a higher race of men lived in villages built out over the edge of lakes in Switzerland. These people, called the Swiss lake-dwellers, seem to have tamed the cow. How do you think they did it? They probably kept cows at first for milk only. Instead of hunting all the time for food, the people began to give some time to their cattle and so became herders.

Churning the First Butter. Then a wonderful discovery was made by some one, and that was how to make butter from milk. Probably some lake-dweller

was carrying upon a journey a skin or leather bag of milk, and the motion churned the butter. Milk will not keep long without souring, but butter keeps much longer. The cow, with her milk, butter, hide,

FIG. 9. *A beef breed (Shorthorns).*

and meat, must have done a great deal to help these ancient people to better ways of living.

Hitching Cattle to Loads. We do not know when cattle were first yoked up and hitched to loads. Perhaps a cow was tied by a leather thong, when suddenly she made off through the woods, dragging a man or the log to which she was tied. Then some

one hit upon the idea of tying a cow to anything he wished to have moved.

The First Plow. After the yoke was invented, some clever person made a rude plow of sharp sticks tied with thongs, and agriculture took a long step forward, because this enabled the farmer to use animal power to till the soil, instead of doing it all by hand.

Two Kinds of Cattle. Cattle were early brought to America from Europe. Men began to want two kinds of cattle, one for milk and butter and the other for beef. They found that a good milch cow is not very good for beef, for her food all goes to milk; while a fat cow will not give much milk, as her food makes flesh or muscle. By carefully selecting the good milkers for mothers, farmers have developed a fine dairy animal, such as the Jersey, the Guernsey, or the Holstein.

Beef Cattle. Other cattle raisers have bred from the large, heavy animals and have herds of fine beef cattle, such as the Shorthorns (Figs. 9 and 17), Herefords, or Galloways (Fig. 10). The beef cow is square, with all bones well covered with flesh. Her back is straight and her legs full and thick. The neck is full and stocky, the legs short and set far apart to support the large, heavy body. The more meat these animals can make from a given amount of food, the more profitable they are.

Their Care and Feed. Beef cattle need different food and care from the dairy animals. The beef

type do not require such warm barns as the milkers do, because fat animals never need such warm housing as do lean ones. They seem to do better in dry, open sheds that are well bedded. They need such foods as will make them fat most quickly and at the least expense, and cattle feeders know this well.

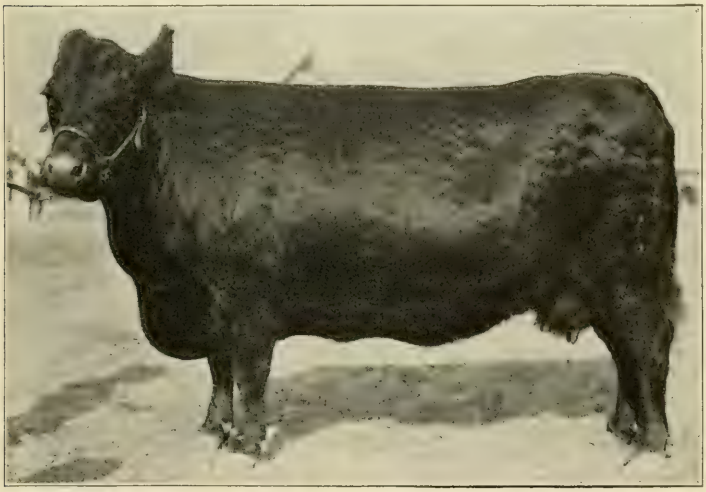


FIG. 10. *A Galloway cow.*

Getting Ready for Market. Sometimes calves are fed fattening foods as soon as they can digest them. They are kept on such food until they are ready for the market at from ten to sixteen months of age. Other cattlemen give their young herd the freedom of the range or pasture for a few months, or, perhaps, for a year or two, and then put them on rich,

FIG. 11. *An empty dinner pail.*

fattening foods for a few months before they are sold to the butcher or the packer.

Feeding Meal. When teaching a young calf to eat meal, the farmer puts him in a box stall with another, older calf, and the young one will learn from his companion. Another way is to take a little meal in the hand and put the hand in the mouth of the young calf. (Fig. 11.)

A Mixed Food. A good meal ration for calves is a bushel of ground corn, a bushel of ground oats, a peck and a half of wheat bran, and the same of oil meal, all well mixed. As soon as calves will take hay or fodder, it should be given to them. They will begin to nibble and taste it when two or three weeks old. The best hay is clover, alfalfa, or cow peas. As soon as they begin to chew the cud, finely cut hay is mixed with the meal. In this way one can prepare the calf for weaning. (Fig. 12.)

Saving Cream. When calves are fed on skimmed milk they miss the butter-fat that has been taken away as cream. In its place the farmer feeds the calf some corn meal or linseed meal. One or two cents' worth of meal will serve the calf as well as twenty-five cents' worth of cream.

Choosing a Good Dairy Cow. The dairy cow is shaped like a wedge. The neck, thighs, and shoulders are thin and lean. She should be thin, not because she is poorly fed, but because she is turning a large part of the feed she eats into milk. She should be quiet and gentle. She should be strong and have room for a large quantity of food. Her hips are prominent and wide apart, and the rump is high. The hind legs are trim and set well apart.

FIG. 12. *Where are our mothers?*

Most important of all, she has a large, well-shaped udder. The floor of the udder is straight and extends well forward and well backward, too. The

FIG. 13. *The dairy type (Jerseys).*

udder is soft and fine. The teats are evenly placed and of medium size. The buyer should milk out a few streams to see that the openings are not so small as to make her a hard milker. The milk veins which extend forward from the udder should be large, with many branches, because they supply the blood from which the udder secretes the milk.

The Jersey Type. The Jersey cow (Fig. 13) is famous the world over for her rich milk. These cows were the first dairy animals to become popular in our country. They change a large part of their food into milk instead of into flesh or fat. Jersey milk is the richest of all. The Jersey heifer matures

early and may become a mother at between two and three years. So the dairyman does not have to feed her long until she more than pays her way. This breed came, in the first place, from Jersey Island, in the English Channel. The island is only eleven miles long by five and a half wide, but it is very rich and productive; and the farms there are very small, sometimes not more than two or three acres. The principal industry is dairying, and the stock has been kept pure by forbidding foreign animals to be brought in. The milk is nearly all made into butter.

The Guernseys. The Guernsey cows, like the Jerseys, come from one of the islands by that name in the English Channel. They are somewhat larger

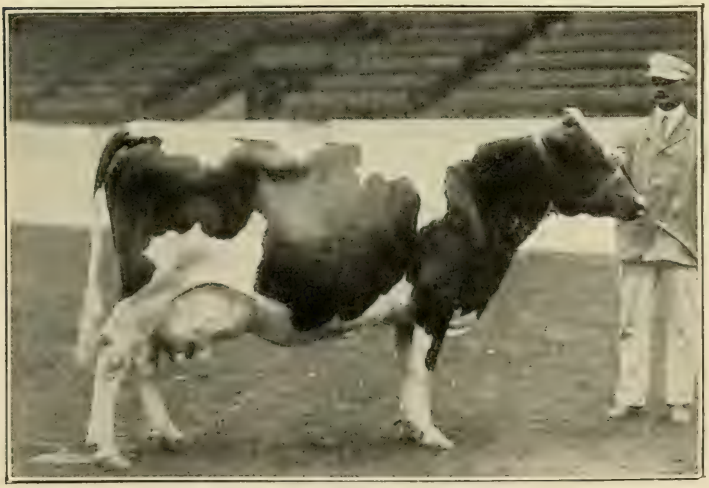


FIG. 14. *A record cow (Holstein).*

than the Jerseys. They have coarser bones and carry more flesh. Guernseys are noted for their yellow milk, which is only second to that of the Jersey in richness. But they often give a greater amount than the Jersey.

The Holstein. This dairy animal was bred 2,000 years ago along the Rhine, in Europe. The Dutch first brought these cows to America, shortly after the settlement of New Amsterdam. The Holstein (Figs. 14 and 107) is noted for the great amount of milk given. The milk is not so rich in butter-fat as that of the Jersey or Guernsey, but the large amount makes her a most desirable cow to keep near large cities like New York, where the milk is sold by measure. Other noted dairy types are the Ayrshire, the Brown Swiss (Fig. 15), and the Dutch Belted.

The Babcock Milk Test. For a long time dairymen did not know how to choose the cows which gave the richest milk. Not many years ago Dr. S. M. Babcock, of Wisconsin, invented a machine to test milk for the amount of butter-fat. Now every farmer may know which cows are valuable and which ones are not. Refer to page 247 for full description of the Babcock Milk Test.

What a Good Cow Produces. A good cow should produce from twelve to fifteen pounds of butter a week. One of the highest records ever made was by a Holstein cow that made thirty-three pounds of butter in one week (Fig. 14).

Caring for the Dairy Cow. Twice each day the dairy cow is driven to the barn to be milked, and the more milk she gives to each pound of food, the more valuable she is (Fig. 16). In order to give an abundance of milk, she must have the best of care and food, and kind treatment; and she must be milked at regular hours. She should have water and plenty of good food at every meal time.

Their Food. In summer, when the cows are in

FIG. 15. *Brown Swiss twin calves, bull and heifer.*

pasture, they need very little other food unless the pasture becomes short and dry. Then corn, alfalfa, peas, oats, rye, or some other crops may be cut green and fed to them. Water and shade should be within reach of cows at all times in hot weather (Fig. 1). In winter they like hay, root crops, and silage.

A Balanced Feed. It is best to feed some dry hay or fodder, some silage or green food, and some grain. The careful dairyman always feeds just the right amount of each to supply what the cows need without any waste. He calls this a "balanced ration."

Testing Cows. Some pure-bred cows are poor milkers. The only way to make sure that a cow is worth her board is to test her milk for butter-fat and weigh the milk. Every dairyman should keep a record of each cow for one year. A spring balance with a paper beside it will enable the farmer to weigh the milk and put down the amount quickly.

An Easier Way. Or, instead of weighing the milk every day, the farmer may weigh the milk of each

FIG. 16. *A row of money makers.*

cow for three days each month. The sum of these weights multiplied by ten will give the year's production. Take samples for the Babcock test in the second, fourth, and seventh months after the cow freshens. If you add these and divide by three you get the average daily production of butter-fat.

Cow-testing Associations. Dairymen who find it

FIG. 17. *A Shorthorn bull.*

difficult to test their own cows are in some instances banding together in cow-testing associations. To this association each farmer contributes a small fee and with this money an expert is employed who spends his time going about among the dairies and testing the cows of each herd. This plan has been used in Holland for many years, and is the reason for the great advance in the dairy business in that

country. Farmers who desire to form such an association should write to the Department of Agriculture, who will send a man to assist in forming the organization.

Uses Made of Beef Cattle. It is said that every grown person in the United States eats, on an average, one hundred and fifty pounds of meat in a year. The greater part of this is furnished by the great herds pastured on the Western plains. Leather for many purposes is made from the hides, and butterine is a product of the fat or tallow of beef. Buttons are made from the bones; combs, from the bones and hoofs; and glue, from the sinews, bones, and hide trimmings.

How to Get Good Stock. The cheapest way for a farmer to build up a fine herd of either dairy or beef cattle is to save only the calves whose father or sire is a pure-bred animal. (Fig. 17.) There is a true saying among stock farmers that "The sire is half the herd." The way to improve a scrub herd is to obtain a pure-bred sire. The first calves are half pure. When these calves become cows and mothers, their calves are three-fourths pure stock, and so on. Scrub cattle have no place in the fields of a good farmer.

QUESTIONS

(1) If men had to choose between having either horses or cattle alone, which should they choose and why? (2) How do you think butter making was discovered? (3) How do you think the first plow was invented? (4) Name the chief dairy types?

CHAPTER III

MILK AND BUTTER

Milk as Food. Milk is a good food for every one. The Laplander milks his reindeer, and the Arab his camel. The people of India milk their buffaloes, and the mountain people their sheep. A quart of cow's milk contains about the same amount of food as three-quarters of a pound of beef. Thus we see that milk is cheaper than meat or eggs. As the cities grow there is a greater demand for milk, but the buyers insist that it be clean.

Keeping Milk Pure and Clean. Milk absorbs or takes up odors. If a cow is fed cabbage, onions, or turnips a few hours before she is milked, you will notice the flavor of those vegetables in the milk. Milk that stands uncovered in dirty barns has the odor of the stables. Therefore, the barn must be clean and light, with plenty of windows to admit the air, and the cows should be fed proper food. They should always have pure water, because milk carries many germs, especially those of typhoid fever. Feeding should be done after milking, so the air will not be full of dust to settle in the milk.

Milking the Cows. The udders of the cows must be washed, and the milker's clothing and hands should be clean before a drop is drawn. All pails and vats for holding milk should be thoroughly

washed with warm suds and then rinsed with scalding water. As soon as milk is drawn, it is well to cool it to stop the growth of the germs that cause it to sour.

Butter-fat. If we look at a drop of milk through a microscope we shall see many tiny, roundish bodies with a pearly look floating in the fluid. Fifteen thousand to twenty-five thousand of these little bodies placed side by side will measure an inch, and there are millions of them in a drop of milk. These particles are the fat of the milk, from which butter is made. They are lighter than milk, and when milk stands for a time they float upward. With some of the milk on top of the pan they form the cream.

Ready to Churn. After the cream is removed by a skimmer or the new hand-separator, it should stand until it ripens, or sours. It is most easily churned at a temperature of from fifty-six to sixty degrees Fahrenheit. The room should be, as nearly as possible, the same temperature as the cream.

Churning. When this cream is put into a churn and dashed about, the little particles of fat hit together and stick to one another until they unite to form small pieces of butter about the size of a grain of wheat. Then we can see the butter-fat in the buttermilk.

Preparing Butter for Market. When the butter is gathered from the churn, it may be washed to remove part of the buttermilk. Then the whole butter mass

is pressed together and rolled with a wooden paddle to remove the rest. Three-fourths of an ounce of fine table salt should be added to each pound of butter and evenly worked into the butter mass with the paddle. The worker firmly rolls and presses the butter, but does not rub it, because that destroys the grain. When the butter is free from buttermilk, it can be made into a tempting lump and stamped and rolled in oiled paper. Butter is judged for its flavor, color, grain, and the amount of salt, but in a great measure it is judged by its general appearance.

FIG. 18. *The old way of separating cream.*

FIG. 19. *The new way—cream separator.*

The Churn. Farmers, today, prefer the barrel churn, without a dasher. In operation this churn throws the cream back and forth against its sides. Churns

should never be filled more than half full. Butter-making is greatly aided in late years by the use of the separator and butterworker (Figs. 18 and 19).

Cheese-making. Cheese may be made from cream, skimmed milk, or the whole milk. Most of the cheese we buy at the store is made from the whole milk. Years ago our grandmothers made cheese as commonly as they did butter, but cheese-making is such a long process that to-day it is done in creameries or factories. Cheese is the solid part of the milk in such form as will keep for long periods. A little difference in the process of the making, produces a different sort of cheese. One book tells us of one hundred and fifty-six different kinds. They are usually found in three classes—hard or soft cheese, cream cheese, and sage cheese.

Cottage Cheese. Cottage cheese is a home product made by heating sour milk, which has thickened, to the point where the curd separates from the whey. The whey is drained off through a cheesecloth, and the dry curds are seasoned with cream and salt. A great deal of this is sold on the market for table use.

By-products. The by-products of the dairy are skimmed milk, buttermilk, and whey. These are chiefly used in feeding young animals on the farm, because it costs less to ship fat stock than it does feed or milk. The curd of the milk is dried in large factories and ground fine and used in the sizing of paper. Milk sugar is made largely from whey. This

is much used for babies and invalids. Other foods and drinks which are becoming popular are made from the dairy. Up to 1850 the dairy work was all done and marketed from the farm. Now the milk is largely taken to creameries and factories, and butter, cheese, and condensed milk are manufactured there.

QUESTIONS

(1) How do you judge a dairy cow? (2) Which cow would you keep for butter making and which for selling milk? (3) What kind is most common in your neighborhood? (4) Would it pay better to keep a different kind? (5) Why is the Babcock test a great invention? (6) What is a balanced feed? (7) How would you test a cow to decide if she were worth keeping? (8) How would you proceed to develop a fine herd of cattle? (9) Which dairy type do you like best? (10) Why? (11) What other animals are sometimes kept for their milk? (12) Which is the cheaper food, milk or beef? (13) How does milk sometimes spread disease? (14) What is butter-fat? (15) How is butter made? (16) What makes the difference in cheese? (17) Name some other uses for milk. (18) Make questions of your own for use in class.

For exercises, problems and experiments, refer to the Appendix.

CHAPTER IV

SHEEP

Wild Sheep of Asia. On the plains of Asia there may be seen to-day small flocks of wild sheep. They are larger than our common sheep, with such immense horns that it would require a foot line to reach around one at its root and a four-foot line to measure their length. The wool of the wild sheep is brown, with a buff-colored streak along the back. These wild sheep are strong, quick, and suspicious, so they are very hard to catch. They are hunted for their flesh and their skins, which are made into clothing. They have a coat of fine soft wool to keep them warm, and over this is a long coarse hair, which serves as a raincoat.

Another Kind of Wild Sheep. In the mountains of Greece is another type of wild sheep, smaller and less active than those of Asia. It is believed that our domestic sheep have come from one or the other, or perhaps both, of these wild types.

Taming the Sheep. Some writers think the sheep was tamed before the horse or cow, because they were small and could not defend themselves so well. Sheepskins made fine clothing for the cave man. The first animal we find mentioned in the Bible is the sheep, but the Bible mentions other domestic animals.

Where Sheep Live. The sheep can live on rough hillsides and mountain cliffs where other domestic animals would starve. They thrive best in cool climates, because of their heavy coats of wool. They require less grain and will eat more kinds of food than the horse or cow. So they are more easily cared for (Fig. 20).

The Use of Sheep. A flock of sheep increases very rapidly, for ewes, or mother sheep, often bear twin

FIG. 20. *A good animal eats no more but pays better.*

lambs every year. The lambs become full-grown in a few months, and their flesh makes excellent food, while the fleeces make woolen clothes for the people of many lands. When prices of wool are fair, a good ewe will pay her board and keep through the year with her fleece. The flesh of the sheep is worth about half as much as the wool. If she raises two lambs they are clear gain to the farmer. Sheep have no equal as weed-destroyers, for they eat nearly every weed that grows on the farm. In small numbers they build up and enrich the land, for sheep manure is worth more as a fertilizer than

that of any other farm animal except poultry. A few sheep will pay their way and make money for their owner on any farm that is not wet and marshy. They will not thrive on low, moist land. Aside from their fleece and mutton, the bones are used for fertilizer. The skins make leather for boots and shoes. The tallow is made into candles, and the skins of the intestines are made into strings for musical instruments.

Fig. 21. *A Merino ram.*

Two Kinds of Sheep. We raise two types of sheep, because those that produce the best wool do not make the best mutton. If a farmer is raising sheep for mutton mainly, he keeps a herd of Shropshires or Southdowns or some other mutton type. If he is chiefly interested in growing fine wool, he keeps American Merinos or some breed like them.

Merinos for Wool. The oldest races of the domesticated sheep are probably the Merinos (Fig. 21). They were very likely kept in Palestine in Bible times, and it may be that King David when a lad kept watch over a flock of Merinos. They came to America from Spain and have been greatly improved by American farmers. They are the best

wool-producers, yielding heavy fleeces of very fine wool that is used to make the finest and most expensive woolen goods.

Thrive in Large Flocks. Though the Merinos are not so hardy as the wild sheep, they are hardier than any other of the domestic breeds. They will thrive in larger flocks than any other kinds, so they are used in the range country of the West. They have a long life and grow good fleeces to a ripe old age, while the fleece of the mutton type begins to lose in weight at an early age. Sheep on ranches of our Western states are kept a thousand or two thousand in a flock and sent off in the summer with a herder and a shepherd dog. If the herder has a horse, he sometimes cares for five thousand in a flock. One rancher often owns from twenty-five thousand to fifty thousand sheep. The cattle men object to large flocks of sheep, for they eat the grass so close that other animals cannot be grazed there. Cattle also dislike the odor left by sheep.

FIG. 22. *A Shropshire ram.*

The Shepherd Dog. The shepherd dog, or collie, tends the flock and rounds them up when they stray. He watches them at night and keeps off the mountain lions. These dogs are very intelligent. They obey

the voices and spoken commands of their masters, and even understand signals of the arms.

Care and Fleeces of Sheep. The Merinos stand more neglect than other sheep. They can get through the winter on good straw, a little grain, and some hill pasture. However, their mutton is only fair, and they do not raise as many lambs as other breeds. Their bodies are covered with large folds or wrinkles of skin that make shearing difficult, but these very wrinkles only make so much more surface for good wool to grow on.

Sheep for Mutton. Shropshires and Southdowns are the best liked of the mutton types in America. The Shropshires (Fig. 22) have nearly black faces and legs, and no horns. They rear more lambs than other kinds, but their wool is not so fine as that of the Merinos. Mutton sheep are profitable even on high-priced land, if it is near a good market. Fancy lamb mutton is a delicacy that people like and are willing to pay for. Southdown ewes (Fig. 23) usually rear two lambs each year, and they are good mothers.

Some Dogs Kill Sheep. Two difficulties have stood in the way of sheep-raising on a small scale. These are expensive fencing and dogs. Sheep must have better fences than cattle. Wire fences keep stray dogs from chasing the flock at night and killing many sheep, but until lately wire fences have cost so much that very few farmers could afford to use them.

Food for Sheep. Sheep are naturally grass-eating animals, for nature seldom fed them any grain. So they are prepared for bulky food. In England they seldom taste grain. They are fed on pastures, hay, and roots—mainly turnips. In changing the

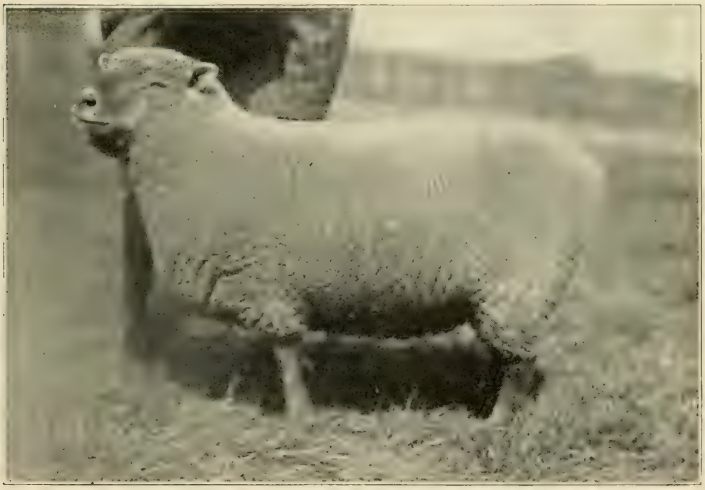


FIG. 23. *A prize Southdown ewe.*

food of sheep, we should do so very gradually. Usually lambs are simply put on pasture during the summer months and sold before it is necessary to house them for the winter. Some Western sheep growers put their lambs on the range to run free from eight to twenty months. Then they are shipped to Eastern farms to be fattened for market. Here they are fed corn, clover, or mixed hay and, perhaps, oats, peas, or barley. The best pastures for

sheep in the corn belt are clover and alfalfa. They need shade in their fields to protect them from the hot sun until shearing time. (Fig. 24.)

Fattening Lambs. Sometimes when lambs are fattened for the market, they are "forced." This means that they are fed rich food from their birth until they are ready for market at from six to ten weeks. These are called "hothouse" lambs, and they furnish the finest quality of mutton to be had. They need good housing and extra care.

Weaning Lambs. A pound of flesh can be put on a baby lamb at much less cost than when he is older. Nothing is better for them than mother's milk. Some are allowed to run with their mothers until they weigh seventy or eighty pounds, when they are to be sold as mutton. Lambs that are to be kept on the farm should be weaned when ten or twelve weeks old. (Fig. 25.)

Shepherds. No lad who is rough or brutal with animals should be put over a flock of fine sheep. If he loses his temper and abuses his flock, they will not do well, for they are peace-loving animals. The good shepherd is always kind and gentle. He keeps his feed troughs clean, he feeds by the clock, and he feeds plenty of a good, balanced ration. He keeps salt and pure water where the sheep can get them, for it is a mistaken idea that sheep do not need water. The shepherd that allows maggots or ticks or lice to trouble his flock in hot weather is not worthy of the name.

FIG. 24. *All farm stock need shade.*

Shearing Sheep. It takes several seasons for a man to become a good sheepshearer. A good shearer will take the wool from sixty to eighty sheep a day with common hand sheepshears. Shearing machines, which are sheepshears attached to a long rod and managed by power, are now very common. The sheep is turned into a narrow alley and in a few minutes he comes out without his coat. It is far easier to shear with the machine than by hand.

FIG. 25. *Dorset ewe and lamb.*

Though a practiced hand can shear almost as fast as a machine, beginners can shear twice as fast with the machine. The machine takes off the fleece

smoothly and evenly without any ugly cuts. It saves from two to eight ounces of wool. The sheep should not be sheared too closely with the machine; enough wool should be left to protect the animal from flies and sunburn. Most shearing is done in June, but some sheep-raisers advise shearing twice a year—in April and in August. It is better for the sheep to be relieved of the burden of the wool in August, though the fleece is shorter and not so valuable. After shearing, the sheep are sometimes made to swim through a cleansing bath, which keeps their skins in good order.

Land Suitable for Sheep Farms. There are many farms in the Eastern states of our country that are well suited to sheep-raising. Some of these farms are too poor for crops, but they would make good sheep farms if several of them were put together, for sheep need a large range of pasture. In New England high and rocky land suitable for sheep-raising can be bought at a very low price.

QUESTIONS

(1) Where did the forefathers of our sheep come from? (2) Have you any reasons for believing that the sheep was tamed before the cow or horse? (3) Could you think of a reason why sheep will not thrive on a wet or swampy farm? (4) Which of the mutton types do you like best? (5) Why? (6) Are Merinos raised in your county? (7) Why, or why not? (8) Why are Merinos raised on the large sheep ranches? (9) What advantage have sheep shearing machines?

For problems and experiments refer to the Appendix.

CHAPTER V

SWINE

The Wild Boar. Long ages ago there roamed through the forests of Europe herds of fierce, wild boar. They usually ate fruit, roots, and grass; but when they were hungry they ate snakes or fowls or fish. Perhaps they sometimes devoured men whom they found weak or disabled. They were dangerous beasts. To hunt them with nothing but clubs and bows and arrows required great courage.

Taming the Wild Beast. But somehow the brave men who then dwelt in the forests, after killing wild boars for meat for many years, set out to tame this ugly beast. And they did it, too, but they never left us a word to tell us how it was done

Improving the Hog. By carefully choosing and keeping the best hogs, the farmers have made the fine breeds of to-day quite different from the fierce wild boar. The wild hog did not take on fat, but our domestic breeds will fatten in a remarkably short time. They sometimes become too heavy for their legs to support them. The legs have become shorter than those of the wild boar, the snout and neck are also shorter, while the shoulders and hams have come to take on flesh marvelously.

Protecting Hogs. The hog has very little covering for his body, for the few bristles and hairs do

not protect him from the swarms of flies. The hog never perspires, so in order to keep cool, this animal should be kept in shaded pens or where there is water in which to wallow. Those that are kept in woods or groves do not need the wallow so badly save to protect them from flies.

Giving Hogs a Square Deal. Swine have always been looked upon as filthy animals. In ancient times Moses was taught to have his people abstain from eating pork, because it was said to be unclean. This is rather unfair to the hog, for when he is provided with large yards, he keeps his bedroom clean. "It is only when the small pen is made to serve as dining room, bedroom, and wallow, all in one, that the hog is filthy. That is not his fault." It is the way in which the farmer forces him to live.

Their Useful Snouts. Hogs have to dig for some of their food, and so they have tough noses with a sort of disk or shovel on the snout for that purpose. Since they use their noses to dig for roots that they like, we use the name "rooting." It is said they have a keen sense of smell and can be led by it straight to their food. The pig can follow a trail almost as well as a dog.

Best Breeds Developed Here. Hogs, like most other domestic animals, were brought to America from Europe. Most of the best breeds of hogs have been developed here. The Poland-China (Fig. 26) was developed in Ohio; the Chester-White, in Pennsylvania; the Duroc-Jersey, in New York and New

Jersey; and the Cheshire (Fig. 27), in New York.

Two Kinds of Hogs. Some hogs are raised for lard and others for bacon. Corn is good food for hogs that are grown for lard, and so the lard type is the most common and the most profitable in our

FIG. 26. *A prize Poland China.*

country. In England, the bacon type is raised. Some hogs are useful for both purposes.

The Kind to Raise. The hog yields meat at a lower cost than any other animal when he is well cared for and properly fed. One should not raise scrub hogs, which are sometimes called "razor backs." It takes two years to get a scrub to weigh as much as a well-bred pig will weigh when nine months old. If a farmer has only scrub stock, he can improve his herd in a very few years by the use of a pure-bred sire.

What They Eat. When hogs are free to roam the woods they eat roots and such nuts as acorns and

beechnuts. They will eat almost anything, whether it is meat or plant (Fig. 28). It is said they once did great service by devouring rattlesnakes on the frontier.

FIG. 27. *A Cheshire pig.*

Hogs in the East. There are two ways of raising swine common in our country. In the East each farmer keeps a few hogs in small pens or yards and feeds them the waste from the kitchen and farm. Such hogs are usually kept for home use.

The Western Hog Farm. In the Corn Belt of the Central West there are great hog farms. Hogs are often raised on farms where cattle are fattened for the market. Here both hogs and cattle are fed on corn. The hogs run with the cattle and grow fat on the corn which the cattle waste. Where hogs are put on pasture they grow rapidly on clover, alfalfa, or rape pasture. (Fig. 29.)

FIG. 28. *Good feeders.*

Hog Cholera. Cholera often destroys an entire herd in a few weeks. The hogs lose their appetite, their eyes become inflamed and red blotches appear on their skins. The pen can be burned to prevent the disease from spreading, and the serum treatment given to the hogs infected.

Pigs Sent a Boy to College. A boy whose parents were too poor to send him to college, decided to make the money for his education himself. He bought a fine sow and began to raise pigs. They increased rapidly and by saving the money he received from their sale he had enough to pay his expenses at college for two years.

QUESTIONS

(1) In what ways do our hogs differ from the wild boar? (2) How has this change come about? (3) What protection do hogs need? (4) Why? (5) Which breeds do you find in your county? (6) How do the East and West differ in hog raising? (7) Where in your county are most of the hogs raised?

FIG. 29. *Berkshires on clover.*

CHAPTER VI

POULTRY

The Original Home of Poultry. Our chickens have probably come from the wild jungle fowl of India. Early man used to snare and kill these large wild birds for food and rob their nests, because he liked the eggs to eat. When men settled down and gave up their wandering life, they tamed and fed the jungle fowl. In time their wings grew smaller, because they used them so much less, and their bodies grew heavier. So to-day we have the contented hens that stay quietly in their pens and cackle to let us know when they have an egg ready.

Value of Fowls to the Farmer. Since the farmer has learned in the last few years to take better care of his poultry, it is now thought that they pay better for what they eat than any other stock on the farm. There is a great demand for "broilers" from ten to twelve weeks old, and they bring fancy prices. The number of eggs used in the United States daily is beyond our imagination. It is estimated at about forty-four millions. Besides supplying eggs and meat for the farmer's use, the chickens, if they are allowed to roam, catch many grasshoppers and insects. During the summer months they get most of their food on the range. They like grass, seeds, bugs, lime, and grit.

Four Classes. Chickens have been divided into four classes. The large, fat, meat-producing kind does not lay well. They are the Cochins and Brahmas (Fig. 30). The Leghorns and Minorcas are especially valuable for producing eggs. They are a small, wiry sort with large combs. They lay large, white eggs and seldom want to hatch them, so they can be kept laying for long periods. Their flesh is not so excellent for the table as other breeds, but they are very popular among poultry keepers near large cities where fancy prices are paid for eggs. The fancy or game chickens are beautifully feathered birds and are kept for show. To this class belongs the bantam that is too small for real use.

The General-purpose Fowls. But the best chickens for farmers to keep are the general-purpose

Fig. 30. *Light Brahmas.*

fowls that have nice, tender meat. They both lay well and make good mothers. To this class belong the different kinds of Plymouth Rocks (Fig. 31), Wyandottes (Fig. 32), and Rhode Island Reds. These breeds were all developed in America.

FIG. 31. *Barred Rock.*

Habits. Chickens swallow their food whole. It is softened in the crop and ground into particles in the stomach, or gizzard, which contains gravel or grit. Fowls tip their heads back to swallow when they take a beak full of water, because they have no muscle in their throats. Chickens wallow or take a dust bath to drive away insects or clean their skins; and in wet weather they oil their feathers so they will shed water well and so keep their skin dry.

The Nests. A hen will hide her eggs, if possible, so a cozy place should be arranged in a quiet, dark place for her nest. She begins to lay in the spring, one egg each day. If left to herself, she would commence to sit as soon as she had twelve or fifteen eggs. By removing the eggs she is kept laying a much longer time. The breeds that do not sit

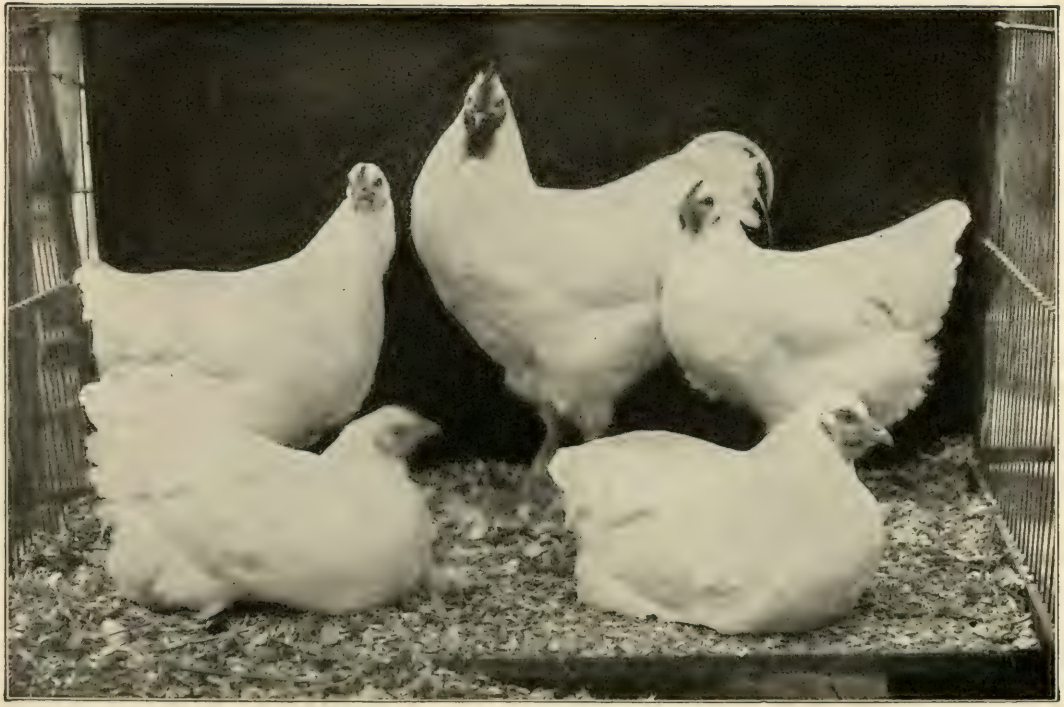


Fig. 32. *A pen of White Wyandottes.*

have been known to lay as many as two hundred thirty eggs in a year.

Poultry in Pens. Chickens that have free range are more profitable and do better than those kept in pens. But fowls can be kept under many conditions. To do well they must have reasonably warm, dry quarters with plenty of light and fresh air. In parts of the West, where it is dry, a frame of poles is set up in November and covered with straw. The chickens run inside this warm shelter and do well. If a hen is protected from draughts, frost, lice, and bad air she is likely to think spring has come in February and will begin early laying, or perhaps she will lay all winter. Some breeds lay well in the winter time when they have good care.

Care of Henhouse. Farmers should clean up their old henhouses with a shovel, broom, and boiling water. They should paint the roosts with kerosene to kill lice, and whitewash the walls. The cracks can be stuffed with straw and covered with tarred paper. Very soon the farmer will see his hens doing better. Leaves or straw make a fine floor covering, and they force the fowls to scratch for the grain. The house should be kept clean and fresh leaves or straw put in each week. (Fig. 33.)

Laying Hens. Laying hens require different food from those intended for table use. Variety of food is important. One reason the hen lays in summer is because she chooses her own food and has a balanced ration. She eats all day long, a little at a

time, and does not mope. A moping hen does not lay well, as exercise is necessary. Chickens in a pen need animal food, such as meat scraps and skimmed milk, to take the place of the insects that they get when they are allowed to roam. Cracked oyster shell furnishes lime for making the eggshell, and grit must be provided for grinding their food. Fresh water in clean dishes should always be within reach. During the winter season, corn may be given once a day because it is a warming food. Ground bone, table scraps, cooked potatoes, turnips, and vegetable tops are given instead of green food. Eggs, like milk, often show by their color, flavor, and odor what food the hens eat.

Hatching Little Chicks. Hen's eggs are hatched by keeping them at the same warm temperature for twenty-one days. Many farmers prefer the hen to incubators for hatching. Perfect-shaped eggs with good firm shells should be selected for hatching. The fresher they are the better. When two broods of chicks are hatched at the same time, one hen may be able to mother both.

How to Care for the Brood. Little chickens must be kept dry and must be carefully fed three times a day. Corn meal and bread crumbs and the yolk of hard-boiled eggs are a good beginning. If chicks are in a pen, cut grass from the lawn makes good green food. Soon a little chicken will eat wheat and cracked corn. Chicken lice are a great trouble to the tiny chicks and the mother hen, and the nest

FIG. 33. *A sanitary poultry house.*

should be dusted with powder a week before the chickens are hatched. Some of the powder may be mixed with lard and rubbed well on each chicken's head.

Brooder Chicks. Incubator chickens have no mother to teach them to eat grit and green stuff.

When chicks are first brought to the brooder, bread crumbs are sprinkled upon the floor among the grit, and in this way they learn to take food and grit at the same time. To make them eat promptly, the

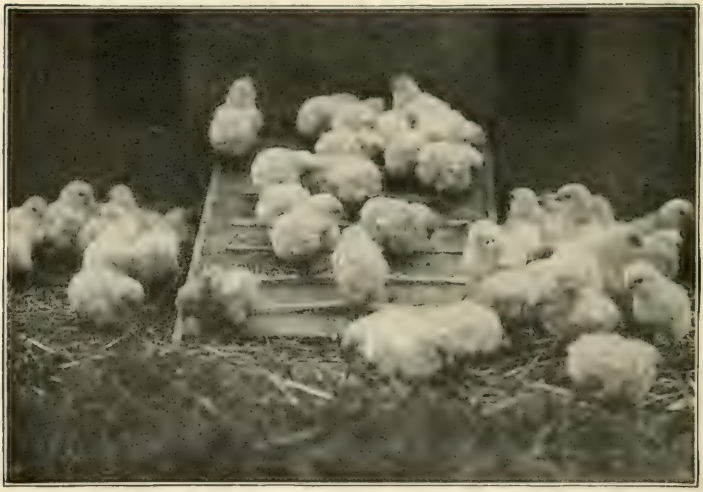


FIG. 34. *Incubator babies.*

food may be taken away after five minutes. (Fig. 34.)

Fattening Broilers. When the chickens are weaned from the hen, the cockerels are put in a yard by themselves and fed on porridge made of four parts of corn meal, two parts of middlings, and one part beef scrap. The mixture is wet with skimmed milk until it will run from a wooden spoon. They are fed this at morning and at evening. They are allowed plenty of shade and kept as quiet as

possible. This makes them more meaty and soft than those that exercise. Chickens about a hundred days old gain the most rapidly. They often gain from one and three-fourths to two and one-fourth pounds in a month. When cockerels weigh two pounds or over they should be sold for broilers.

Poultry Pests. Hawks capture many chicks. A good marksman can kill a few and hang them on poles around the yard as an object lesson. The best remedy is to keep the chicks in yards covered with wire until they are large enough to run for shelter. It is well to have low-growing shrubs where chickens can hide. If pigs run in the same field with chickens they must be watched, for if a pig once gets a taste of chicken, he will chase them continually. Rats trouble chicks at night. Cement floors and stone foundations in chicken houses will keep out rats. Poison may be used if it can be kept away from the chickens.

QUESTIONS

(1) Which do you think will pay better on the farm, the Leghorns or the Barred Rocks? (2) Give reasons. (3) How do fowls keep themselves clean? (4) Why do we scatter grain in straw for the chickens to search out? (5) Why should farmers use incubators? (6) What is the use of grit in chicken feed? (7) Why is oyster shell eaten by hens? (8) What is the cause of soft-shelled eggs? (9) Why should chickens be penned up and kept quiet when fattening for market?

For exercises, problems and experiments, refer to the Appendix.

CHAPTER VII

TURKEYS, DUCKS, AND GEESE

Turkeys. A flock of turkeys has helped many a farmer's daughter to a new winter outfit or bought her things to go away to school. Besides being a profitable bird at Thanksgiving time, they destroy millions of bugs which would injure the crops. The bronze turkey (Fig. 35) is the most common in the United States. Some turkeys are hatched by hens and some by incubators. The first food should be the curd of milk made like cottage cheese. To the cheese should be added chopped boiled eggs and a bread made of corn meal, skimmed milk, and salt. After turkeys are six weeks old, they get their own living catching grasshoppers and bugs. They need clean pens and clean food. Dampness is sure to kill young turkeys, so they should be kept in their pens in the morning until the dew is off the grass.

Fig. 35. *Bronze turkey.*

Fattening Turkeys. The turkey is usually allowed to roam until he is ready for market,

but about the first of October he should have an evening meal of good yellow corn. It is well to begin with a little at a time, but by the first of November he must go to bed with a full crop every night. This makes the flesh yellow, juicy, and tender.

Ducks. Pekins are the most popular ducks (Fig. 36). Duck's eggs can be hatched under hens or in incubators. The first food of the ducklings should be a moist mash instead of dry feed. Ducks need plenty of water to drink, for they take a mouthful of food and wash it down with water. They must have drinking pans deep enough so they can stick their heads in over their eyes, because that is their way of keeping their nostrils and eyes clean. The birds are dry-picked to save the feathers for pillows. Duck's eggs are popular, especially at Easter.

FIG. 36. *Pekin ducks.*

Geese. The goose is the Christmas bird (Fig. 37). When geese are allowed to roam they gather most of their food, which is usually grasses and insects. In the winter months they must be fed one meal a day. Geese graze as freely as cattle and have been accused of destroying the roots of grass. They must

have plenty of water for the same reason that ducks need it. The eggs are best hatched under a hen. A sitting goose is very cross and has been known to break a man's arm with a blow of her wings.

Young goslings are easily chilled and must be looked after during cold rains. To make a rapid

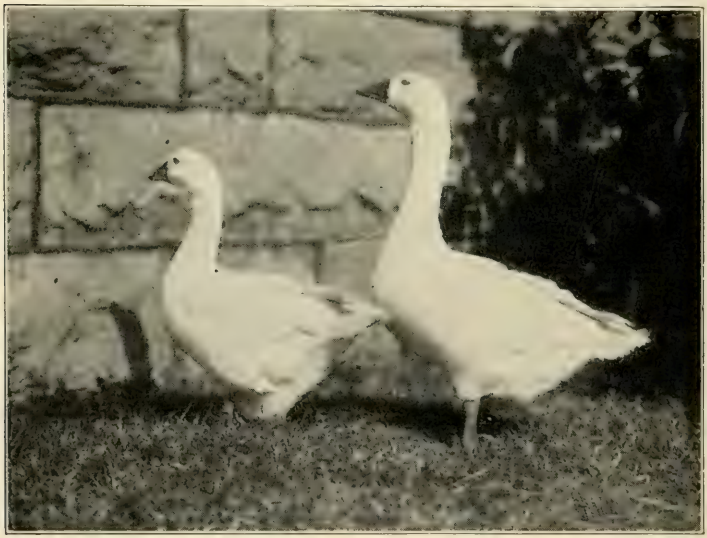


FIG. 37. *The Christmas bird.*

growth, geese must be fed wheat bran, corn meal, and scraps. They should have plenty of shade, water, and grass. They may be made ready for market in three months. Their feathers are valuable for pillows and many other things.

CHAPTER VIII

INSECTS

Insect Enemies. Almost every plant has an insect enemy that feeds upon it; and the farmer who wishes to protect his crops, orchards, and gardens must know how to fight these plant enemies. Insects form about nine-tenths of all the animal life upon the earth. Hundreds of millions of dollars' worth of farmers' produce is lost each year because of insects. (Figs. 38, 39, 40, 41, and 77.)

Insect Friends. Certain insects, however, are useful to mankind. Some gather honey and carry pollen from flower to flower, while others spin silk, and still others clean away dead animals. These friends of man are: bees (Fig. 45), wasps, dragon flies, tiger beetles, silkworms, and many others.

Parts of Insects. Insects when full-grown have the body divided into three parts: the head, the middle part, or thorax, and the abdomen or back part. On the head are the eyes, the feelers, called *antennæ,* and the mouth. The chest or thorax bears the wings, of which there are usually two pairs, and six legs.

Biting Insects. There are among insects two kinds of mouths. Such insects as grasshoppers and beetles bite the food. Others, such as mosquitoes, bedbugs, bees, and butterflies, suck their food.

Insects with biting mouths have two pairs of jaws with which they chew their food; and they often eat bark, leaves, fruit, and flowers. All these biting insects may be killed by spraying poison on the plants on which they feed.

Sucking Insects. Insects with sucking mouths usually live upon the sap of plants or the blood of

Courtesy U. S. Dept. of Agriculture

FIG. 38. *Knotty apples from trees that were not sprayed.*

animals. Some few of them, such as bees and butterflies, feed largely upon the nectar or sweets of flowers. Since they get their food from the inside of the objects on which they feed, we can not poison them, but must find some other method of fighting them.

Contact Insecticides. Substances have been discovered which will kill insects when covering or touching their bodies. These are called contact

insecticides. Insects do not breathe through their noses or mouths, but they have little holes, or pores placed along both sides of their bodies, and through these the air passes in and out. When anything clogs these breathing pores, they die. It has been found that certain oils and powders will destroy insects by smothering them. Oils may be mixed with

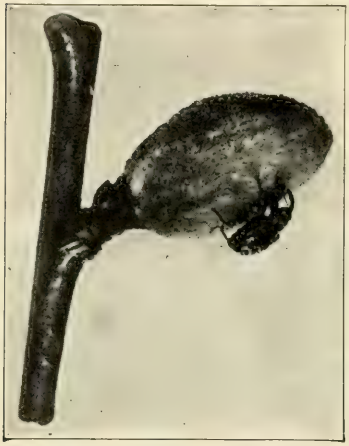
Courtesy U. S. Dept. of Agriculture

FIG. 39. *Apples from trees that were sprayed. No farmer can afford to neglect his fruit crop.*

other materials so as to prevent damage to the plants on which the insects live. Kerosene emulsion is such an insect destroyer. Poisons may be put on the plants before insects appear as a protection, but contact insecticides must be applied to the insects themselves.

Moulting of Insects. Insects have no bones or inside skeleton, but the skin becomes very hard and

horn-like and is usually considered the skeleton of the insect. As it becomes hard it will not stretch; and when the insect has grown so large as to entirely fill this hard coat, a new or soft coat forms underneath; and the old one is shed or cast off. The casting off of an old coat, or shell, is called moulting. The skin is moulted several times during the life of the insect, and each time it becomes larger. The chief changes in the insect's life usually come in the last two moults.



Courtesy U. S. Dept. of Agriculture

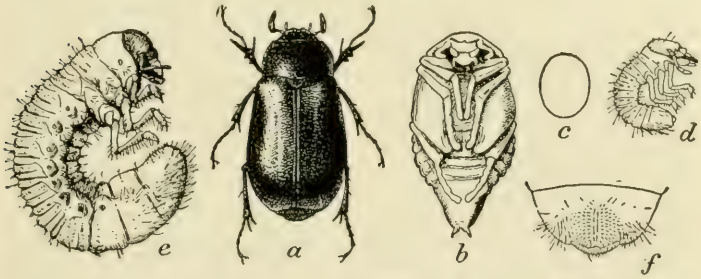
FIG. 40. *Curculio depositing its egg upon a young peach.*

Stages of Development. Wasps, bees, butterflies, moths, beetles, flies, and mosquitoes have very remarkable changes in the last moults. Such insects are said to have four stages of life: (1) the egg stage, (2) the larva or grub stage, (3) the pupa stage, (4) the adult stage. (Figs. 42 and 43.)

Courtesy U. S. Dept. of Agriculture

FIG. 41. *The young grub destroying the fruit.*

Larva Stage. Eggs hatch into the larva stage, which is the time of growth and when most of the eating is done. The larva of a butterfly is a caterpillar, that of a fly is a maggot, and the larva of a mosquito is a wiggler. Some insects eat all the time during this growing stage, never going to sleep.

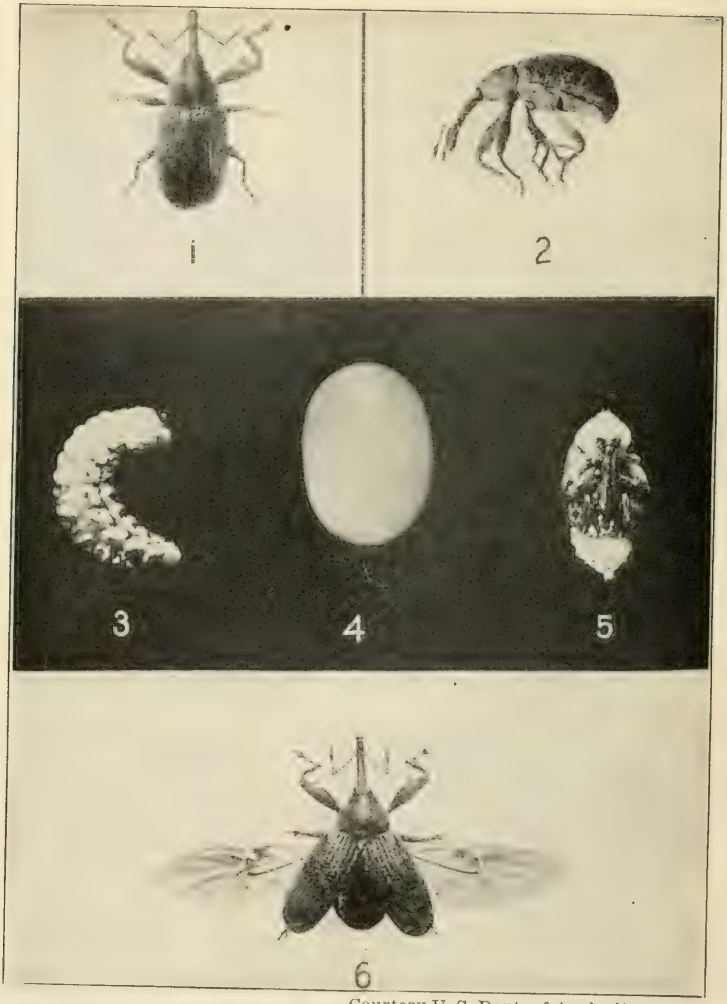


Courtesy U. S. Dept. of Agriculture

FIG. 42. *May beetle, called also June beetle or June bug; a, beetle; b, pupa; c, egg; d, newly-hatched larva; e, mature larva; f, anal segment of same from below.*

They stop only long enough to cast their coats. The kinds that live on flesh have, in some instances, been known to eat two hundred times their own weight in a single day.

Pupa Stage. The larva then goes into a resting or sleeping state, enclosing itself in a case of some kind. This is called the pupa stage. Silkworms spin for their pupa stage a silken covering called a *cocoon*. While in this state the insects go through many wonderful changes. Wings and legs are grown and after a short time the full grown or adult



Courtesy U. S. Dept. of Agriculture

FIG. 43. *Mexican Cotton Boll Weevil. 1, Weevil, back view; 2, weevil, side view; 3, fully-grown larva; 4, egg; 5, pupa ready to transform; 6, adult weevil with wing covers raised and wings extended, ready to take flight.*

insect comes forth a fly, a mosquito, or a beetle.

Freezing the Insect. The blood of insects is transparent like water and is pushed along through the body by the beating of a large vein or artery which lies along the back, instead of by the beating of a heart. Insects are cold-blooded and can freeze without being killed. During the winter insects hibernate; that is, a great many varieties live through the winter hidden away among old grass or under stones, logs, bark, and in the ground. Even the eggs of insects may be frozen solid and remain uninjured.

Insect Life Short. Insects generally die soon after laying their eggs, though some kinds live longer, raising several broods. A great many die before their eggs hatch. Insects are found in all countries at all times of the year. They are found in our homes, gardens, and fields; in the air, water, and the earth: both within and upon the bodies of animals. We shall learn more of the different kinds of insects as we study the chapters on crops.

QUESTIONS

(1) How do insects compare in numbers with animals? (2) Name some insects that are man's friends. (3) Name the parts of the insect's body. (4) How many legs have they? (5) What is the difference between biting and sucking insects? (6) Why does a farmer need to know how an insect takes its food? (7) Why do insects moult? (8) Explain larva, pupa, and cocoon. (9) What is peculiar about the blood of insects? (10) What is meant by hibernating?

CHAPTER IX

THE BEE

The First Sugar Makers. All the old Bible countries had their beekeepers. Before the growing of sugar cane and the making of sugar was begun, bees furnished the only means of sweetening food. Our savage forefathers probably robbed the hollow trees where bees stored their honey and in time learned how to capture swarms. In England, not many hundred years ago, swarms of bees were so prized that they were willed from one family to another.

Finding the Bee-Tree. To find a "bee-tree," the hunters took to the edge of the woods boxes of diluted honey; then they followed in the direction the bees took as they flew home. It was believed when the bee had his honey basket filled, he took the straightest way possible to the bee tree. That is how we came to have the expression, "Take a bee line."

The Honey Train. An American invented the hive which makes it possible for one man to take charge of many bees. There are many men who make beekeeping their business (Fig. 44). It has been estimated that if all the honey manufactured in the United States in one year were put in cars, it would make a train thirty-five miles long.

Where the Honey Comes From. Bees, with their long tongues, take the sweet juice, or nectar, from

Courtesy of "Bee Culture," Medina, Ohio

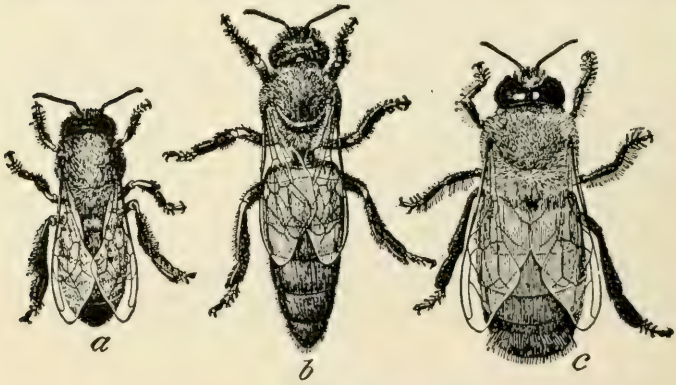
FIG. 44. *A profitable apiary.*

flowers, clover, buckwheat, alfalfa, black gum, chestnut, and catnip. This nectar we may taste by pulling a clover blossom to pieces, but only the bee knows how to make it into honey.

Pollen and Wax. It was once thought that the bees used the little yellow balls, which we sometimes see clinging to their hind legs, for making wax; but now we know the little yellow balls are made of pollen which the bee gathers from flowers for the purpose of feeding its young, and that the wax is secreted from their own bodies in much the

same way as a cow secretes milk. The wax forms in little scales on the under side of their bodies, and when they want to use it they pick it off with their feet. After mixing it in their mouths, they use it in building the beautiful combs with the six-sided pockets in which they store honey.

Members of the Bee Family. We do not care to



Courtesy of U. S. Dept. of Agriculture

FIG. 45. *The honey bee; a, worker; b, queen; c, drone.* [*Twice the natural size.*]

go very near bees when they are at work, so not many of us know the difference between the queen, the workers, and the drones (Fig. 45). The queen is the largest and the most important bee in the hive. If we examine the cell, or living room of the queen bee, we shall find it nearly four times as large as those of the other bees. It is about the size and shape of a peanut and is usually placed on the edge of the comb.

The Work of the Queen. The queen is the mother bee, and she lays all the eggs. It is said that a queen bee has laid more than three thousand eggs in a single day. There are some seasons when she does not lay so many, and there are other seasons when she does not lay at all; but it does not take long for her family to become too large for the hive.

Why Bees Swarm. When the family becomes too big, they form a new family, or, in other words, they "swarm." (Fig. 46.) A cloud of bees comes out of the hive and lights on a near-by bush. From

Courtesy of "Bee Culture," Medina, Ohio

FIG. 46. *A stand of bees near the swarming time.*

here they send out scouts to find new housekeeping quarters; they also wish to make sure their queen is with them. If they find she is not with them, they return to the old hive and wait for her before they start again. If the beekeeper is watching, he makes ready a clean, fresh hive and either shakes them in or places it where they will go in.

The New Queen. The queen which takes her place in the old hive comes from an egg laid in the queen's cell. She has been fed with "royal jelly." This is much richer food than that which is fed to the baby bees which grow into the workers or drones, and it makes a much larger bee. (Fig. 45-b.)

Getting a New Queen. In case an accident happens to their old queen, the bees have a curious way of getting a new one very soon. The drones choose three cells which contain newly-hatched bees, they knock out the partition cells, kill two of the bee-babes, and feed the third on "royal jelly."

Dividing the Work. There are from thirty thousand to forty thousand workers in a good strong colony, and each bee has its own work to do. The young bees build the comb, feed the newly-hatched bees, and do general housework; those a little older secrete wax and help their elder brothers to shape pockets for storing the honey which these older bees bring in. A queen may live four or five years, but the workers that are hatched in the spring, work so hard that they often wear themselves out in forty or fifty days.

The Drones. The drones are the male bees. They are larger than the workers and have no sting. Somebody has called them the "tramps" of the bee family, because they do no work. When the workers tire of feeding the drones, they kill them and throw them out of the hive. (Fig. 45-c.)

The Kind to Keep. Bees have been known to make from twenty-five to thirty pounds of honey in a year in one hive. The Italian bees are considered the finest, because their longer tongues can reach nectar in the flowers that the black bee can not reach. They are also more gentle and easy to handle.

Helping the Bee. To secure honey in the best shape for the market, the beekeeper places in the top of the hives frames which hold just one pound of honey. (Fig. 47.) These have a sheet of wax on which is impressed a network of six-sided cells. From this foundation, new cells are built by the bees. A machine has been invented that saves the time and energy of the bee in wax making.

The Honey Extractor. Once a beekeeper's little son was playing with a piece of unsealed honeycomb in a basket. The lad had tied a piece of string to the handle. As he whirled the basket around and around in the air, his father noticed the honey dripping from the basket. When he found the cells of the honeycomb were nearly emptied without injuring the comb he thought, "How much labor it would save the bees if they could fill their combs again instead of having to make new ones!" So

Courtesy of "Bee Culture," Medina, Ohio

FIG. 47. *It's all in knowing how.*

ne invented the honey extractor which empties many combs at once and gives us the clear strained honey. It removes the honey from the comb without injury to the comb and without destroying its place in the frame; and these old combs are put back in the hive to be filled again. In this way bees are kept busy gathering honey instead of building comb.

Keeping Them Warm in Winter. Bees must be protected from the cold in winter, or they may die. The "box hive" incloses the real hive, leaving a space to be filled with chaff and other packing material. A small opening is left so the bees can get out in cold weather. They must have exercise in the open air to keep well.

Do Not Starve Bees. In removing honey from the hive, care should be taken that there is enough left to feed the bees through the winter season. Sometimes a keeper prefers to feed the bees on a sirup made of sugar, so he can sell all the honey.

Another Service. Besides the income the bees bring the farmer in honey and wax, they do him another great service. They scatter pollen from one plant to another. Many plants cannot bear fruit or seed unless their pollen is mixed. The wind does some of this, but the bee is the best mixer. He dives into the heart of a flower for nectar and gets his body covered with pollen and takes it with him to the next plant. It is said clover would not grow on the island of New Zealand till bumblebees were taken there to scatter the pollen.

Busy as a Bee. Now we know what busy, strange, helpful little creatures the bees are, and we do not wonder at the old saying, "As busy as a bee." Every farm has enough plants to provide several swarms with pollen and nectar, so that each one may have its own honey. What one needs to know about beekeeping he may learn largely from books, because it is said that more books have been written about the bee than about any other domestic animal.

QUESTIONS

(1) Why were bees more highly prized in the olden times than to-day? (2) What plants are good for honey bees? (3) Where do the bees get the wax? (4) What is "royal jelly"? (5) How do bee farmers aid their bees in honey making? (6) What other service does the bee perform besides making money? (7) Why would not clover grow in New Zealand at first?

For exercises, problems and experiments, refer to the Appendix.

CHAPTER X

BIRDS

A Story. A certain beautiful poem tells this story. Once upon a time the farmers of Killingworth were troubled and angry, because the birds ate so much of their fruit and grain. So they held a town meeting and ordered every bird killed. Only one man, the village teacher, pleaded for the birds. He said it would be lonely without their cheerful songs. He reminded the farmers of the many insects which the birds devoured. He told them that the few cherries and the small measure of grain the birds ate were only just wages for the hard work they did in protecting the farmers' crops from worms and bugs. But the farmers did not heed his warning. The parent birds were shot and the little ones starved in their nests. For one long summer

FIG. 48. *The Red-Headed Woodpecker, an enemy of tree insects and a friend of the farmer.*

there were no birds in Killingworth. Hundreds of caterpillars and cankerworms and small insects destroyed the crops and the leaves on the trees. The land looked like a desert. At last the foolish farmers saw their mistake. They hastened to send away for many cages of singing birds which were again allowed to fly about at will. The story ends here, but we are glad to know that the birds we all love so much are of great use to us.

Fig. 49. *The Bobolink, an enemy of grasshoppers, caterpillars, army worms and the like.*

Service to the Farmers. It will be impossible to mention here all the helpful birds. Robins hop about the fields and lawns and gardens, destroying grasshoppers and earthworms. The bluebirds, warblers, and chickadees work among the tree-tops, catching the insects which eat the tender leaves. The nuthatches, creepers, and woodpeckers (Fig. 48) patrol the bark of the trees, finding plant lice and borers.

Other Friends of the Farmer. The swallows, flycatchers, and kingbirds sail about the air, snapping

up flies and mosquitoes. When darkness comes, the owls and nighthawks go on duty and capture insects of many kinds. They swoop down and catch moles, meadow mice, and rats that do harm to farmers' crops.

Grosbeaks Are Friends. Grosbeaks are of such particular service to the farmer that in many states they are protected by law. The rose-breasted grosbeak, or "potato-bug" bird makes a tenth of his diet of potato beetles (Fig. 77). He also eats the cucumber beetle. He is accused of eating peas, but he is so useful in the garden that it is worth one's trouble to put netting over the peas. He may also be kept away by a scarecrow. He is very fond of orchards, for cankerworms, caterpillars, and the moths and scale insects that attack trees are his special delight at meal time. The cardinal, or red-bird, belongs to the grosbeak family. They have been accused of pulling sprouting

Fig. 50. *The Meadow Lark.*

grain, though the examination of the stomachs of five hundred cardinals did not prove this to be true.

Tarring the Seed. To prevent the western grosbeaks from pulling the seed grain, the farmers soak the seed corn or other grain in a barrel of water and stir it thoroughly with a stick dipped in gas-tar. When the grain becomes black, it is spread on sacks and dried in the sun. With this coating of tar, it is safe from the birds. Seed planted with a checkrow planter is not disturbed because the earth is packed.

FIG. 51. *The common Quail or Bobwhite.*

Protecting Grain Fields. Some farmers protect their fields of ripe grain by planting a few rows of millet on the edge of the field. Birds prefer millet to other grain, but it should be sowed so as to ripen at the same time as other grain.

The Grosbeak and the Orchard. Mulberry and june-berry trees will protect an orchard in the same way. The black-headed grosbeak, if not prevented, eats a good deal of fruit; but it has been estimated

that for every quart of fruit he eats, he consumes, by measure, a quart and a half of black olive scales, a quart of flower beetles, and a large quantity of codling moth babies and cankerworms. If this is true, he certainly saves much more fruit than he destroys.

Policemen of the Air. Some one has called the birds the little policemen of the air, because they protect us from the robber bugs and caterpillars. Insects make up nine-tenths of the animal life of the world, and it has been estimated that a bird will destroy thirty insects daily, so he is a very valuable little policeman.

Eating Weed Seeds. Another great foe of the farmer is weeds. In one state alone the tree sparrows are reported to have eaten eight hundred seventy-five tons of weed seed in one season. This included smartweed, ragweed, bindweed, crabgrass, and many others. The bobolink and meadow lark destroy many insect enemies of the crops and untold quantities of weed seed. (Figs. 49 and 50.)

FIG. 52. *Making friends of the birds.*

Big Appetites. Birds need a great deal of food, because they are so active. They eat all the

time they are not sleeping or caring for their young. One flicker was found who had in his stomach five thousand ants; a nighthawk ate at one time sixty grasshoppers, and a bobwhite (Fig. 51) ate seventeen hundred seeds of weeds for one meal.

Making Friends of Birds. Birds may be coaxed to stay near the house and garden by protecting them from cats and bird-dogs and by making nesting easy for them. One kind-hearted farmer built a home for a wren. It was a box six inches square and about eight inches high. He put a little perch on the front and an entrance hole only one inch across, so the sparrows could not get in. He did not paint it, but left it wood color, for birds do not like bright-colored dwellings. The same little wren came on the fifth day of May every year for seven years and kept house in it. Martins and bluebirds also settled down in his bird houses. (Fig. 52.) The farmer's wife coaxed the orioles to build their strange little pouch nests on the limbs of their elm trees, by putting out yarn and cotton twine on the bushes in the nesting season. Covered arbors were made and vines allowed to grow to make sheltered places for rearing their young.

Sharing with the Birds. A big mulberry tree in the garden furnished food for many songsters as well as plenty of pies for the farmer's family. On top of posts in the yard, out of the reach of cats, were shallow dishes which provided water for the birds; and the farmer left an opening under the eaves of

his barn so the swallows could get in and keep house among the rafters, because they keep the barn free from gnats and flies. This bird-lover was not so cordial to crows, blue jays, sparrows, and chicken hawks, for they destroy the eggs and the young of the song birds.

QUESTIONS

(1) What birds get their food among the tree tops? (2) Do you know these birds? Get a bird book to aid you in learning them. (3) What kinds work on the bark of trees? (4) Name some that get their food on the wing. (5) How may orchards be protected from birds? (6) Why do not birds like bright-colored bird-houses?

For exercises, problems and experiments, refer to the Appendix.

PART II. SOILS AND FARM CROPS

CHAPTER XI

SOILS

What the Soils Do. The layer of dirt or crust that covers the earth is called the soil. It is so thin in places that the rocks appear through it. In other places it is deep. Plants and insects, birds, beasts, and men, are all fed on what grows in this layer of soil. It is marvelous that soil will produce so many different kinds of plants.

A Light Soil. As we go about we notice that the soil of some fields looks quite different from that of others. Here we find a loose soil in which we can easily see a large amount of common sand. There we find soil that contains so much clay that bricks can be made of it. The more sand a soil contains the easier it is to cultivate it. It works better under the plow and harrow. For this reason a sandy soil is said to be a light soil.

Heavy Soil. Clay soils stick together and are hard to work, both when they are very wet and very dry. If we make clay into mud pies, they will crack when they are dry. Clay soils behave this way in the fields. We have all seen the big cracks in clay soil in the dry midsummer. This kind of soil is said

to be cold, because it holds so much water instead of allowing it to pass through easily. Because clay soils are sticky and hard to work, we call them heavy.

Crops for Clay Soils. Clay soils are excellent for pastures, and they wear well. Apples, pears, and grapes do well on them. They also produce good crops of hay, wheat, oats, beets, cabbages, and turnips. But clay soils are too cold and wet for corn and too hard to allow potatoes to grow freely.

Loam. A soil that is composed partly of clay and partly of sand is called loam. If there is more clay than sand, it is called a clay loam; if there is more sand, it is a sandy loam. A true loam is made up of about equal parts of clay and sand. This is the best farm soil, for loam makes a good home for plant roots. It is easy to cultivate, and because it allows moisture to pass through it readily, no time is lost after rains in waiting for it to dry out.

What the Soil Contains. We know that all soil is made up of fine particles of rock or sand, of decayed plants, of water, and of insect life. It also contains air and another plant life which, perhaps, we do not know about, because we cannot see it. They are so small it would take many thousands of them to measure an inch. This low, tiny plant life we call bacteria. They are very useful in changing the soil so as to make it ready for plant food. Bacteria must have air to live, and that is one reason we must have air in the soil.

Plant Food. In order that plants may grow, they need certain foods that we call plant foods. Plants get this food from the soil and the air. In order not to rob the soil, we must know what our crops are taking out of it and how to put these plant foods back.

Plants Need Many Foods. The plant needs a variety of foods, just as a hungry boy does. Ordinary plants need about thirteen different kinds. Some of these elements, or different kinds of foods, are obtained from the air, and others from the soil. To grow good crops, the soil must not only have enough of all the foods that the plants need, but they must be in such form that the roots can take them up and use them to build up the stalk, leaves, and fruit.

Only Liquid Food. The foods taken from the soil are called mineral foods, because they are actually bits of minerals dissolved in water just as you dissolve sugar or salt. Plants drink their food through tiny, hollow root hairs that take up this water solution. They cannot take up solid particles of soil. So all this mineral plant food must be dissolved in water before it can pass into the plant and become a part of it.

Water the Chief Plant Food. When soil is perfectly dry, plants cannot grow in it, for water generally forms about three-fourths of a plant's weight. Since the plant can take plant food from the soil only in liquid form, we see that water itself

is not only an important plant food, but it carries to the stalk and leaves nearly all the other foods they need. After traveling through the rootlets up the stem to the leaves, the water that is not needed passes off from the leaves into the air. Therefore we see that plants take in much more water than they can use, for the sake of the food that the water brings with it. We are told that timothy hay needs three hundred tons of water to obtain the other foods necessary to make one ton of hay; oats require five hundred tons of water for a ton of plant.

Other Food. A bundle of wheat as it comes from the self-binder weighs about ten pounds, and nearly nine and one-half pounds of this is composed of water and the carbonic acid of the air. A large part of the farmer's labor is done to supply the elements that make up the other half pound of this bundle of wheat. It contains ten simple foods and no two in equal amounts. The wheat cannot spare any one of these ten plant foods. So when the soil loses one element of wheat food, it is no longer good wheat land.

Humus. Different parts of the same fields may have different colors. The red color of some clays is due to the iron in them, but the brown or black color of soils is usually due to the humus that they contain. Humus is the decay of plants. The leaf mould which we find under the dead leaves in the woods is a good sample of humus. This is a very important element in soil. Humus not only makes the

soil dark and rich, but it makes the ground loose and mellow so air can get in. It also enables the soil to hold far more moisture than would be possible without it. Plants, we know, need both air and moisture about their roots, so humus is a valuable aid to the farmer.

Soil and Surface Water. How does the soil obtain and keep moisture and give it over to the plants? If we go into the fields after a heavy rain, we notice muddy streams running from the plowed land, carrying off good, fine soil. Part of the water that falls as rain and snow, runs off instead of sinking into the earth. This we call surface water, and it often does much damage to our fields; but much of the water that falls upon the ground sinks into the soil through cracks and holes and between the tiny grains of soil. When the land is dry the farmer likes a slow, steady rain, because it all soaks into the ground to feed plants, instead of running off as surface water and carrying good soil with it.

Why Clay Soils Are Wet. As the water passes through the soil, each tiny grain of sand and each little particle of earth is covered with a coat of moisture. All through the soil are small holes or open spaces between the grains, and into these the water goes. In such fine soil as clay, which packs closely, the spaces are small, and the water cannot pass through rapidly; so it is kept back in holes, open spaces, or puddles. In loose, coarse-grained earth, such as sand, the spaces are large; and the

water passes through rapidly. This explains why clay soil is sticky and wet while sand is a dry soil and almost never forms puddles.

Holding Water for Plants. It is easy to understand how water will move downward through the soil wherever there are openings or pores. We also know that water-coated particles will pass on some of their moisture to dry ones that touch them, just as lamp oil passes up the wick. Thus, you see, moisture is always moving toward dry areas. This means a great deal to plants, for when their rootlets drink up the water that is around them and the soil about them is becoming dry, more moisture moves toward the dry place and supplies the thirsty plants. In this way plants may obtain nearly all the water in a good soil.

Importance of Drainage. Some regions have considerable rainfall. Water soon forms a coat about each tiny grain of soil and fills the pore spaces. If more rain keeps falling, and the water cannot pass down easily through the soil, we have swampy land. This happens especially where the under drainage, as we say, is not good. In such swampy lands, the open spaces, or pores of the soil, are always full of water, and no air can penetrate the soil.

Good Soil Contains Air. All plants need air about their roots as well as about their stems and leaves. The roots can not do their work without air, and they will not go deeper than the air can follow. Without air, seeds will not sprout, but will rot.

Then, as we have said, there are the hosts of soil bacteria whose work it is to change certain plant foods for the plant's use; and these bacteria can not live without air.

How to Drain Swampy Land. Level fields of clay soil are often unfit for crops, because they do not drain well. They are always water-soaked and swampy. Thus the farmer must drain such fields or allow them to lie idle. The best method is to tile-drain them. This is done by digging trenches from thirty to one hundred feet apart, according to the soil. In the bottom of these trenches tiles are laid. These tiles are merely hollow tubes about a foot long, made of clay and burnt hard like brick. They are laid end to end about four feet below the surface of the ground. Care must be taken to see that the tile line slopes gradually to some lower level at the creek or river.

How Draining Helps. The tile drains carry away the excess of water. This allows air to enter the soil, and plant roots will follow as deep as the air and so get more plant food. Bacteria can also find better homes because of the air in the soil.

A Map of the Tile Lines. The tile should not be too small, as small ones get filled up easily. Nothing smaller than three inches in diameter should be used, and in many places only four-inch tile are laid. Tiling a field costs a great deal of money and it should be done right. A map of the field may be kept showing just where every tile line is, so that

if a section again becomes swampy, it will be easier to find any tile that has filled up and failed to do its work.

The Farmer's Bacteria Friends. We have learned of the tiny bacteria plants that live in the soil and help to prepare food for the plants we cultivate. Some kinds of bacteria live in other places, and others are harmful; but these soil bacteria are very necessary and helpful, and the farmer works hard to make the soil right for them to grow. There are millions of bacteria in a cubic inch of fertile soil. They do not need sunlight as do most plants, but they do require air, moisture, warmth, and food.

How They Help. Bacteria pounce upon all vegetable matter, such as leaves, wood, grass, and dead animal matter, that falls upon the ground and begins to decay, or rot. The bacteria break up all these substances into simple foods that are ready for the plant to drink. It would be of no use to manure soil if it were not for bacteria.

Bacteria and Clover. Some kinds of bacteria set up housekeeping upon the tiny rootlets of certain plants such as clover, alfalfa, soy beans, and cowpeas. They take a certain element, that we call nitrogen, from the air and store it up in little bunches or swellings on the roots of these plants, ready for them to feed upon. Plants must have this nitrogen as food, and soil that contains abundance of it is rich soil. Every farmer boy knows that the fields are richest where clover, alfalfa, or

cowpeas have been growing. (Fig. 53.) The reason is that the millions of bacteria have been at work upon their roots, storing up nitrogen for them and for other plants to feed upon. This explains why farmers use these crops to build up worn-out soils.

Growing Several Crops. The farmer always raises some crops that pay better than others. Corn may pay better than oats, and yet it is wise to grow some oats, because the two crops can be worked at different times. A farmer may raise all the corn he has time to take care of and still raise a field of oats besides. Barley, oats, and spring wheat require attention at the same time. So the farmer usually chooses only one of these crops. Rye and winter wheat must be worked at the same time, and so the farmer grows but one of these in a season.

Not Too Many Crops. It is better to raise a number of crops than to put the whole farm into one, because the farmer wishes to provide work for himself and his laborers all the time. It is not well, however, to have too many crops, because they may call for too much machinery. A farmer can not afford to buy the necessary tools for potatoes or wheat or orchards unless he has a fair-sized field in such crops. But small vegetables and fruit for home use should all be raised on every farm in gardens and small orchards.

Rotation of Crops. Rotation means that the crops grown on each field are changed every year or two. Nearly every successful farmer does this. Still

there are fields that have never grown any crop but cotton; others, nothing but wheat. This is bad for the land, and the thoughtful farmer does not practice it.

Good Reasons for Rotation. By rotating and having several different crops, the laborers and teams are kept busy. The farmer has some crops

Courtesy of Agricultural Experiment Station, Wisconsin

FIG. 53. *Clover sod with potash and phosphorus fertilizer yielded 26 bushels of corn per acre, shown at the left, as compared with 13.5 bushels where potash and phosphorus were used without clover, shown in the center, and 28.5 bushels where peat, potash, and phosphorus were used, shown on the right. This shows the importance of adding nitrogen and organic matter to sandy soils.*

to sell and some to feed. He also escapes a total crop failure, and he keeps his soil in better condition. By growing the same crops on the same fields year after year, certain weeds get the upper hand. By changing crops, these weeds are checked, because the crops are worked at different times and in different ways. Then, too, there are some plant

diseases and insects that will get a big start unless other crops are introduced on the field. When insects find their favorite crop gone and one growing that they do not like, they are without food and starve to death. But perhaps the most important reason for rotation is to keep up the supply of humus in the soil by growing clover, alfalfa, or cowpeas and plowing them under to restore the vegetable mould or humus.

Rotating in the North. There are different systems or methods of rotating crops. Many good farmers in the Northern states divide their farms into five fields, and on each field they raise corn, followed by oats, then by wheat, then clover, and lastly by timothy. Then they plow the timothy stubble and again start with corn. Try to make five diagrams or maps to show what each field contains each of the five years.

In Potato States. In some potato-raising sections, they have a three-year rotation: a crop of potatoes is followed by one of wheat or oats, and that by a clover crop. Such a farm is divided into three fields. In the Corn Belt a good rotation is corn for two years, next oats, and then clover and timothy.

Rotation for Cotton. For cotton plantations a good system is: Cotton the first year, followed the second year by corn with cowpeas planted between the rows or sown broadcast just before the last cultivation of the corn; the third year oats are grown, and they are followed by cowpeas the same season.

Phosphorus a Plant Food. We have learned that a plant needs many plant foods, but the most of them are usually found in the soil and in the air and water in great plenty. If the farmer needs to put nitrogen in his soil, he may do it best by sowing a crop of red clover, alfalfa, or cowpeas. But all plant foods can not be put back into the soil by a crop. If a farmer raises and sells corn or wheat, he is taking out of his soil and shipping away one important plant food called phosphorus. Most of the phosphorus that corn and other grains require before they can grow well, they store up in their seed or grain. And when this grain is sent away to market, it takes with it three-fourths of the phosphorus used by the crop.

Putting Phosphorus Back. This must be put back into the soil somehow; and it may be done by purchasing bone meal from stockyards companies who buy and slaughter our stock, or by purchasing manure for our fields or by buying rock phosphate from the places in Tennessee or Florida where this mineral is mined and ground for fertilizer.

Keeping Up the Land. Phosphorus is the plant food most likely to be wanting in our rolling prairies, in the hilly timber lands, and in soils worn out by long cultivation. If clover will not grow well, one may feel pretty sure his fields need phosphorus, and, perhaps, lime. For most farms, all that is needed to keep them up is plenty of rock phosphate, with a crop of clover, alfalfa, or cowpeas, in rotation and all the manure made on the farm.

CHAPTER XII

PLANTS AND HOW THEY GROW

Learning about Plants. Since men and animals live largely on plants, and farmers are kept busy growing crops to feed the world, we want to know more about how plants grow and produce seed. We may easily see what the animals about us eat and drink, but it is not so easy to learn just how plants eat and grow and bear fruit.

Dividing Their Work. Plants need food, water, and air, just as animals do. They also need warmth and light. The plant has different parts—a stem, roots, leaves, and flowers. It divides its work up among these parts. The roots of the plants have their work, and it is different from that of the stem and leaves.

Roots and Their Work. Let us first look at the roots. Pull up a radish from the garden, and you notice that the upper part of the root is large and round and is stored full of food. Below is a tap root which grows smaller and smaller to the end several inches down. All along this tap root are tiny rootlets with root hairs branching off from them. These root hairs cover only the tips of the smallest rootlets, but they extend out in all directions. They are very close together, for often there are as many as thirty thousand on one square inch.

They are not young roots, because they never grow larger. They are only tiny little hollow tubes which contain sap. They have no pores, or holes for water to enter, but it easily soaks through their thin walls. Thus these root hairs drink in the soil water which contains many of the plant foods; and the sap carries this watery food up along the larger roots and stem to the leaves. Here the sunshine helps to make the plant food ready to build up the stem, leaves, and the fruit of the plant. The larger roots do not take plant food from the soil. Their work is to hold the plant firmly in its place in spite of storms and heavy rains. When a plant is taken up to be transplanted, most of the small rootlets with their many long hairs are broken off. Perhaps you can now understand why a plant is so likely to wilt when it is transplanted.

The Stem. The stem, or trunk, bears the leaves and holds them up in the air and sunshine. It carries the watery plant foods from the roots up through the outer wood layer to the leaves. The materials, or starch and sugar from the leaves, pass down through the bark to the part where they are needed to enlarge the plant.

The Leaves. But more interesting than roots or stem are the leaves. They serve as so many stomachs where the plant food is digested and made ready for use. The chief work of the leaves is to make the plant foods over into starch and sugar. They take a large part of this starch and sugar,

called carbon, from the air, but the other parts come to the leaves through the root hairs. The leaves also give off to the air all the water that is not needed by the plants. If the leaves give off more moisture than the roots supply, as they often do on very hot days, the plant wilts in order to prevent further evaporation.

The Flower. The starch and sugar made by the leaves is either stored up for food or used at once to build plant tissue. When enough has been stored, the plant begins to flower. The flower is sometimes beautiful like the apple blossom, but often, as in the wheat or oats, it is not showy.

The Seed. The flower of plants has a very important work to do, because it contains the parts which create the fruit. The fruit contains the seeds from which new plants may be grown. If the flower fails to do its work, there will be no fruit, no seeds, and no new plant, unless a new plant can be started from a slip or cutting of the old plant.

The Father and Mother. The flowers of different plants differ very much, but they usually have two parts. One is the "pistil" or mother part, which contains the ovary or seed food. This seed food will not grow into seed unless it receives some pollen or yellow dust that grows on another part called the "stamen." The seed itself is a tiny baby plant all tucked under a good cover with food enough for it to live on until it can send out rootlets into the ground.

The Corn Flowers. Every plant must have its flowers with their stamens and pistil, but the stamens and pistil are not always together in the same flower. Examine a cornstalk as it grows. The tassel is the stamen, or father flower, with its yellow dust, or pollen; and the ear is the pistil, or mother flower. If the pollen does not fall from the tassel on the silks of the ear to fertilize the ear, there will not be a grain of corn on the cob.

Carrying the Pollen. The corn is only one of many plants that have their male and female flowers separate. Such plants depend partly upon the wind to carry the pollen from the father flower to the pistil where the new seed is to grow. Some plants depend upon insects to carry the pollen for them. So these plants have developed bright colored flowers that the insects can easily see. They also secrete a sweet food, or nectar, to reward the insects for their trouble. They hold out bright red and yellow and blue petals and say to the insects. "Here you can get good honey."

Night Workers. Some plants depend upon insects that fly only at night to carry their pollen. These plants do not have bright flowers, because colors cannot be seen well in the darkness. They have white flowers; and to aid the insects in finding them they have a strong, sweet odor or fragrance that guides their friends. The insects come from far and near for the sweets. They brush against the stamens and get covered with yellow pollen dust.

Away they go to other flowers, leaving some of this pollen on every plant they touch. When they go in deep for the honey, they leave pollen on the pistil just where it is needed.

Pollen from Other Plants. Plants bear the strongest and best fruit and seeds when the pollen has been brought to them from another plant. In a cornfield the ears on one stalk may receive pollen from its own tassel and from a dozen others standing near. Sometimes when a farmer wants corn for seed, he goes about a certain part of his corn lot before the silks come out and cuts off the tassels of all the poor stalks. In this way he allows the ears to receive pollen from only the strongest plants.

Kinds of Plants. There are thousands of different kinds of plants in the world. Perhaps there was a time when the world was young when there were very few plants. But as they spread over the earth they found different kinds of homes. Some seeds were gradually carried into cold regions, and others into hot places; some found wet spots, and others came into deserts. Some found homes on high, rough mountain tops where the storms raged about them, while others fell into low, shady nooks where they were protected.

How They Came to be Different. As the plants were slowly carried into such different kinds of homes, they kept fighting for life and food. Often many plants were struggling for air and sunshine on the same little spot; and only those that proved

good fighters lived. Slowly but surely many of these plants changed to meet their new surroundings and became unlike their early parents and even unlike their close kin. Each one set to work to protect itself and get its own food, and thus it slowly developed new parts, new ways of growing, and new ways of fighting for food. Only the best and strongest plants lived to spread their seed. In this way the world came to be covered with untold multitudes of different kinds of plants.

One Interesting Habit. It is interesting to study about the habits of different plants and how they grow and spread their kind. One of the important things about them that the farmer needs to know is how they scatter their seed, because many weeds grow and fight for life where the farmer does not want them.

Scattering Their Seed. Some plants, like the cocoanut, grow their seed in a hard shell which is waterproof, and in this they float on streams and rivers to new homes. The seeds of the maple and ash trees have wings, and on these they sail away across the fields wherever the wind will carry them. The dandelion seed has a queer little balloon on which the wind carries it to some far-away home. Then we know the burdocks and stick tights that catch in our clothes or fasten themselves on passing animals and hold tight for a long ride, to fall at last and set up housekeeping in a new region. Any boy or girl who will examine the seeds of plants

and do a little thinking will discover many interesting and wonderful secrets about their different habits.

How Man Helps. Man has chosen certain plants that furnish food for him and his flocks, and these he tries to help to good homes where they will grow and bring forth their harvest of grain or fruit. He spreads and sows these plants in several different ways. He sows the seed of the common grains or cereals, and covers them with earth. Sweet potatoes are grown from slips or plants; Irish potatoes, from the "eyes" of the potato; grapevines from cuttings or twigs clipped from the vine. Sugar cane is grown by planting a short piece of the stalk. Many plants do not come true from seed, and man has learned to grow them by grafting or budding. A bud or graft twig is taken from one plant and so carefully put upon another that it will grow as part of the plant. And the strange thing about it is that it will produce its own kind of fruit and not the kind of the plant on which it is grafted. There is no end to the wonderful things man is learning to do with plants.

QUESTIONS

(1) What are some of the parts of a plant? (2) How do root hairs differ from true roots? (3) How do root hairs take in the plant food? (4) Can you now tell why a transplanted plant often wilts or dies? (5) How does the food pass from the roots to the leaves? (6) Why does it need to go to the leaves at all? (7) Why do plants have seeds?

CHAPTER XIII

TILLAGE AND FARM MACHINERY

Sowing and Reaping in Olden Times. For thousands of years after men learned to plant seed they tilled the soil with a forked stick. Their only object seemed to be to get the seed covered in the ground. In Egypt for long ages seed was scattered broadcast by hand and herds of cattle were driven over the ground to tramp it in. These ancient people reaped their grain with a crooked knife and beat the kernels from the husks and chaff with a stick, or

FIG. 54. *The best and cheapest fertilizer.*

flail. Sometimes they drove their cattle over it on the barn floor to thresh it. Then it was ground into

meal in stone basins with stone pestles. The crooked stick also served to dig the root crops.

Wearing Out the Soil. Men of those times did not know how to cultivate crops. They knew that weeds injured the crops, but they did not know that it was because the weeds took the plant food, water, and air that their grain needed. When the land failed to bring a good harvest, the farmer concluded that the field needed a rest; so he rested it, or, as we say, let it lie fallow for one year. He did not know what we do to-day—that his land only needed a rotation of crops, that is, a different crop planted each year, or that barnyard manure would make it fertile again (Fig. 54).

Jethro Tull. About two hundred years ago there lived in England a landlord named Jethro Tull. He watched his crops closely and soon saw that the fields he worked or tilled the most brought the largest crops. He taught other farmers that tillage was the most important part of farming. He believed that fields would never wear out if they were always cultivated thoroughly. He thought that plants took their food in solid little grains or particles, and the only thing needed was to break up the soil very fine and the plants would eat it as a calf eats bran. We know that Tull was mistaken in thinking that plants take their food in solid form, but he did a great service to his farmer friends and to all the farmers since that time by showing them how important tillage is (Figs. 55a and 55b).

Courtesy U. S. Dept. of Agriculture

FIG. 55a. *A field in poor tilth. Crops in such cloddy soil have a small chance.*

Courtesy U. S. Dept. of Agriculture

FIG. 55b. *A field in good tilth. The best time to cultivate a crop is before planting it.*

Feeding Plants. We know that plants can use only the plant food that is prepared for them. If it is not in the right form, it makes no difference

how much food is in the soil, the plants will die in the midst of plenty. It is the farmer's task to see that the plant food in his soil is ready for his crops to use, and he tills the soil so that moisture can enter and be kept near the roots. Tillage loosens the soil so air can enter. Tillage also keeps down the weeds that steal the plant food and keep out the sunlight and warmth that the crops need. We can see that a great deal depends upon the farmer's stirring his soil at the right time.

Keeping Moisture in the Soil. The well-tilled soil is broken into very fine grains or particles (Fig. 55). These fine particles will hold much more water than coarse ones, because each tiny grain has its own coat of moisture. This, you remember, is the reason clay soil will hold more moisture than sandy soil. Clay does not drink it in so rapidly, but it holds on to it better.

Moisture passes easily from wet grains of earth to dry ones that touch them, so we see that the looser the soil is the fewer are the particles which touch one another. If they do not touch one another, water cannot pass so easily from wet particles to dry ones and in this way climb to the surface and pass off into the air. The surface soil especially must be loose to keep the moisture from evaporating, or getting back into the air.

The Dust Mulch. The loose layer of surface, which we call dust mulch, acts just like a blanket. Turn over a log or a board in the barn lot in the

spring and you will find the soil under it more damp than the ground not covered. The board has kept the moisture from passing off into the air. When we remember how much moisture crops need, we will see how important the dust mulch is. Every time it rains hard it packs this mulch down, and the farmer should cultivate his crop again, to loosen the top soil.

Dry Farming. Perhaps you have read or heard of dry farming. In many places in our great West there is not enough rainfall in a year to raise a crop. But if all that falls in two years could be kept, it would raise one crop. The farmers have learned that if they keep a dry mulch on the ground and save all the rainfall of one year, they have a pretty good chance to raise a crop the second year. It means that they must cultivate or till the ground for two seasons to get one crop, but that is better than raising nothing at all on these wide, dry areas. Where rainfall is less than twenty inches per year, dry farming or irrigation must be practiced.

Irrigation. Two-fifths of the land of the United States is too dry to produce regular crops without irrigation. By irrigation is meant the storing of water in lakes and reservoirs by means of huge dams. This is done in the rainy season, when there is plenty to be had. This water is then turned on the fields by means of ditches when crops are growing, where it takes the place of rainfall (Fig. 56). Some reservoirs are supplied from rivers that flow

the year round, while others must be filled in the rainy season. The United States Government is

FIG. 56. *A private irrigation plant.*

spending millions of dollars in the dry sections to save for crops some of the water that is going to waste.

Making Machinery Better. A slight improvement on the crooked stick was a rude plow made from several sticks bound with thongs of skin. This was used after the ox had been taught to bear the yoke. Farming with such tools was hard and toilsome labor with little reward. A brush dragged over the plowed ground was probably the first harrow.

Copper Tools. It was a great step forward when some one learned to smelt copper. Though copper

is soft and will not take on a sharp edge, yet it made far better tools than did sticks. The next step was made when it was found that by mixing tin ore with copper a much harder tool could be made, with a better edge. This mixture is called bronze. Bronze tools were used for untold ages until some clever man found out how to make a fire hot enough to smelt iron ore. When iron tools and weapons were made, we have the beginning of all the wonderful machinery in use to-day.

The First Iron Tools. Iron tools were few and costly at first, because the warriors needed all the iron they could get for their weapons. But men learned at last to make hillside furnaces for smelting iron ore, and then the farmer got a few iron

FIG. 57. *Put the soil in good tilth with a disk harrow before sowing.*

tools. The day came when some clever farmer put an iron share on his plow to cut the soil. From that day to this men have gradually improved iron farm tools, and the splendid horse-power machines of all

FIG. 58. *A tractor engine drawing four plows.*

descriptions which do farm work to-day are the result of the wonderful inventions of many bright minds.

Farm Machinery of To-Day. The poorest farmer of to-day has a plow to turn the sod and stir the soil deeply; he has a cultivator to tear and break the soil, and a harrow to make it fine like ashes for the dust mulch (Fig. 57). Certain soils that

are sandy and too loose need rollers to pack them slightly. Every sort of harvester has been devised for gathering the crop. But farmers have not been content with horse power alone. They have harnessed the wind to their windmills, they have hitched their plows and harvesters to great steam engines (Fig. 58), and they are using the power of gasoline engines to do many kinds of work about the farm (Fig. 59). Even electricity may be had where there is a waterfall to make it cheaply.

Care of Machinery. It is important that the farmer take good care of his machinery and tools. More plows have been rusted out by the weather than have been worn out by use. There are three good rules for every farm. Keep all tools under a good roof when they are not in use. See that all machinery, wagons, and the like are kept well

FIG. 59. *A gas engine is a great labor saver on the farm.*

painted, so they will last longer and save the farmer from buying new ones early. Use plenty of oil to save wear on all machinery. Oil and paint cost money; but if thirty-five cents' worth of paint will make a thirty-five-dollar machine last several years longer, it pays to use the paint.

QUESTIONS

(1) Who was Jethro Tull and what do we owe to him? (2) What do we mean by saying that plant food must be in the right form? (3) How may a farmer save the moisture in his soil for the crop? (4) What is meant by a dust mulch? (5) What is dry farming? (6) In what different ways is water obtained for irrigation? (7) What are the objections to copper tools? (8) In what way is bronze better for them? (9) Why was it so long before iron tools were made? (10) What invention do you think has meant most to the farmer? (11) Why?

For exercises, problems and experiments, refer to the Appendix.

CHAPTER XIV

CORN

America and Corn Discovered. When Columbus sailed toward the west over the unknown ocean, he hoped to reach the rich cities of Asia and the Spice Islands. Here he expected to obtain a rich cargo of spices, some of which were worth their weight in gold. But, instead of reaching China, Columbus landed upon a new world where white men had never been before. Instead of rich cities, he found only a vast wilderness inhabited by savages whom he named Indians. The Indians lived by hunting and fishing and by raising a few plants which were new and strange to Columbus and his sailors. These were squashes, tobacco, and maize, or corn. Columbus never knew what a wonderful golden treasure he had found in this Indian corn. It has come to be one of the most valuable crops in the world. When the corn crops fail there is a scarcity of food for rich and poor and hard times for everybody for many months.

Corn Saves the Pioneers. This Indian corn was a great blessing to the early immigrants from Europe, for the wheat and rye which they had brought with them would grow only in well-tilled fields and these pioneers were poor farmers with poor tools. There were no well-tilled fields, and men would not work.

They would have starved if the Indians had not furnished them with corn. The Indians taught the white men from Europe how to raise corn and how to make from it dishes fit for a king to eat.

Indian Farming. The Indian methods of farming were very crude and simple, for they knew very little about tilling the soil. The Indian squaws killed a patch of forest trees by cutting a girdle around each one when the sap was running in the spring. After the trees died and the sunlight shone in, the squaws scratched the grains of seed corn into the ground, with a crooked, sharp stick for a hoe. Here, without the use of plow or harrow, the corn sprang up in the rich earth, and a harvest of yellow ears provided food for winter.

Where Corn Grows. Since that time corn has been one of the chief crops of the American farmer in most sections, and to-day it is the most important of all. Corn can be raised in nearly every part of North America. In the North, where the summers are short, the farmers have developed a kind that grows only three or four feet high and that will ripen in seventy days. In the Southern countries of Mexico and South America there are kinds of corn that grow more than twenty feet high and require six months in which to ripen.

The Corn Belt. Corn is now raised in many countries, but about three-fourths of the world's supply is grown in the United States, and nearly one-half of the world's supply in the seven states known as

the Corn Belt. They are Illinois, Iowa, Nebraska, Missouri, Kansas, Indiana, and Ohio. The Corn Belt supplies many other states and countries with its surplus of corn. Besides a good soil in which to grow, corn needs hot weather with long days of bright sunshine and a great amount of rain.

A Corn Train. If the corn crop of the United States in 1912 had been placed in wagons, with fifty bushels in each load, and each wagon and team had been allowed twenty feet of space, the train of corn would have reached more than nine times around the earth at the equator.

Corn Land Valuable. Where corn thrives, it yields about twice as much food for each acre as is produced by any of the other grains. That is the reason why land in the Corn Belt is very high in price. Corn is grown in many places where only a half-crop is obtained, for a half-crop of corn yields as much food as a full crop of wheat or rye.

Choosing Good Seed. It is believed that the farmers in any state in the Union could increase the yield of corn from five to twenty bushels an acre if they were trained in choosing their seed corn. In order to choose well the farmer must be a good judge of an ear of corn. To know a prize ear is not such a difficult lesson to learn.

The Prize Ear. A perfect ear should be round, tapering, and full and strong in the middle. It must be firm to the touch, and the kernels should not be loose on the cob, as this shows that the ear

is not thoroughly ripened. The distance around the ear one-third of the distance from the butt should be about three-fourths of the entire length. The rows of kernels must be straight, and there should not be fewer than sixteen nor more than twenty-eight rows on the cob. In most sections the ear is from eight and one-half to ten inches long, and it should be filled out to the tip (Fig. 60).

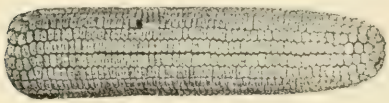


FIG. 60. *A prize ear.*

Good Kernels. The kernels to be planted should be wedge-shaped, with the edges touching those next to them their entire length from crown to cob. They should have deeply indented crowns without pointed or sharp corners. The color needs to be true to variety and free from mixture.

Cobs. Ordinary types of white corn should have

FIG. 61. *A cob may be too large or too small.*

white cobs, and yellow corn should have red cobs. However, certain varieties of types vary from this

rule. The deeper or longer the kernel, the greater the proportion of corn to cob. An extremely large cob means late maturity and less corn in proportion to cob (Fig. 61). The ears should carry their size well out to the tips. The wider the furrows between the rows of grain on the cob, the lower the proportion of corn to cob (Fig. 62).

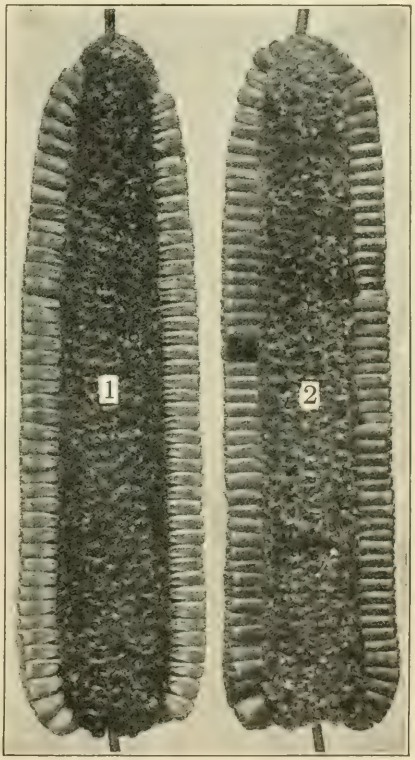


Fig. 62. *Space between kernels next to cob, objectionable. Ears Nos. 1 and 2 are same length and circumference. Ear No. 2 shelled out 33 per cent more corn by weight than No. 1.*

When to Select Seed. Some farmers are satisfied to choose the finest ears from the crib, but a better way is to select from the fields at husking time. By taking seed from stalks bearing two well-formed ears, the next crop will have more two-eared plants, and thus the crop will be larger. In order to choose seed for any crop, it is safer to see the plant on which it grew,

because like produces like. Careful selection of seed is the most profitable farm work.

Curing the Seed. Every ear intended for planting must be gathered before the autumn freezes, since freezing corn that is not well dried injures the seed germ. Seed corn should be hung up where the air can circulate about it freely. A good place to hang seed corn is in the attic over the kitchen, with the windows open.

The Corn Tree. The "corn tree" is a device for drying corn. It consists of an upright post driven full of small-headed nails. An ear of corn is easily stuck on each nail by jamming it into the pith at the butt end. A wall driven full of nails will serve the same purpose of holding the ears apart so they will dry quickly.

Testing Seeds. Every ear intended for seed should be tested to see if the corn will sprout or germinate. Take six seeds from each ear and plant them for a test, keeping the ear marked by number. This will insure a good stand and prevent replanting, which causes a spotted field and a poor and uneven crop (Fig. 63).

Improving Corn. A good way to improve the variety is to plant the seed from the hundred best ears on one side of the field and to choose the seed for the next year from this planting. In this way a farmer will improve his crop every year.

Planting Evenly. To-day most farmers plant with machines, and the planter will not drop the corn

evenly unless the kernels are of the same size. It is, therefore, wise to shell off and discard the kernels

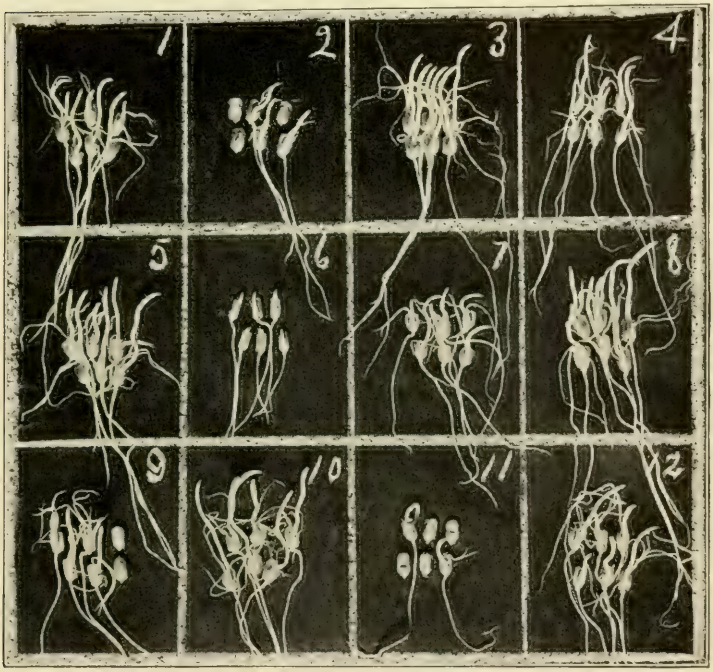


FIG. 63. *Testing twelve ears of seed corn.*

on both the tip and butt of the ear which are of irregular size and shape. The corn grader is a machine which will do this work of sifting out the poorly-shaped kernels, or it may be done by hand if the crop is small. It is a good plan to test the corn planter to be sure it will drop three kernels in a hill.

FIG. 64. *The old way of spreading manure leaves the field unevenly fertilized and the crop grows and ripens unevenly.*

Making the Soil Rich. The farmer prepares his fields well before sowing. He adds to the soil by spreading over it barn-yard manure, for manure contains the most plant food of anything he can put on his fields (Figs. 64 and 65). Instead of spreading manure on the corn lot, the farmer may choose fields to plant where he has the year before raised a crop of clover or cowpeas, because he knows that these two crops enrich the soil for corn (Fig. 53). Sometimes he buys a fertilizer made of certain foods which the plant needs, but this costs a great deal of money.

How to Plow. To prepare the ground the good farmer plows rather deep to bring fresh soil up to the air and sunshine. The air and sunshine help to make the plant food ready for the little corn rootlets

to take up. The ground should not be plowed when the soil is very wet, for it stays in hard lumps and is not easily broken up so the roots can reach into the earth.

How to Keep the Ground Moist. The plow is followed by a disk or spring-tooth harrow (Fig. 66) until all clods are broken and the surface is mellow and fine like ashes. This ashy top soil acts like a blanket to keep the moisture in the ground from escaping.

Planting the Crop. Field corn should be planted in rows about three and one-half feet apart. Years ago a few grains of seed were dropped into each hill by hand and covered with a hoe, but to-day the farmer uses a checkrow planter drawn by a team.

FIG. 65. *Manure should be spread evenly.*

This machine plants the corn so it can be cultivated both ways and be kept clean more easily.

Keeping the Weeds Down. A few days after planting, the field should be harrowed to kill the grass and weeds that are ready to sprout, because they grow faster than the corn. When the corn is a few inches high the harrow must be used again to break the crust and to supply air to the soil as well as to keep the weeds and grass down.

Plowing the Corn. The field should be cultivated two or three times more, but after the corn roots have spread out between the rows, it is not safe to plow too close to the row or too deep, for fear of breaking off millions of little rootlets that are feeding the plant. This applies also to the raising of sweet corn or pop corn and other crops needing tillage.

FIG. 66. *Spring-tooth harrow.*

Gathering the Crop. When the lower leaves on the stalks begin to die, the corn is ready to cut.

FIG. 67. *The corn cutter.*

This may be done with a hand cutter or with a corn harvester (Fig. 67). About sixty hills are cut and gathered into one shock. The tops are bound together so the shock will stand while the corn cures, which requires about six weeks. When the leaves are dry the husking takes place, and the ears are stored in well-ventilated cribs built high from the ground and protected from the rats and mice. Send to the Department of Agriculture for plans for the crib.

Saving It All. In some places the corn is husked, or picked, standing in the field and the cornstalks are burned. This is a great waste, for cornstalks make good food for horses, cattle, and sheep, and they like it very much. A machine which husks the corn and shreds the tops and leaves makes a feed called corn stover that is as good for live stock as timothy hay. Making fodder into stover saves it all.

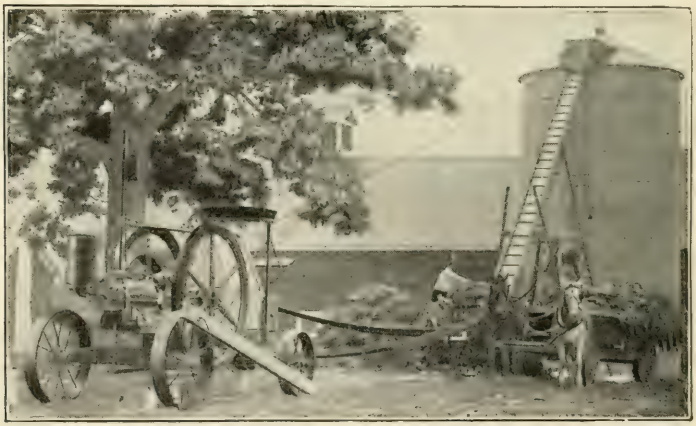


FIG. 68. *Filling the silo.*

A Great Discovery. Every farmer knows that cattle like green feed much better than dry. But for a long time nobody knew how to keep feed green through the winter. Many years ago, in Europe, a stack of wet, green grass was covered with earth by accident. When winter came this stack was uncovered and the grass was still green and juicy. It was greatly relished by the cattle.

Building Silos. After that, farmers began to dig pits in the ground to keep feed green. Such pits were called silos, and to-day they are made above ground of cement or wood and placed near the cattle barns (Fig. 68). Cattle will eat more silage than fodder, and cows fed on it give more milk. When corn is grown for the silo it is planted about one stalk every seven inches. in rows three and one-half feet apart.

Corn a Treasure. Corn is the backbone of farming in our country. Not only is it good for live stock of all kinds, but it feeds more people than any other grain except rice. Many useful things are made from corn besides the fodder, grain, and meal for feeding. The silks are used in the making of filters, and corn husks are made into mattresses. Pith is used for the packing of cofferdams of battleships. Oil, varnish, starch, alcohol, and many other articles are made from corn. There is one factory in the United States that makes forty-two different corn products.

QUESTIONS

(1) Which has meant more to the world the riches of the Indies or the golden corn? (2) Why? (3) Why was corn more necessary to the early pioneers than wheat or barley? (4) What makes land in the corn belt so valuable? (5) What is the best way to choose seed corn? (6) Why does plowing ground when it is wet injure it? (7) What harm is done by cultivating corn deep after it is waist high?

For exercises, problems and experiments, refer to the Appendix.

CHAPTER XV

WHEAT

White Bread. Nearly the entire wheat crop of the world is used for human food. Wheat bread is such a common food in our country now that we do not realize that it is still considered a great treat by some classes of people in other parts of the world. The poor peasants in many lands eat bread made of rye, barley, or millet, because it is cheaper than "white bread." Millions of people in Asia eat rice, but wheat flour makes a light bread that is more healthful and tempting than that made by any other grain; and as fast as the poor classes of people can afford it, they demand wheat bread.

The First Wheat Farmers. Who the first people were to raise wheat we do not know, because it happened, like so many other interesting things, before men learned to write. Neither do we know where it first grew. The ancient lake-dwellers of Switzerland raised a kind of grain very much like our wheat. Some scholars believe that the early home of wheat was in the Euphrates Valley, in western Asia. Others think it first grew in Palestine. A kind of wheat has lately been found growing wild on the mountains of Palestine, and some people are sure that our wheat has come from this wild kind. Wheat was grown in China many hundred years

before Christ lived, and the Chinese said that it was given to them direct from heaven.

Wheat in America. Wheat was the first grain brought to our country by the Jamestown colony in 1607. These pioneers cut down forest trees to build a fort, and in the cleared places they sowed

FIG. 69. *The reap hook, an ancient tool for reaping grain.*

wheat. The first crops were very poor, but they wanted white bread, so they kept planting a little more each year. The crops were cut with the reap hook, or sickle, which is merely a knife with a curved blade (Fig. 69). It was threshed by being trod upon by horses and oxen.

The World's Crop. Our country does not produce so large a part of the world's wheat crop as it does of the corn. Europe raises twice as much wheat as does North America. European countries get twice

as much from an acre as we do, so they can raise it as cheaply as we do on our large farms in the West.

Kinds of Wheat. There are several kinds of wheat. Some kinds are sown in the fall and remain on the field through the winter. Such kinds are called winter wheat. Others are sown in the spring and are called spring wheat.

Climate. Wheat is better suited to short summers than is corn, so it can be grown much farther north. For several years farmers have been moving by hundreds to the wide prairies of western Canada for this purpose, and they are making it a great wheat country.

Preparing the Soil. This crop will grow on a great variety of soils, but it seems to thrive best on a light clay. The land that is to be used for winter wheat needs to be plowed as early in the summer as possible. Such early plowing loosens the ground so it will hold more moisture. The soil should be made fine and loose. For spring wheat one may plow the fall before, or early in the spring.

Sowing the Seed. Winter wheat is sown early in the fall, so that it may grow strong before the cold weather comes. Spring wheat should also be sown early, because wheat will sprout and begin its growth while the weather is still cool. Six to eight pecks of wheat are sown to the acre, and the seed is planted about two inches deep. The lighter and looser the soil, the deeper should be the planting. In olden times wheat was scattered by hand and

harrowed in, but now it is nearly all sown by the drill (Fig. 70).

Cultivation. In most countries wheat receives no cultivation between the sowing and the harvesting. In some places it is harrowed or rolled after the seed has begun to sprout or after it has taken firm

FIG. 70. *A wheat drill.*

root. This is done to kill weeds and to keep moisture in the ground, as we do for corn. But most wheat farmers think this does more harm than good. In Japan wheat is planted in wide rows and hoed. Vegetables are raised between the rows. A hundred years ago wheat was hoed with a mattock. Wheat may be pastured in the winter when the ground is frozen, but not late in the spring.

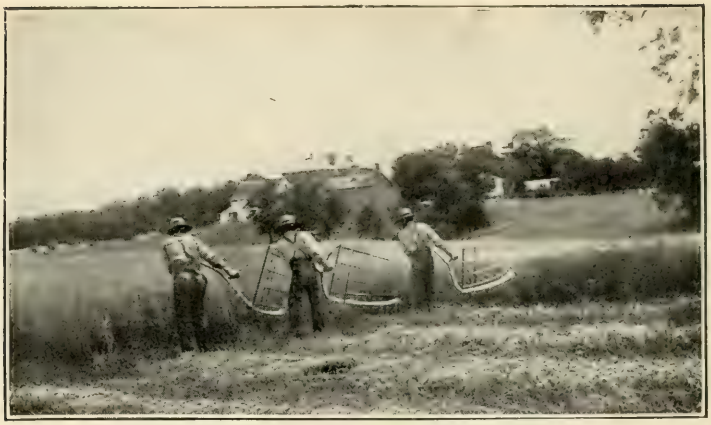


FIG. 71. *The cradle was a great improvement over the reap hook.*

Wheat in Rotation. Wheat should never be grown on the same fields year after year with no change of crop. It was grown in England for many years to test this. When it was grown on the same field every year for twelve years the average crop was a little more than twelve bushels to the acre. When it was grown every fourth year, with three other crops between, the yield for each acre was twenty-eight bushels, or more than twice as much.

Enemies of Wheat. Wheat seems to have more enemies than any other crop that the farmer raises. He never knows when he sows his fields what he shall reap or whether he shall reap at all. Very hot or cold weather may ruin the crop. Drouths may come and the plants die of thirst; or it may rain too much and drown the wheat. Storms of hail or wind

or floods may ruin it. Smut, or rust, or insects may devour it. The farmer has more risks to run in growing wheat than in almost any other farm crop, yet mankind is willing to pay extra for wheat bread.

Harvest Home. In most regions wheat must be harvested very promptly, or much of the crop may be damaged or lost. Before good machinery was invented it was a very toilsome task to gather the wheat crop. So much hard work had been put into it and such a long time had gone by since the grain was sowed that the farmer was always anxious at harvest time to reap his crop and pay his expenses. At the close of the season the people held great rejoicings, called in England "harvest home." They formed a procession, with music, to bring home the last sheaves of grain. The workers and

FIG. 72. *Cutting wheat with a cradle.*

pretty maidens danced along, merrily singing:

> "Harvest home, harvest home,
> We have plowed, we have sowed,
> We have reaped, we have mowed,
> We have brought home every load,
> Hip, hip, hip, harvest home."

The Sickle. We have said that many years ago wheat was cut with a reap hook, or sickle, held in one hand (Fig. 69). A large part of the world's crop is still cut in that way among the peasants of Russia, China, and Japan. With a sickle a good worker can cut about an acre a day.

The Scythe or Cradle. The Romans thought they could cut more if they had a longer blade and used both hands, so they invented the scythe. This allowed the grain to fall over when it was cut and some clever man placed wooden fingers above the scythe to catch the grain and help to lay it straight for binding. This was called the cradle. It is still in use in many places in our country for cutting small patches of oats and wheat (Figs. 71 and 72).

Animal Power. But the cradle used only hand power, and men needed horse power to save both time and money. The first machine to use animal power was a wheat-header used in France about the time of Christ. It was a two-wheeled cart, pushed by an ox yoked behind. On the front edge of the cart were sharp fingers, or teeth, like a big comb, to catch the heads of wheat and pull them off and rake them into the cart. This machine later disappeared.

The Header. Hundreds of years later men began to make machines with the power in front. This method with horse power meant a side-cut. The wheat-header is a machine that cuts off the heads and throws them into a wagon that is driven alongside. It saves binding and shocking. Wheat must be dry before it is cut in this way, for the grain is either stacked or threshed at once without time for curing. If it be damp, green, or weedy, it will not thresh well and is liable to spoil in the stack. The header is chiefly used in dry countries. The header of to-day cuts a strip twelve to twenty feet wide. In the state of Washington three headers and one threshing machine usually work together on the mammoth farms. In this way from fifty to seventy-five acres of wheat are harvested in one day.

The Reaper. Another machine has been worked out to harvest the wheat where the header is not successful. A machine was developed that would cut and bunch the grain. This was called the reaper (Fig. 73). McCormick's machine was first used in the harvest of 1831. It was a rather crude affair, drawn by one horse, but it was a good beginning. It meant cheap bread for mankind, but the farmers at first refused to use the reaper. They laughed at it; they said it would not work on hillsides. But they sat on the fence and watched it. Then they shook their heads and went back to their old cradles. McCormick talked and urged the people to try it, but it was ten years after the machine proved itself

before a farmer was found who would buy one. The next year two reapers were sold, then fifty, then a thousand. The grain was raked from the platform of the machine by a man walking behind. It had to be bound and shocked by hand. Not long afterwards larger and better machines were made. It took

FIG. 73. *The first reaper.*

much hard work to change the reaper into the modern binder (Fig. 74).

The Self-binder. The machine in general use in our country to-day is the self-binder, which cuts, binds, and dumps the bundles in piles to be shocked by hand (Fig. 75). On some of the large grain farms there are as many as fifty self-binders, and these often cut six hundred acres of wheat in one day. To make a device that would bind the wheat was a hard task. Finally one was made that would

do the work, but it bound the bundles with wire. Pieces of wire found their way into the throats of cattle, and farmers would not buy the binder. Some cheap binder twine must be found. Mr. William Deering spent much time and a great deal of money to get a twine that would knot easily and firmly.

FIG. 74. *The modern binder drawn by a traction engine.*

He finally found that Manila hemp would act just right, and this made the binder complete. Our binder twine is usually made of a mixture of Manila and sisal fiber. Millions and millions of pounds of binder twine are used every harvest.

Combined Harvesters. The most complete machine of all is the combined harvester, which is used chiefly on the bonanza farms on our Pacific coast, where there is nothing to fear from rainy weather. This machine cuts, binds, gathers, cleans, and bags

the grain without a single touch from human hands. On one side the wheat is cut, and on the other sacks of wheat are dropped in piles ready for the market. This machine is drawn by great teams of from twenty-four to forty horses and mules, and it har-

FIG. 75. *Shocks of golden grain.*

vests from thirty to forty acres of grain a day. It requires only four men to operate it.

Steam Harvesters. There are large combined harvesters run by steam. They harvest from seventy-five to one hundred twenty-five acres a day. They are used only on very large farms, from three thousand to twenty thousand acres each. In the days of the old Romans it took four days and a half of

work to raise and harvest each bushel of wheat. When the reaper was invented it took three hours of labor for each bushel, and to-day it takes only ten minutes. This is what machinery has done for the farmers.

How Much We Eat. It is said that, on the average, every person in the United States eats about five bushels of wheat in a year. Five bushels of wheat make a barrel of flour, and a barrel of flour turned over to the baker makes about two hundred fifty loaves of bread.

Other Uses of Wheat. Most of the American wheat is made into bread, but there is also a great amount used for breakfast foods. Some wheat is fed to stock, especially to poultry. Wheat, bran, and middlings in great quantities are bought at the mills and fed to cattle. Macaroni is made from wheat, and so is starch, which is used for paste or sizing. The straw is used for feeding and bedding cattle and for making straw hats and bonnets.

QUESTIONS

(1) Why do not all people eat wheat bread? (2) How was wheat first harvested and threshed in America? (3) Why can Europe raise wheat as cheaply as we do? (4) Does corn grow as far north as wheat? (5) Give reason. (6) Why should fall wheat ground be plowed early in the summer? (7) Name some of the enemies of wheat. (8) Why is the modern wheat-header suited only to dry regions?

For exercises, problems and experiments, refer to the Appendix.

CHAPTER XVI

THE FIELD OR IRISH POTATO

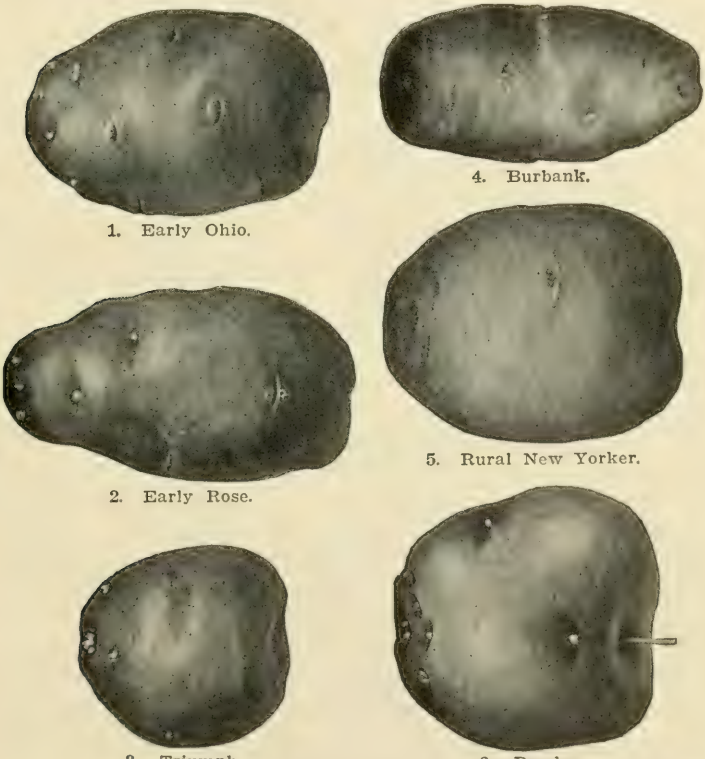
The Potato's Early Home. The early home of the potato was in America. White men had never seen it until after the discovery of the continent by Columbus. The Indians of South America, from Chili to Colombia, were raising potatoes for food. How long they had been doing this we do not know. The Spanish explorers carried the potato to Europe, where it was first grown in Spain and Italy.

The Potato in Ireland. Some years later, we are told, Sir Walter Raleigh was cultivating it on his farm in Ireland. He called it "Battata." The potato came to be raised as the principal article of food in Ireland; and when, in 1846, there came a total failure of the potato crop, caused by the blight, a terrible famine and great suffering followed. It drove thousands of Ireland's best thinkers and workers to America.

A Widely-grown Crop. Potatoes are a more important crop in Europe than in America, and it is a staple product in many lands besides our own. Next to rice, it is probably the most widely-grown crop in the world.

Not a Root, But a Tuber. The part of the potato that we eat is an underground stem which is called a tuber. It is not a root, like the sweet potato or

radish, for there are no rootlets growing upon the white potato. All the roots are found extending out from the stems.



Courtesy of Agricultural Experiment Station, Wisconsin

FIG. 76. *Standard varieties of potatoes. Early varieties, 1, 2, and 3. Late varieties, 4, 5, and 6.*

The Kinds of Seed. The potato can be raised both from the seeds which grow in the seed ball at the

end of the stalk and from the tubers. The farmer always plants tubers, because they produce other tubers just like themselves. The potatoes grown from the seed do not always come true to the variety.

The Potato Eye. Each eye of the potato will grow a new plant if a piece of potato is left on it large enough to feed the young plant until it can put out strong roots. When potatoes are allowed to sprout in the cellar they use up some of their plant food so they shrivel. These potatoes should not be used for planting.

Cutting the Seed. Irish potatoes are usually cut into two or more pieces for planting. Some careful farmers cut two eyes to each piece; others claim it pays to use more seed and take a half potato for each hill. The seed is best cut a short time before it is put into the ground. One experiment station found an increase of fifty-four bushels per acre by placing the potatoes in a well-lighted room with a comfortable temperature for several weeks before planting.

How to Choose Seed Potatoes. Our plants grow from the bud in the eye of the potato, and so we should know just what kind of a plant the seed potato grew on. We must see to it that we choose seed taken from vines that are good producers. Some vines have twice as many potatoes as others. Therefore, we select our seed potatoes, as we do corn, not from the bin, but from the potato field, as

they are dug. It matters not if the seed potato be large or small if it came from a hill bearing a large

Courtesy of U. S. Dept. of Agriculture

FIG. 77. *Colorado potato beetle at work on the plant: a, beetle; b, egg masses; c, half-grown larvae; d, mature larvae.*

yield of fine potatoes. By careful selection, year after year, a farmer can greatly improve his variety

and produce larger crops on the same space of ground (Fig. 76).

Climate and Soil. For the best crop one needs a deep, fertile soil with plenty of moisture, but not too wet. A cool climate is most suitable. The seed-eyes are planted from two to five inches deep, and the most successful growers do not hill up the plants until late in the season. Moisture is held better if the ground is kept level.

Cultivating the Crop. A few days after planting a harrow or weeder is run over the field to destroy all weeds as soon as they are started. This weeder is used once a week until the plants are six or eight inches high. Then the fields are cultivated between the rows about every ten days.

Insect Enemies. One of the first enemies the plant meets after it appears through the surface is the flea beetle that gnaws small holes in the leaves. They may be checked by spraying with the Bordeaux mixture or with Paris green. This remedy will also stop the ravages of the potato beetle, or Colorado bug (Fig. 77). Potatoes are commonly sprayed about five times, beginning when the plants are about six inches high and repeating the operation every ten days.

The Potato Scab. Another enemy of the potato is the scab, which is a very tiny plant growing on the surface of the tuber. Scabby potatoes do not bring good prices. If seed potatoes are given a bath in a solution of formalin for about two hours

before they are planted, the formalin will kill the scab growth without injuring the potatoes. One-half pint of formalin to fifteen gallons of water makes a proper solution, which will do for several bushels of potatoes, as it can be used over and over again.

The Blight. Another disease for the potato farmer to guard against is the blight. This is a tiny plant

Courtesy of Agricultural Experiment Station, Wisconsin

FIG. 78. *A field of potatoes yielding 350 bushels per acre.*

or fungus growth which attacks the plant above ground. The blight sometimes destroys a crop completely. Spraying is the remedy for this enemy, also.

Harvesting. Early varieties of the potato are dug as soon as they are big enough for market. Late potatoes are left in the ground until the vines are

dead. They should be gathered when the ground is dry and placed in a dark, cool place. Potatoes stored in the cellar should always be covered to keep the light from burning them. In some regions farmers raise from three hundred to five hundred bushels per acre (Fig. 78).

Potato Machinery. In order to grow potatoes profitably, one must plant a good many acres to afford the machines needed. A potato planter, a sprayer, and a digger are needed, and the wear on these tools amounts to thirty or forty dollars a year.

Uses of Potatoes. Potatoes are used mostly for human food, but they make good rations for stock, either raw or cooked. Alcohol and starch are made from potatoes.

QUESTIONS

(1) How did white potatoes get the name "Irish"? (2) What is the difference between a root and a tuber? (3) Why do potatoes that have sprouted in the cellar make poor seed? (4) Why not choose seed potatoes from the bin? (5) Many growers do not hill up the rows until late. Why? (6) Why cannot a farmer afford the necessary potato machinery unless he raises good-sized potato crops? (7) Make questions of your own for class use.

For exercises, problems and experiments, refer to the Appendix.

CHAPTER XVII

THE SWEET POTATO

The Sweet Potato a Root. The sweet potato is not related to the Irish potato. It is not a tuber, but a true root grown large. Instead of eyes it has small rootlets running out from it. The sweet potato has blossoms very like the flowers of the morning glory, and it belongs to the same family of plants.

Its Home. The sweet potato seems to have first come from the warm regions of America. It is now raised principally in the Southern states and upon islands in the Pacific Ocean.

Climate and Soil. Four months of mild weather without cold winds or frost are needed to grow sweet potatoes. They will thrive in almost any loose, well-drained soil, if the climate is warm. A light sandy loam gives a cleaner potato, and these are the best sellers.

Planting. For a new crop, all of the sweet potato may be planted. They are usually started in a hot-bed, and sprouts or young plants are transplanted, or taken up and set out again, in the field in rows about three feet apart.

Cultivation. It makes very little difference what crop has just been taken off the field that is to be put to sweet potatoes, but it is unwise to have them follow sod, because sod ground contains many cut

worms that harm this plant. It is not necessary to plow deeply, but all weeds must be kept down by good cultivation until the potato vines cover the ground.

Harvesting. The sweet potato, like the apple, is easily damaged by bruising. Extreme care must be used in handling them. All bruised potatoes should be laid aside for immediate use. Those intended for the market may be graded—that is, the large ones should be separated from the small ones. Time spent in grading and packing is worth while, for this care brings better prices.

Storing the Crop. Sweet potatoes are hard to store, because they rot so easily. They should be partly dried and cleaned and then placed in a dry, warm bin. If all bruised ones and those that are beginning to rot are removed from the bin, they will keep for some time.

Uses of the Plant. Sweet potato vines make a very good hay that is sometimes used as ensilage for filling silos. Potatoes too small to sell may be fed to stock, for they are rich in sugar and starch. Sweet potatoes are largely used on the table, but some are dried and ground into flour and some made into starch, glucose, and alcohol.

There are eighty different varieties of sweet potatoes. The kinds that are dry and mealy are preferred in the North, while the juicy, sugary varieties are most popular in the South.

CHAPTER XVIII

COTTON

The Home of Cotton. Our great-grandmothers grew cotton in their front dooryards as a flowering plant. It is supposed to be a native of India. But Columbus found some kinds growing here when he came to America. Now it is one of the important crops of the Southern farmer.

Climate. Cotton is a warm-weather plant and needs a rather long growing season. Warm, moist nights with the weather becoming warmer is best for the growing plant; while later, when the fruit is setting and ripening, dry weather with occasional showers is better. Too much rain when the fruit is ripening causes the stalk to grow too large, and the bolls are then late in ripening.

The Best Soil. Cotton grows best on a clay loam or sandy loam soil that is well drained. On bottom land which overflows stalks sometimes grow so large and become so tough that they have to be cut down with axes before the land can be cleared and plowed for another crop. Good cotton land must hold moisture well. There should be much humus in it and a good dust mulch on top. It is well to plant peanuts or some bush variety of cowpeas between the cotton rows and plow them under with the cotton stalks after the cotton has been picked. This will

help to maintain the humus. But clover grows well in winter in the Southern states, and it can be used to follow the cotton. It is plowed under the following spring.

Preparing the Soil. Early fall plowing is best where one cotton crop is to follow another. In this way the cotton stalks and the weeds are plowed under. This enriches the soil and kills the boll weevil and other insects. Where the stalks grow large, it may be best to clear the stalks from the land and burn them. But usually they should be cut and turned under with the plow. On many plantations cotton is grown on the same land year after year. In such cases it is usually necessary to fertilize the soil. When the seed of the cotton plant is used on the same farm for feed and only the lint is sold, the stock that is fed on cotton seed helps to furnish fertilizer in the form of manure. This should be saved and put back on the land. But in the far South cattle are not kept in stables, but in the open pastures, and it is, therefore, difficult to save the manure for the cotton fields.

Keeping the Soil Rich. Experiment stations have tested and decided that cowpeas, peanuts, and clover and alfalfa may be grown in a three-year rotation with corn and cotton. This will keep up the nitrogen in the soil. Some have found that potash and acid potash make good fertilizer for many fields.

Deep Plowing. Planting begins in the early spring, as soon as the frost is over. In Texas this

is in March, in North Carolina not till May. The cotton plant has a tap-root that reaches as deeply into the ground as the loose soil will permit. So if the ground is not loose, deep plowing is worth while to give the roots moisture and air. Harrowing till the ground is fine destroys many weeds and makes a dust mulch that saves moisture for the growing plants.

Putting in the Seed. On many fields it is best to plant the seed on beds or ridges thrown up about four feet apart. On dry soils the ground should be kept level. It has been found that four feet is the correct distance between rows, and the plants grow best from twelve to eighteen inches apart. This will leave room for the bushy top that comes later. Early planting is very necessary wherever cotton is raised and plenty of seed to make sure of a good stand. Not less than thirty pounds per acre should be planted. As soon as the plants are well started and all danger from frosts is past, the plants are thinned with the hoe till they are the correct distance apart. In the olden days a negro plowed the ground with a plow and mule, dropped in the seed, and covered it by hand. Good farm machinery now makes planting easier. On some of the plantations to-day all the work is done by one machine which opens the furrow, drops in the seed and fertilizer, and covers it all in one trip. Most of the work is done by the hands of colored laborers.

Cultivation. The cotton field should be cultivated

frequently, but not too deep, until the plants begin to mature bolls (Fig. 79). Even after the bolls appear it is well to keep a crust from forming on the ground. But if the land was well prepared before the crop was planted, it can be laid by, because the early tilling served to lay up sufficient moisture and to prepare plenty of plant food to mature the boll.

FIG. 79. *A cotton boll and leaf.*

Ready to Pick. Eight or ten weeks after planting the cotton is in flower (Fig. 80). The cream-white blossoms soon turn to a pinkish or reddish color and drop off. The seed pods which form are the size of an English walnut. When these are ripe they burst open like milkweed pods, and the cotton is ready for picking (Fig. 81).

Harvesting. Texas planters begin to pick cotton about the middle of July. More northern states harvest from four to six weeks later. No machine has been invented that can do this work well, so the picking is done by hand. The work is hard and tiresome. Many negroes are used, because they stand the heat better. They are paid from thirty to fifty cents a hundred pounds. Since cotton does not ripen all at once, a field has to be picked many times before the frost destroys what is left. If all is left standing to be picked at the same time, it is apt to be injured by dust and rains. Cotton may be picked as late as December in the warmer region about the gulf.

Eli Whitney. The white thread of the cotton boll is filled with small dark seeds nearly twice the size of an apple seed. When these were picked out by hand a workman cleaned about a pound a day.

FIG. 80. *A blossom of the cotton plant.*

Eli Whitney was a graduate of Yale College who went South to spend the winter. One dark night at a social gathering he heard the Southern planters talking about what a drawback the taking out of the seeds was to cotton raising. This was the first time Whitney had ever seen cotton or cottonseed, but he began to work on a machine for the purpose of separating them.

The Cotton Gin. Whitney's new machine was a wooden cylinder on which were fastened hooks arranged like the teeth of a saw. When the cylinder was turned these hooks passed between the wires of an upright frame and pulled the fiber of the cotton through, while the seeds fell to the ground on the other side. Improvements were soon made on this machine. Now the cotton fiber is pulled from the teeth and blown into the press room free from dust and seed.

Baling Cotton for Market. Here in the press room it is baled in hard, round bales of about five hundred pounds for market. The cotton is pressed very close to save shipping and to prevent it from easily catching fire. One-half of our raw cotton is shipped to European countries where they make muslins and finer materials than are made in the United States.

Use of Seeds. From every pound of lint about two pounds of seeds are removed. In the cottonseed mill the seeds are crushed, and the oil which is pressed out is sold in large quantities for various purposes. It is often used instead of lard or mixed with it.

One-third of the oil is bought by packing houses and used in this way to make lard. It is also used in the manufacture of butterine and in place of olive oil. Fish are packed in it. The poor product, that cannot be put to better use, is made into soap.

Oil Meal. After the oil is crushed out, the rest

Courtesy of Hilliard Land Company, Florida

FIG. 81. *A cotton field ready for pickers.*

of the seed is ground into meal which is used instead of corn to feed to cattle. In this way the Southern farmer feeds his cattle from his own produce, instead of buying grain. It is said that the meal from a bushel of cottonseed has as much food value as a bushel of corn. When the corn crop fails in the West, farmers import cottonseed. It is also valuable

for fertilizer. Two tons and a half of cottonseed hulls equal a cord of wood for fuel. Such fuel is used in Southern factories. The ashes are then used for fertilizer in raising tobacco.

Two Kinds Most Raised. Sea-island cotton is so called because it requires the salt sea air to thrive. It is the best cotton in the world, because its fiber is longer, stronger, and finer than the upland variety. It has black seeds, while the upland cotton has green ones. The upland cotton is raised in the states away from the gulf and is largely manufactured in our cotton mills.

Cotton-boll Weevil. The cotton-boll weevil attacks the buds and the seed pods of the cotton plant. It is a small gray beetle about a quarter of an inch long (Fig. 43). It spreads very rapidly and often destroys entire crops. The loss in Texas alone has been millions of dollars. The United States Government has spent a great deal of money fighting the boll weevil, besides what has been spent by the cotton states. It will feed and breed only in the cotton plant, but it lives through the cold season under the moss of trees and under rubbish.

Fighting the Weevil. Clean farming methods and early harvesting have been the ways recommended to fight the weevil. If the cotton is all harvested and the plants are destroyed by the middle of October, the weevil will die of starvation. Where this has been done, it was found that only three weevils out of a hundred lived through the winter. Cotton

stalks may be removed most effectively by uprooting, piling, and burning. Some cut them down with a stalk chopper, then plow deeply and harrow the field. Others turn in enough cattle to eat the green cotton in a few days. In addition to destroying cotton plants, all kinds of rubbish along ditches, fences, and field borders should be cleaned up so the weevil may have no winter shelter.

To Hasten the Crop. The use of fertilizer hastens the ripening of the cotton and makes it possible to harvest it in time to starve out the weevil. A failure of the cotton crop is a serious thing, because there is nothing to take its place. The Cotton Belt of the United States extends from the Carolinas to Texas and Oklahoma. Three-fourths of the cotton of the world is raised in this belt, and about ten million bales are yearly sent to Europe and the manufacturing parts of the United States.

QUESTIONS

(1) Why does cotton require deep plowing? (2) Why are late rains harmful to cotton? (3) What is the reason for thinning cotton plants to a certain distance? (4) Why not leave the cotton unpicked until all is ripe? (5) What has Whitney's invention meant to the South? (6) Had it any effect on slavery in the South? (7) Why? (8) What is oil meal and what is it good for? (9) Why is it desirable to have cotton that matures early? (10) What means are used to fight the weevil?

For exercises, problems and experiments, refer to the Appendix.

CHAPTER XIX

THE HAY CROP

Timothy. One of the chief hay crops of America is timothy. It is grown chiefly in the northern part of our country east of the Rockies. Timothy is popular with farmers, because the seed is cheap and because it will produce a good hay crop the first year after it is planted (Fig. 82). It is easy to kill it by plowing. Timothy fits well into a system of rotation with other crops. It needs a good soil and plenty of rainfall. It is not only an excellent hay crop, but it is used in nearly all lands intended for pastures. After a few years other pasture grasses take its place.

The Clovers. Another hay crop is red clover. This plant, like so many others, came to us from Europe. It has been grown for many hundred years. Farmers have known for a long time that clover seemed to make the land richer, but they did not understand why this was so. We now know that clovers and their kin, such as alfalfa, cowpeas, and soy beans, enrich the soil through the work of the bacteria on their roots. We have learned that the bacteria take nitrogen from the air and store it in little swellings on the roots of these plants. When the sod is plowed for other crops, the nitrogen helps to produce much better yields (Fig. 53). These

clover-like plants are called legumes. They are valuable because of the hay and pasture they yield and because they help us to build up the land on which they grow, with plant food. Most crops leave the land poorer, but legumes leave it richer, at least in nitrogen.

Kind of Soil for Clover. Red clover requires a good soil. Many farms are too poor to grow it. The

FIG. 82. *Timothy hay.*

land should be well drained, because the roots will reach down five or six feet if the land is not swampy. Sometimes a sprinkling of lime to sweeten the soil will help a clover crop to thrive. This is true of some sections of eastern Ohio, southern Indiana, and Illinois.

Ready to Cut. Clover is usually sown in the spring on the winter wheat crop. It lives about two years. Clover grows two crops a year. The second

crop is often cut for seed. In order to obtain the best hay, clover should be harvested just after it has

FIG. 83. *A hand dump rake.*

come to full bloom. Hay cut later is not so good.

Careful Handling. In harvesting the clover crop, it should reach the barn or stack with the least handling and exposure. If it is allowed to become too dry in handling, the leaves will crumble and fall off, and they are the best part of the hay.

Curing Clover Hay. Clover hay should be well cured in the sun, or it will heat and spoil in the stack or mow. Some farmers cut it in the afternoon, and after the dew is off the next morning it is tedded, raked, and put in the cock before night (Figs. 83, 84, 85, and 86).

Uses of Clover. Red clover is used for hay and for pasture. It is often used as a green-manure crop to be plowed under if the ground is poor in humus. Even where it is cut for hay, the stubble and roots

turned with the plow show gains in the crops that follow, because of the extra amount of nitrogen left behind. Clover makes an ideal hay for cattle, and where it is raised, it should make up a half or more of the roughage of milch cows. Sheep and young stock make excellent growth on clover hay or the clover pasture.

Getting a Stand. Where the soil has been worn out by many crops being taken off and no plant food or humus put back, red clover will not often grow. In order to bring such land up, a heavy coat of barnyard manure will help to give clover a start. Another way to get a set of red clover on poor land is to

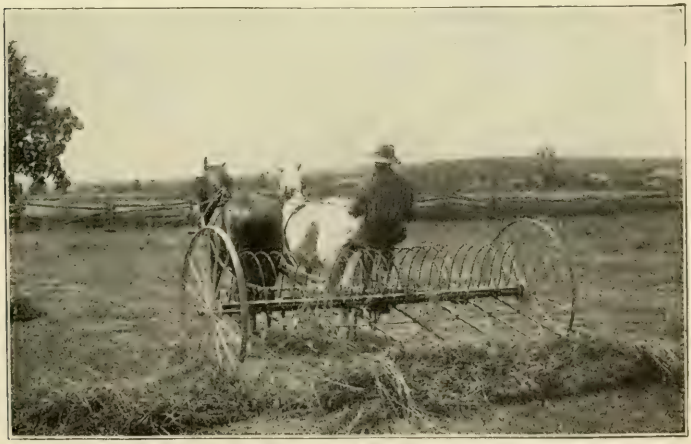


FIG. 84. *A self-dump hay rake.*

spread straw over the wheat or rye ground that has been seeded to clover. This is done in early spring, before the clover seed has begun to sprout.

Alsike Clover. Still another way to get one's poor fields seeded to red clover is to first sow Alsike clover. This will grow on soils that are too wet or too dry or too poor for red clover. Alsike is hardier and less likely to be attacked by disease.

Alfalfa. Another clover-like plant that is coming to be even more important than clover is alfalfa

FIG. 85. *Hay loader.*

(Fig. 87). It was brought to America in the early days by the Spaniards, but only in recent years has it become a widely grown crop in the United States. Like clover, it is a legume whose roots are homes for bacteria. Thus it both brings the farmer fine hay and pasture, and it enriches his fields at the same time. Alfalfa has for years been a leading crop in the West. It is now being introduced widely in the great Corn Belt. It is a fine feed for milch

cows and for fattening hogs, lambs, and cattle.

The Soil and Crops. Alfalfa has a long tap-root which reaches down deeper than any other farm crop, often being twelve feet long (Fig. 88). Thus, you see, alfalfa needs a well-drained soil. It thrives wonderfully in dry regions. It continues to grow throughout the warm season. In Canada they cut

FIG. 86. *Horse power is cheaper than human labor.*

three crops of it in one season, while in Arizona eight cuttings are often harvested.

How to Start Alfalfa. Alfalfa is not a successful crop on poor land. If the land is not rich enough, a heavy coat of manure may be necessary. In many places east of the Mississippi River lime is needed to give alfalfa a start. About twenty-five pounds of seed are sown to the acre in the East, but much less is used in the West. It is best to sow alfalfa in the late summer or early fall. It is sometimes seeded

with grain in the spring. The field should be mellow and fine as a seed bed, for alfalfa is not a strong plant until it gets a good start. Weeds will injure it, so it is well to sow seed that is free from weed seeds. Alfalfa may be grown on the same field for a longer time without change than most crops, but it should be plowed in at intervals of from five to seven years and some other crop sown.

Good for Horses. There is no one thing so good as alfalfa for the working horse. It builds up his worn-out muscles and keeps him strong and healthy. He needs much less grain when he can have alfalfa hay. It ought to be free from dust, but it does not

Courtesy of Santa Fe R. R.

FIG. 87. *A field of alfalfa—six crops to the season.*

gather dust so easily as clover. It is not safe to feed too much to horses.

Alfalfa for Other Stock. Milch cows thrive on alfalfa, and nothing better is grown for calves,

sheep, and hogs. Alfalfa and corn fed together make a finely balanced food for stock, because the food element that is lacking in corn is found in alfalfa; and what alfalfa lacks, corn will supply. Not only is alfalfa the best forage food for stock, but it will do more even than clover to build up the soil. Its roots go down very deep, and thus it gets food where no other farm crop can.

Courtesy Santa Fe R. R.

FIG. 88. *Alfalfa plant showing long tap-root.*

The Cowpea. The cowpea is another legume and is a cousin to the clover and alfalfa. It has come to be an important hay crop in our Southern states, for it likes warm climates. It will grow on almost any kind of soil that is not too wet. Like clover, the cowpea will make good hay or green feed, and it enriches the soil.

The cowpea is an annual plant and resembles the bean. Some varieties are bush-like while others are trailing. As it is difficult to cure without losing the leaves, it is sometimes grown with German millet to help save the leaves and to assist in speedy curing.

CHAPTER XX

ORCHARDS

Helping One Another. Fruit trees of some kind will thrive in any section of our country, so every farm should have its own fruit. Some farmers make fruit-raising their chief business, while others have only a small orchard for family use. If the raising of fruit is the principal object of the farmer, he should locate where many other farmers are doing the same thing, so that they may form companies to help one another in many ways, especially in obtaining good prices for their crops.

Keep Near Market or Railroad. It is well not to go too far from the railroad to raise fruit. When peaches are to be handled, they should not be hauled more than three miles. Strawberries must also be marketed soon after they are picked and with as little cartage as possible. Apples are more firm and will endure more handling, but the expense of a long haul reduces the profits.

Hill Lands for Orchards. It is usually better for orchards to be upon land higher than the rest of the farm. The cold air is heavier and settles into the valleys and lowlands, so the hill orchards are not so likely to be caught by late spring frosts.

The Best Slope. The north and east slopes of hills are preferred for apple orchards, because they

are slower in warming up in the spring. This keeps the blossoms from coming out too soon and being injured by late frosts. Trees set on southern slopes receive more sunshine, and their fruit is more highly colored. But southern slopes are usually drier than northern slopes, and thus the fruit does not grow so large.

The Influence of Water. Land sloping toward a river or a large body of water is good fruit land, because the water keeps the air from too sudden changes. The fruit should be on the slope that receives the wind after it has crossed the water. Air near water is kept from getting suddenly colder and there is less likelihood of frosts. (Fig. 89.)

Kinds of Soil for Fruits. For apple, pear, and plum trees a farmer should choose a deep, moist, clay loam. A sandy loam is better for peaches and cherries.

Preparation of Fruit Land. The soil should be prepared as carefully for a fruit orchard as for corn. It is plowed deep for planting the trees, so the roots may reach out far and wide for food. The surface should be harrowed to a dust mulch. If the field is wet and swampy, it must be drained.

Planting Trees. The trees may be planted either in the spring or fall. If the soil is in good shape, fall planting is better, because the trees get a start before winter. To make tillage easy the rows should be straight. Apple trees are commonly planted forty feet apart each way, but sometimes they are planted

closer. Pears are set about twenty-five feet apart and peaches and plums each twenty feet. There should always be room enough between the trees so spraying may be easily done and the crop harvested conveniently.

FIG. 89. *Irrigating an orchard.*

Setting Trees. When a tree is taken from the ground the more roots that are saved the better. But with the best of care many of them are broken or bruised, and others must be cut. All the broken roots should be cut back from the injured end with a sharp knife, so the smooth wound will heal quickly. Since the tree has lost many of the rootlets that supply it with food, the branches must be cut back, too, else they will need more food and moisture than the roots can supply. People usually leave too much of the top on a tree that is transplanted. The trees should not be exposed to the sun and wind before planting, and the planter should not allow the roots to dry out. If the roots are covered with a coat of clay, it is well to dip them in water before setting them.

Packing About the Roots. The holes dug for the trees should be a little larger than the roots seem to need, so that they can be placed straight. Since the roots feed the tree, it is very important to pack the soil well about them, so they can get plenty of liquid food from it. The upper roots should be raised until the soil is packed firmly under them. Roots should never be crowded together, but spread out naturally to grow as they will. In the bottom of the hole the soil must be packed very tight, but the top four inches should be loose for a dust mulch. A common mistake is to pack the soil tightly on top and leave it loose underneath. This brings the moisture to the surface and causes the young trees to die of thirst.

FIG. 90. *A crop between rows.*

Tilling the Orchard. The old idea that orchards would take care of themselves after planting is a thing of the past. Now the successful fruit growers till their orchards as regularly as they do their crops. Trees make nearly all their growth early in

the year, before the hot months of midsummer, so it is during the spring months that they need plenty of food and moisture. Then is the time to cultivate the orchards. More than nine-tenths of the fruit is water, and we know that tillage is very helpful in saving moisture. The drier the season, the more the harrow and cultivator are needed. After July, when the growing period is over, a crop may be sown on the orchard to be plowed under later as green manure (Fig. 90).

Injury to Trees. In tilling orchards, care must be taken not to injure the trees. The grass and weeds that grow close to the trunk of the tree do very little harm, and they had better be let alone, rather than run the risk of injuring the tender bark of the young tree.

Pruning. If young trees are well pruned when they are set out, they will need very little more trimming until they begin to bear. Shoots that cross each other and interfere with other branches should be removed. When branches are likely to become too crowded, the knife should be used. Many fruit growers change the shape of their trees to their fancy by pruning. They cut the tops back so the trees will spread out instead of growing tall, for it is difficult to spray a tall tree, and the fruit is harder to gather.

Spraying Fruit Trees. All fruit trees have enemies which the farmer must fight. More than twenty-five years ago a man who was employed by

the state of Illinois to study plants, discovered that Paris green would kill the potato beetle. He said that he believed the same poison would stop the cankerworm from injuring the apple crops. For a good many years farmers doubted and shook their heads; but here and there a man began to spray with Paris Green to protect the crops, and they found it worked well. Fewer apples were found wormy in orchards that had been sprayed. (Figs. 38 and 39.) This was only the beginning of an intelligent fight to protect crops and trees from insects. Many discoveries have been made since, and now the best farmers everywhere are spraying with different mixtures to save their trees and fruits, their gardens and other crops. In the West, where the finest of fruit is raised, state laws have been passed, commanding every orchardist to spray his trees whether he finds them troubled with insects or not. This is to make sure he will not grow millions of insects to attack the orchards and crop of some neighboring fruit grower who is careful in spraying.

Bordeaux Mixture. Besides the insects which injure our trees, there are tiny robber plants, or fungi, like mildew and the brownrot, that attack peaches and other stone fruits, sometimes even apples and pears. In France, where many grapes are raised to make wine, the grape farmers near Bordeaux found that their vines were being injured by mildew. So they set very earnestly to work to find a check for

this enemy. After much experimenting, they discovered a poison spray now called the Bordeaux mixture. It is used all over the world to-day to kill the fungi that are injuring gardens and orchards.

Spraying Machines. A farmer who has not more than five acres in his orchard can use a spraying machine worked by hand. There are many kinds of good spraying outfits. (Fig. 91.) It is chiefly important to be sure that the liquid is well stirred by some means, so that the poisons will not settle to the bottom of the barrel instead of reaching the tree. The best fruit growers spray their trees regularly. (Fig. 92.) Peaches and prunes are usually not sprayed unless they are attacked by the scale. In many places apples are sprayed three times—once just before the blossoms open, again just before the blossoms fall, and a third time about ten or twelve days later. The mixture used is three or four pounds of copper sulphate, five pounds of lime, and a half pound of Paris green in fifty gallons of water.

Thinning Fruit. Some fruit growers are now urging the thinning of the fruit crop. A part of the fruit on heavily-loaded trees is taken off before it is half grown, so that which is left may grow to a larger size. Though it costs a good deal to thin, the growers argue that it costs no more to pick the fruit when small than when it is full grown; and the fruit that is left to ripen is so much larger and brings so much better prices that it is well worth

while. In Western regions the trees bear such heavy loads that the branches break unless some of the fruit is removed. When the crop is light there is no need of thinning. Apples usually grow in clusters from three to a half dozen in a bunch. If one

FIG. 91. *A good spraying outfit for the orchard.*

is growing fancy fruit he should remove all but the best apple of each cluster. Pears grow like apples and may be thinned in the same way. In thinning stone fruits, the work may be done by pulling the fruit off; but with apples and pears it

is safest to clip them with sharp-pointed shears, because pulling is apt to break the branch. A fruit tree that has been properly pruned and the crop thinned, will not need props to keep it from breaking down; and it is more likely to bear a good crop every year.

Harvesting Fruit. A farmer who grows fruit for market must pick it carefully to prevent bruising. In order to make the fruit attractive to the buyer, the grower grades his apples, that is, he sorts out those of the same size and packs them together. Boxes are being used for packing, though many still prefer barrels for apples. Neat and careful packing helps to secure good prices for the fruit crop.

Peaches. Though many peaches are raised in California, the greater part of them come from the Eastern states. A mildly temperate climate favors this fruit. They must be packed quickly and closely and sent by fast freight when shipped. Packers get two cents a basket, and an expert packer can fill a hundred baskets in a day.

Apples. Of all the many fruits grown in our country, the apple is the most important. More than forty million barrels are used every year, or about a half barrel for every man, woman, and child in the United States. There are fewer difficulties to meet in raising apples than any other fruit. The tree is hardy and is not easily injured. There are many varieties of apples that keep well through

the winter. All kinds are firm and can be handled and marketed with less care and trouble than other fruits. Apples may be put to many uses. They are eaten raw or they may be cooked in a variety of ways. Some are dried or made into jelly, and in this form they may be kept for a long time.

Seedless Apples. Since we have varieties of seedless oranges, men have been trying to develop an

FIG. 92. *The successful orchardist always sprays.*

apple without a core. When this kind takes the place of those we now use it will be a splendid thing for us all, because there are certain insects that live in the core of the apple and there is so much waste in removing it. Some day seedless apples will be a very common thing.

CHAPTER XXI

SUGARS AND OTHER CROPS

Where We Get Our Sweets. Each person in the United States eats, on an average, more than seventy pounds of sugar in a year. Sugar is made from the sugar cane, the sugar beet, and the sap of maple trees.

Sugar Cane. Sugar cane may be grown in the Southern states wherever cotton is found. It very much resembles corn in appearance. Cultivated cane never produces seed, so the new crop must be grown from cuttings of the stalk. It takes a ninth part of the old crop to plant the field for a new one. The seed cane is usually stored on the land in the fall and covered with a layer of leaves and a thin layer of earth to protect it from the frost. In the spring it is uncovered or "hooked up" with long hoes and cut into pieces two feet long.

Planting. The land is plowed and thrown into ridges eight feet apart, and the seed stalks are laid end to end in double rows in a trench on top of the ridges. An extra piece of cane is put near each joint so the sprouts will be regular. Cane should send up a sprout at every joint. Covering is done with a hoe or a machine. A machine covers ten acres in a day. The first crop is known as plant cane. The next year it will spring up from the same

roots, or it may be planted again. A good crop will come from the stubble even the third year. The land is then plowed and sowed to cowpeas. The fourth year a new crop of cane may be raised on the land where the cowpeas have been plowed under. Cane sometimes grows fifteen feet high.

Harvesting. Harvesting begins in October. The sugar forms most rapidly then, but the crop must be cut before the frosts injure it. Colored workmen using a long knife go through the fields cutting the stalks very close to the ground, for the lower ends yield the most sugar. The leaves and tops are trimmed off, and the stalks are laid in piles. At the factory the stalks are cut and shredded into small pieces, and the juice is crushed out between heavy rollers. This juice is put into large tanks with milk of lime to be made clear. Then it is made into syrup, and the molasses is separated from the sugar, which is then dried into large crystals and refined into our white sugar.

Sugar Beet. It is impossible to tell by taste whether the refined sugar is made from cane or from sugar beets, but the raw beet sugar has a disagreeable odor and taste. Beet sugar was not discovered by accident. It was made after years of experimenting. More than two hundred years ago a German druggist first found sugar in beets, and sugar being at that time a dollar a pound, Napoleon offered a prize to any one who could make sugar from beets. The art was soon discovered, but it is

only within a short time that beet sugar has been made in the United States. The soil and climate of the greater part of our country will raise the sugar beet. The labor required to produce beets is much

Courtesy of Santa Fe R. R.

FIG. 93. *A field of sugar beets.*

more than that required for an equal crop of corn, wheat, or potatoes; but the income is much greater.

Preparation and Soil. The land for sugar beets must be a rich, deep soil. Plenty of moisture is needed while the plants are growing, and dry, warm weather when ripening. If sugar beets are to follow a grain crop, the land should be plowed lightly as soon as the grain is harvested. The ground is then dressed with a coat of manure, and later in the season it is plowed deep. The subsoiling plow that loosens the earth to a depth from fourteen to eighteen inches, enables beets to reach down into the

soil where they will receive plenty of moisture at all seasons. Before planting, the ground is dragged or harrowed and rolled to pack it firmly. The beets are planted with machines. Horse-power machines plant four rows at a time. Since the sugar beet needs about four or five months' time to grow to the full size, it should be planted two or three weeks before corn. (Fig. 93.)

Harvesting. In October the farmer takes a few beets to the factory to be tested for the amount and quality of juice. As beets increase in weight rapidly the last six weeks, it is well to delay harvesting as long as is safe to avoid danger from frost. The beets may be plowed loose eight or ten days before removing from the ground. They are then pulled by hand and the top cut off close to the root to remove the matter that prevents the separating of the sugar from the juice. The beets are then sent to the factory. Europe produces larger crops of sugar beets than any other part of the world.

Rice. Rice furnishes the principal food of half the human race. It first came from the East Indies, but is now raised in many parts of the earth. It was probably brought to America when the Carolinas were settled, and it is now the staple product of South Carolina. There are two kinds of rice, the upland rice and the lowland rice. Lowland rice was first grown in places that were overflowed by the tides, but irrigation is now used to raise this variety in most of the Southern states. Upland rice does

not need to be flooded, but is cultivated much as oats or wheat.

Growing Rice. The ground is prepared for rice and the seed is planted, harvested, and threshed very much the same as wheat. Where the rice crop

Courtesy of the Alabama Tobacco Company

FIG. 94. *A heavy crop of tobacco and drying barn.*

is flooded with water, the ground is allowed to dry out at harvest time. The upland rice is thought by some planters to be better than the lowland variety, but the yield is not so great.

Rice Products and Enemies. From the thresher, the rice is sent to the mill in barrels. A little more than half of it comes out clean rice, a small part is polish, and about a third is bran and waste. The

rice polish and bran are mixed and sold to feed pigs. The rice-stalk borer, the chinch bug, and the "black weevil" are all enemies of the rice crop.

Tobacco. The United States produces more tobacco than any other country in the world and sends

Courtesy of the Alabama Tobacco Company

FIG. 95. *Drying and curing tobacco in a well-ventilated barn.*

more than one-third of it to other lands. The variety of tobacco raised depends upon the soil, climate, and the use it is to be put to. (Fig. 94.)

Wet soils of clay produce large, heavy plants that cure to a dark brown or red. Light, sandy soils raise a thin leaf curing to a bright red, mahogany, or yellow color. The quality of tobacco is affected by the soil, kind of manure used, and the climate,

more than almost any other plant. In the northern regions the seed is sown in a hotbed protected by cheesecloth. The young plants are tender and need watering with a weak manure water. They should be transplanted when five or six weeks old. They may be well cultivated until the plant begins to bud; then, if no seed is desired, the plants are topped so the strength may all go to the leaves.

Fertilizer. Barnyard manure produces a rank growth of tobacco, but it is poor in quality. Potash is the most important plant food for tobacco. Nitrogen is supplied in cotton-seed meal.

Curing. When the leaves begin to turn yellow, the stalks are cut close to the ground. They should

FIG. 96. *A heavy crop of oats.*

be wilted by cutting them when the sun shines the hottest. The plants are then hung up in the drying

house without being crowded together. (Fig. 95.) After drying, the leaves are removed and tied up in bundles called hands. The tobacco leaf loses more than three-fourths of its weight in curing. Tobacco is made into cigars, cigarettes, cheroots, and snuff.

Oats, Barley, Rye, and Buckwheat. Other grains fit for temperate climates are oats, barley, rye, and buckwheat. All are sown much like wheat. Oats grow on light or heavy soils, but do not like too much water. (Fig. 96.) In the Western states oats are frequently sown on corn lands without plowing and are covered with a disk harrow. The varieties that mature early escape the rust. These plants furnish green forage, hay, and straw, while the grain products are food for both man and beast.

QUESTIONS

(1) Before the discovery of sugar cane, how did people get their sweets? (2) From how many plants do we get sugar now? (3) What do you know about maple sugar? (4) In what way is the raising of sugar beets more trouble than corn? (5) Compare the raising of wheat and rice from planting to harvest. (6) Why should not tobacco plants touch each other in the dry house? (7) Name all the grains grown in your county.

For exercises, problems and experiments, refer to the Appendix.

CHAPTER XXII

THE FARM GARDEN

The Boy's Garden. The garden is a chance for the farmer boys and girls to have a little farm of their own. It is impossible for every child to have much space in the school garden (Fig. 97), but at home he should have a little plot of ground to raise his crops. Here he can plant what he likes and learn many important lessons about how to till the soil and to care for plants. Any boy likes to try experiments for himself and to feel that there is one spot where he is the "boss." Whatever is raised in the child's garden should be his produce to sell or give away as he pleases.

A Good Story. The story is told of a certain farmer's boy who was anxious to leave the farm. He was tired of the salt meat and potatoes that were served at his father's table three times a day. One summer he went to work for a neighbor. Here they had plenty of delicious sweet corn, tender young beets, sliced, ripe tomatoes, and meaty Lima beans, with a juicy melon from the spring house for dessert. The boy went home, started a garden, and decided to stay on the farm. (Fig. 98.)

Gardens Everywhere. It is surprising how many garden crops can be grown in every part of the United States. In the cooler climates, garden truck

grows rapidly because of plenty of moisture. In Dakota the best place for a garden is where some large snowdrift has melted late in the spring. In Texas vegetables grow the year around. Different

FIG. 97. *A school garden.*

varieties belong to different sections of the country, so seeds should be selected that have been tested and do well in the region where they are to be planted.

Location and Soil. Since the garden belongs to the kitchen, it should be as near it as possible. Almost any soil can be graded, manured, and drained into a good garden, unless it is a very stiff clay that will not admit draining. The best garden

soil is a sandy loam that will dry out quickly after rains, so that it may be cultivated often.

Fertilizing. Plowing in the spring must be done as soon as the ground will permit, but it is better to plow the garden in the fall so that freezing will crumble the ground into fine particles. Garden plants are grown close together in a small space, and we want them to grow quickly, so they need a great deal of plant food. A thick dressing of stable manure, from five to ten loads to an acre, should be put on before the second plowing. If this garden manure is hauled in the fall and made into a long, narrow heap mixed with sods and forest leaves, it will be well rotted and fine by spring; and it will easily mix through the soil, giving every inch of ground its portion. Leaves from the lawn should always be piled on the garden to decay.

Well-rotted manure supplies all the nitrogen a garden requires, but to give vegetables a good flavor, potash is needed. Wood ashes will furnish this. After the manure is plowed under, the ashes are sifted on top, and then the surface is harrowed until all is fine as an ash heap. Dried hen manure, pounded fine and sifted, is often harrowed in with the ashes and is especially good for some garden crops.

Preparation. The garden should be plowed from six to eight inches deep and harrowed four or five times. All stones must be removed. If these can be buried so as to be beneath the reach of the plow,

FIG. 98. *A boy's garden—Beautiful as well as profitable.*

they will help to drain certain wet spots in the garden. A hand roller and hand rake are used for pulverizing and crushing lumps of earth left by the harrow. For root crops in clay, a subsoil plow that drags a second share after the first and breaks and loosens the bottom of the furrow to a great depth is often used.

Garden Tools. Small hand tools, such as trowels, spuds, and dibbles, are used in transplanting. The hoe and steel garden rake are useful in finishing the top of the ground. The common hoe is too wide for narrow rows and delicate plants, so there are

many different sorts of blades made. Markers for keeping rows straight and a small hand roller, are great helps. The wheel hoe is the best cultivator. Every farmer should have blades of different sizes and a set of disks which can be used on the cultivator.

Mulch. We know that a covering of fine, dry earth, or a dust mulch, prevents moisture from escaping from the ground. "A finely raked garden bed is dry on top, but the footprints of the cat remain moist for days, because the animal packed the soil wherever it stepped, and the water climbed up from one grain of earth to another until it reached the surface." Besides convenience in cultivating, it is wise to plant seeds in rows, instead of in beds which have been raised or hilled up, with high beds and low places between. When we leave the ground rough, or make large holes around our garden plants, we leave more soil exposed to the air, and this helps moisture to escape from the ground. In a very wet season, it is well to hill up crops like potatoes or corn, because we then wish to get rid of part of the moisture.

Planting. We are usually told to make the earth firm and well packed over newly-planted seeds, because this brings moisture to the seeds lying near the surface and so hastens the sprouting. As soon as the seeds have sprouted, the ground should be loosened to stop evaporation. Large seeds can be planted deep and the earth well packed over them,

then the top is raked. To water a bed, wet it thoroughly in the evening. When the morning sun begins to dry it out, loosen the top earth to stop the rise of moisture. Sprinkling the plants every few days is very harmful. Do not sow small, slow-sprouting seeds like celery and onions in land that bakes. A layer of chaff or a board may be laid on the row to hold moisture, but it must be gradually lifted as soon as the seeds get a start.

Transplanting. In thickly-sown seed beds one must thin or move the plants to the garden as soon as they have their first true leaves. While seeds of lettuce, onions, radishes, peas, and many other things, can be sown in the ground in the early spring, we can gain from four to six weeks by sowing the seeds of others indoors and transplanting them. Many farmers buy their egg plants, tomatoes, cauliflower, and peppers from hothouse gardens; while others grow their own in window boxes, hotbeds, and cold frames.

The Window Box. A window box fifteen inches square and six inches deep, or old tin pans nearly filled with soil, are put in a south or east window. Suitable soil or dirt has been obtained in the fall and stored in the cellar or some convenient place. This is mixed with a little coal ashes or fine sand to make it light and loamy. The seed is scattered and covered lightly. The soil is then watered with a fine sprinkler. Squashes and cucumbers may be planted on pieces of sod turned upside down. These

sods can be set into the ground as soon as the soil can be worked.

Hotbeds. Hotbeds are box-like frames sunk in the ground and covered with a sash filled in with glass or cloth. Some of the soil in the frame is taken out, and horse manure is put in its place. When packed solidly in the pit, the manure rots and produces heat. Over the manure is three or four inches of fine garden soil in which the seeds are planted. The manure keeps the soil above it warm. Hot air or hot water pipes are sometimes used under the hotbeds instead of manure. A well-drained spot, sheltered from the cold winds and sloping to the south, is best, because the sunshine is very helpful. It takes care and judgment to handle a hotbed properly, because plants must be aired and watered at proper times.

Cold Frames. The cold frame is like the hotbed, but has no manure in it and therefore no bottom heat. A combination hotbed and cold frame may be made of a large drygoods box partly filled with horse manure well trampled down and covered with clean straw. Small, shallow boxes are nearly filled with soil. After the seed has been planted in them, they are placed on the top of the manure and covered with a pane of glass. Thus each box becomes a little hotbed. The glass is removed now and then for air. If the manure becomes too warm, the small boxes are raised on bricks. When the heat of the manure is gone, the hotbed becomes a cold frame.

Preparing for Transplanting. When the ground out of doors gets ready for transplanting, the plants in the window boxes may gradually become used to the colder air by having the window raised a little at a time. The hotbed sash is left open on bright, sunny days until the plants are ready for living in the open air.

Transplanting. In transplanting, one must handle plants gently and plant them in freshly-turned soil which is very fine. A hole is made with a dibble or trowel. Put a cupful of water in each hole, and press the earth firmly about the roots. Roots of plants are often broken off in transplanting. Except with tomatoes and eggplants, part of the leaves may be cut off so the roots will not have too much top to feed until they get a firm hold. If the soil is freshly turned and the transplanting is well done, it is not necessary to water plants. If late in the season the gardener may transplant on a rainy or cloudy day. A handful of grass or hay packed around plants that have just been set out is better than covering with tin cans or flower pots, for they need light and air to breathe.

Rotating or Changing Crops. Every vegetable has its own insect enemies and diseases. If the same vegetables are raised year after year on the same soil, these insects and diseases will grow worse. The vegetable also uses up some of the particular plant foods that it needs. Some plants are surface feeders, the roots not growing deep. Beets, carrots,

and potatoes grow deeper and are able to feed where the others could not. If vine crops are followed with root crops, the latter will do well by feeding below where the others did. Radishes, early lettuce, spinach, or peas may be harvested early, and cabbage, beets, or late sweet corn planted in their places.

Planting Between Rows. Planting between rows sometimes works well. In late June, when potato vines are well started, and the rows are well cleaned, late sweet corn is often planted between. However, if the season is too dry, this may injure both crops. Sowing turnips broadcast in late sweet corn or among tomatoes and squash, is worth trying.

Weeds. Weeds take moisture and plant food out of the soil, and they spoil the shape of many vegetables by crowding in upon them as they grow. They should not be allowed to reach the second leaf. In hand weeding it is well to collect the weeds in a basket. They sometimes take root again when left on the mellow garden soils. When weeds get a start, it is a good plan to cut off the tops with a sickle before seed forms on them. Mulching between the rows with a layer of straw prevents weeds from growing.

Mulching. In a dry season, after plants have been cultivated a few times and are well above ground, hay or straw about four inches deep may be put between the rows. This saves the labor of weeding and keeps the soil moist and cool. It is

especially good for potatoes, tomatoes, cabbage, beans, or vine plants, though in a wet season straw holds too much moisture.

Peas. Peas are the first product of real food value of the early garden. They are both delicious in flavor and very nourishing. By sowing the seed about a week apart, and using different varieties, one may harvest peas all summer. But the late varieties are in danger of mildew. Peas grow best in a cool climate, in a light, moderately rich soil. The first plantings should be in as soon as the ground can be worked. The soil must be kept mellow and free from weeds to raise good peas. They need not be staked with brush when the garden is worked with a horse cultivator. Where the brush is used they may be sowed in double rows. There are a great variety of peas, and those that have been tested in your region should be planted. Peas are injured by mildew and the pea weevil. The weevil may be killed in the seed by placing them, before planting, in a closed vessel containing carbon-bisulphide.

Beans. String beans should be sown as soon as the ground is free from frost, and every two weeks afterward to keep a supply for the summer. A sandy soil and a southern slope are best for beans, because they are tender and easily frosted. They should be planted less than two inches deep, for the growing top of the little plant is liable to be torn off as it comes through the ground. When

beans are to be used green, they must be picked frequently, for if the pods are allowed to ripen, the plants will stop producing. The bean weevil is a serious enemy and should be treated like the pea weevil. Lima and butter beans are best grown in Southern climates. Poles or stakes for these should be set at least four feet apart each way for their vines to climb on. The worst disease of string beans is the brownish or reddish pitted spots upon the pods; they spoil the appearance of the crop and cut down the yield.

Beets. The root crops all need a loose, deep soil. Subsoiling or double plowing is useful in hard earth. Beets are grown in rows three and a half feet apart. They may be sown very early, for the young plants will endure a light frost. They should be thinned when the plants are just big enough for greens. For winter beets, seed may be sown in July or August in the central states. After the first heavy frost, the gardener should take up the roots, cut off the tops, and store the beets in a root cellar or pit. Leaf-blight is common with the beet in some places. This is prevented by spraying with the Bordeaux mixture.

Turnips. Turnips should be planted on a rainy day and the seed covered lightly. About three-quarters of an ounce of seed to a row one hundred feet long. Young plants are thinned from five to seven inches in the row. If the plant grows too slowly, it is stringy and bitter. The fall and winter

crops of turnips are sown in July, after the early garden crops are harvested. The white and yellow varieties are equally good, except that the white turnip keeps best through the winter. Except the maggot, the turnip has no insect enemies.

Carrots. Carrots are good for soups, salads, stews, and other savory dishes. Carrot seed sprouts slowly, so it should not be sown deep. The earth must be kept loose. Radish seed sown in the same row will break the earth crust, and show where to expect the row of the carrots to appear. If seed is sown several times, a week or two apart, there will always be some carrots on hand. The plant has no serious insect enemies.

Parsnips and Salsify. Parsnips may be treated exactly like the carrot. Parsnips and salsify may be left in the ground all winter without protection, and they make delicious fresh vegetables as soon as the ground thaws. Salsify, or vegetable oyster, should be sown very early in the spring and the plants should not be crowded.

Radishes. Radishes need a mellow, quick soil. They do not thrive in clay. To be tender they must grow rapidly and should be eaten while small. Grubs burrow into the roots and make them wormy, if the same piece of ground is used every year.

Horse-radish. Horse-radish is grown from small roots that are trimmed from large ones when the crop is stored in the fall. These sets are planted two or three inches deep, top side up, and from

fifteen to eighteen inches apart in fairly wide rows.

Swiss Chard. Swiss chard provides "greens" all through the season. Only one sowing need be made. The chard is cultivated the same as the beet and thinned to twelve inches. If, when the outer leaves are as large as your hand, they are stripped off, a new supply of tender ones will keep coming.

Asparagus. Asparagus is a hardy plant. Its seed may be sown either early in the spring or late in the fall. When the roots are a year old, they should be transplanted in rows five feet apart, away from roots of trees or other plants. As much stable manure as can be plowed under, plowing ten to twelve inches deep, should be put on. Dig a trench nine or ten inches deep, and lay the roots about two feet apart in the bottom, covering them two inches deep with loose soil. The young roots that come up from the seed every summer should be weeded out. If the seed balls are cut off before they turn red, the plants can be kept from self-sowing. When the stalks begin coming up in the spring, the ground may be mulched with manure. This will save hoeing and also feed the roots.

Sweet Corn. If good seed is planted, it will produce a tender, sugary ear of sweet corn. Corn varieties mix so easily that only the most careful selection of kernels can improve a strain of corn. If the first lot is planted early in April, it will ripen the latter part of June in the latitude of New York. The corn should be planted thickly in drills with six or seven

kernels in a hill. If some should fail to sprout, there will be plenty left. If all seeds grow, it is easy to thin them. Be sure that there are not lumps or stones over the corn. The plant cannot fight its way out like beans and pumpkins. After the corn

FIG. 99. *A well-cultivated cabbage lot.*

is up, a handful of wood ashes on each hill will "make it jump." Break the crust after rains, keep the weeds and suckers down, and cultivate between the rows. For a continuous crop, plant every ten or twelve days until the latter part of July.

Cabbage. Cabbages need a moist, deep, well-drained soil. They thrive better in a spot where

cabbage, turnips, or mustard have not been grown for three years. Select good seed, and sow in a hot-bed or window box. When the plants are in the fourth leaf, thin them to secure stocky plants, and transplant only the best roots. When transplanting, remove the upper part of the leaves, set the plants firmly, and stir the surface soil. To stop the heads from bursting as they form, one may loosen the roots by slightly lifting and twisting the plant. Whitish butterflies lay their eggs on cabbages. These hatch green worms that eat the leaves. Kill the worms and spray with Paris green and water, or sprinkle with salt, lime, wood ashes, or pepper. The cabbage maggot works at the stem or root and causes decay. A piece of tarred paper put around the stem on the ground drives away the moth that lays the eggs. (Fig. 99.)

Lettuce. Lettuce is the most widely-grown salad vegetable. It is now ready for the table every month in the year. Winter and early spring crops are grown in cold frames. Seed for an early spring crop may be sowed in a cold frame in March. Sowings in the garden can be made from April to October. The cabbage varieties, or head lettuce, are blanched by tying the tops together.

Cucumbers, Melons, and Squashes. The seeds of cucumbers, melons, and squashes should be planted in shallow hills, three or four in a hill. They are all tender to frost. If each hill is covered with a box frame, it can be raised on warm days and taken

away when frost is past. The cucumber beetle and the "stink bug" are the chief enemies of these plants. Ashes, lime, and tobacco dust are used to drive them away. Muskmelons grow in warm, sandy land. Soil and location affect them greatly.

Onions. Onions are grown from seed or sets in the open ground or in hotbeds. If sown outside, the seed should be put in as early as possible in shallow rows three feet apart and covered with a half-inch of fine, moist earth. They must be carefully weeded.

Tomatoes. Tomatoes grew first in the South, so they need long seasons to ripen. Now, by selecting the right variety, the tomato can be grown in nearly every section of the United States. The plant may be started under glass or in window boxes about March first. They should be put in a cold frame where light and air are admitted on sunny days, until the ground in the garden is warm. Tomato plants are set from two to four feet apart. They need moderate pruning and some simple means of holding the plant off the ground when the fruit is ripe. The varieties differ in color from pink and creamy and bright yellows to bright red.

Grapes. In order that grapes may ripen, they need a warm soil and a sunny exposure. A trellis is used for support. Ten feet between the vines is best for most kinds. The Concord grape is raised in New York and Ohio; the small Delaware, in Delaware, Maryland, and New Jersey; but if we wish to see great clusters of white grapes, we must go to

California. The largest grapevine of the world may there be seen. It covers half an acre.

Raisins are dried grapes. There is a raisin vineyard in southern California which covers five thousand acres. Vines are pruned every year and the grapes gathered from the new shoots. Five-sixths of the grapes in California are made into wine or grape juice, or they are pressed as raisins. The dried currants that we use are really dried grapes. Grapevines are the prey of downy mildew, when it is hot and dry—also of black rot. Vines that have been weakened by bearing too heavy crops are often attacked. Prunings and fallen leaves and fruit should be destroyed, and the vines sprayed with the Bordeaux mixture. The first spraying should be done in the spring before the growth starts, and this should be followed every three weeks through the summer. To protect grapes for home use from black rot, frost, and birds, the clusters may be covered with paper bags which are allowed to stay on until the fruit is ripe. The warmth induced by the bags makes the fruit ripen earlier and it is larger.

Raspberries and Blackberries. The raspberries and blackberries do well in cool soil kept moist by mulching, after the ground has been thoroughly prepared. The shoots of both raspberries and blackberries that are sent up one season, bear fruit and die the next season. Pinch back the new shoots when they are two or three feet tall. This hastens the throwing out of side shoots upon which fruit

will be borne the following year. As soon as freezing weather is over in the spring, these side shoots should be cut back from nine to twelve inches. When the crop is gathered the old canes or shoots should be removed, and new ones cut away, leaving four

FIG. 160. *Nothing so fine as home-grown strawberries.*

to five good canes to each hill. For red rust, one must pull the plant out of the ground and burn it. Spraying has a good effect in fighting off the diseases of the plants.

Strawberries. The strawberry thrives best on a strong sandy loam or a light clay loam. For most purposes the plants do well to grow in narrow,

matted rows. They should be set out in the spring as early as the ground can be worked, in rows three and one-half feet apart, with the plants from one to two feet apart in the row. Planting may be done with a trowel or dibble. One must take care to spread the roots as much as possible and to press the soil firmly about them, holding the plant so the bud will be just above the surface. As fast as runners form, they should be removed, so that the strength of the plant may be used in producing fruit. (Fig. 100.) During the first season, strawberries are worked often. Weeds must be kept down, and the surface soil should be loose and open. Just before the ground freezes, a thorough cultivation should be given. After the ground is frozen, the plants may be mulched to the depth of two inches with straw. The second season should bring a good crop.

QUESTIONS

(1) What are the advantages of deep plowing? (2) What are some of the good fertilizers for the garden? (3) What garden tools will save time and improve the crops? (4) Why does the garden need a mulch? (5) Is mulch needed in a very wet season? (6) Why do you hill up potatoes in a wet season and not in a dry one? (7) Why should one pack the top of the ground over garden seeds that are planted with only a slight cover? (8) Is it better to water a garden often or seldom and thoroughly? (9) As soon as the surface is dry after watering or after a rain, why do we cultivate?

CHAPTER XXIII

COUNTRY ROADS

The Importance of Good Roads. Few boys and girls realize how important good roads are to the farmer. Well-made highways enable farmers to save much time in marketing produce, and time is money. Easy travel also saves the energy of the horses, which means economy of feed. When the roads are in order the farmer can use his team when the field work can not be done, and this reduces the idle time of the horses. If travel is easy, the farmer will go to market oftener, selling many odds and ends of farm produce that otherwise might be left to go to waste because of the time it would take to dispose of it to advantage. For these and other reasons a fine public road makes the farms along the way more valuable. (Fig. 101.)

Sociability Encouraged. Aside from the money gain to the farmer, good roads encourage his family to move about more and to enjoy themselves socially. They gain a great deal in this contact with their neighbors. They go oftener to church, to other social events, to lectures, and to the city.

Good Roads and Schools. The older children may go farther to school if the roads permit. Consolidated schools are thus made possible, and pupils may be transported at public expense some distance

to the larger centralized schools, which have so many advantages over the one-room rural school. More expert teachers may be had, a trained superintendent can be employed, the children are better graded and the larger classes create more enthusiasm in study and recitation. A teacher trained in the science of agriculture can be secured to take charge of that subject and of the school garden. Centralized schools, besides being better equipped in every way, may be managed more economically in one building which requires only one heating system and one janitor. And all this is possible only when the roads are kept in good condition.

City People Interested. City people also demand good country roads because the better the roads, the more easily they obtain country produce and the cheaper it is. City people are using the country roads more every year for pleasure-driving and for automobiles. It is said that automobiles, because of the high rate of speed at which they go, do more to wear out the roads than all the heavy teaming of the farmers. The suction of the swift-moving wheels picks up all the finer particles and scatters dust far and wide. Because of the ravage done by the city automobiles, it is unjust to expect the farmers to build and keep the roads in repair. Moreover, the cost of the produce that the farmer takes to market is of as much concern to the people in the city that consume it, as it is to the man who has it to sell.

Marketing Farm Produce. More than two hundred fifty million tons of freight are hauled from farms to the market or railway stations each year. Counting the labor of men and horses, the wear of

Courtesy of the National Paving Brick Mfg. Ass'n, Cleveland, Ohio

FIG. 101. *A brick road raises the value of farm land.*

vehicles and harness, it costs on an average about twenty-three cents to move each one of these millions of tons one mile. Railroads haul a ton of freight for long distances for less than a cent a mile. The farmer's distance to market averages nine miles and so the cost of hauling a ton of farm produce to market averages two dollars and nine cents. Better

roads would permit larger loads to be hauled in the same time and lighter loads in much less time. (Fig. 102.)

The First Expert Road Builders. The Romans were the first to solve the problem of how to build good highways. The central government at Rome built all the roads and kept them up. They were made of stone by trained experts, and in so solid a manner that, though the surface has required repair from time to time, the stone foundations are as good to-day as when they were built two thousand years ago. They will be serviceable for centuries yet to come.

Roads Abroad and at Home. European countries commonly have fine roads because they are constructed by skilled engineers under government service. But most states in our country still have their roads in charge of county officers who are not skilled in road building and who serve only short terms, giving place to others less experienced than themselves. These county officers are perhaps good business men, but are not students of scientific road construction; consequently, although millions of dollars have been spent on American country roads, they are in the main a failure. (Fig. 103.)

Plantation Mud Pikes. The earliest American roads were built in Virginia and led from the plantations to the landings on the rivers. These were simply mud roads built by the plantation owners. Hogsheads of tobacco were fitted with a pair of

Courtesy of the National Paving Brick Mfg. Ass'n, Cleveland, Ohio

FIG. 102. *A brick road needs but little care or repair and brings the market nearer.*

shafts for a horse and were thus rolled along these roads to the river landings by horse power. Supplies for the plantations were hauled homeward in rude carts.

Our Early Roads. Save the Cumberland road, our national Government has done very little road building. The task of constructing good highways through rough and hilly sections has been poorly done and at great expense. In the early days many long roads were made and paid for by private parties, who then made every one who wished to use

FIG. 103. *Every township should own a steam road roller.*

them pay a toll. There are now but few toll roads.

Working Out the Road Tax. There are two ways of paying road taxes used in different parts of our land. One way is for the farmer to take his team and work on the road long enough to pay for the tax levied against him. This method is a failure, for the farmers seldom know how to build good roads and care very little how they work so long as they put in their time and get back to their crops.

A Better Way. The other method is much more satisfactory. It is this: Each farmer pays his road tax in cash and the money is used to employ men who are practiced in road making. Sometimes a man is employed the year round to prevent the

roads from getting out of repair. "A stitch in time saves nine," and so it is with a shovelful of gravel. A man and a horse and cart kept busy at the gravel pit all through the year are worth many times more in securing good roads than all the "working out" of taxes.

The State's Part. Many people are now coming to see that the state ought to keep up at least the main roads as well as build them. This will insure the employment of road engineers, and it will be done in a more permanent manner.

Drainage. It is useless to build a road without first providing a dry roadbed. Standing water and the grinding of wagon wheels will soon reduce any

FIG. 104. *Grading and draining are essential to good roads.*

road to a quagmire. The first step towards making permanent roads is to provide permanent drainage by ditching and tiling where it is necessary. (Fig. 104.)

Grading. Next in importance to drainage comes grading. The narrower the roadbed the easier it is to keep in order, because water will not so readily collect in it, but roads must be wide enough for teams to pass. The surface should be slightly rounded to shed water quickly, and the ruts must be filled as soon as they appear. Here is where the care-taker gets in his best work by preventing deep ruts from forming and keeping the roadbed dry. (Fig. 105.)

Surfacing Clay Roads. After drainage and grading comes the surfacing of the road. On a clay road a fairly hard and inexpensive surface may be made by thoroughly mixing gravel with the clay. This packs well and makes a hard surface, so if the mixture is of sufficient thickness the road will bear heavy traffic.

Sand Roads. Sand roads may be greatly improved by surfacing with clay. Sand mixed with clay does not make so firm a roadbed as gravel and clay, but it makes a fairly good surface.

Loam Roads. There are tens of thousands of miles of loam roads in the Central West and these roads are almost bottomless in wet weather. Loam takes water like a sponge, and on such roads it is not an uncommon sight to see an empty wagon

mired and abandoned. Farmers are told not to work their fields when it is wet, because it will harden them and they will bake afterward. This is the very reason why loam roads should have the surface stirred when wet. Such working is called puddling. It brings the soil grains in closer contact, making a harder surface than before.

The Split-log Drag. The tool most useful for puddling is the split-log drag. The halves of the log are held on edge a few feet apart by rounds inserted like the rounds of a ladder. This drag used on muddy roads will smear or puddle the surface, making it tough and hard. By lengthening one chain and allowing the inner end of the drag to lag behind as it is drawn along, it fills up the ruts and works all loose material toward the middle of the road. This gives the surface a rounded shape for good drainage.

Other Aids to Good Roads. This drag is very useful on dry roads also. By riding on the outer or ditch-end of the drag and driving once on either side of the road, the ruts are filled and the center made higher. There should be a law requiring all heavy hauling to be done with wide-tire wagons only. Wide tires pack and harden the road like a roller, whereas narrow tires cut and injure the road surface.

Gravel and Shell Surfacing. Different kinds of materials are used in surfacing roads. When suitable gravel can be found it will make an excellent

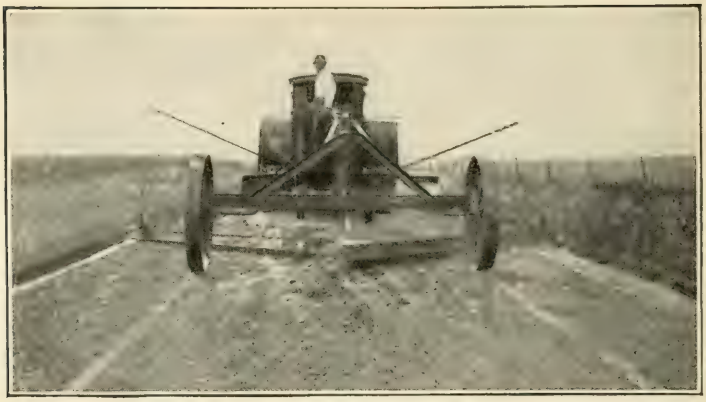


FIG. 105. *Grading a country road.*

road. In communities near the coast, shells from the sea are often used to surface roads and with excellent results.

Stone Roads. Probably the most popular material is broken stone. Stone-bedded roads are said to be macadamized, because a Scotch engineer named Macadam was the first to use and urge this kind of road.

Thick Roman Roads. The old Roman roads were surfaced with stone, which was often several feet thick and thus very expensive. Macadam believed that a smaller amount of stone could be made to serve just as well, and he urged that it would cost much less. The world has come to see the correctness of this plan, and now macadamized roads are found everywhere.

The Macadam Road. In order to build a macadam road, the roadbed is first given the slope desired, so the water will quickly flow to the side gutters. After this the bed is rolled hard with a heavy roller; then it is covered with a layer of coarse stone and rolled again. Then another layer of finer crushed rock is spread on top and rolled until it works in between the pieces of the coarser stone. A layer of still finer crushed stone or sand is next spread on and sprinkled with water, after which it is rolled until a smooth, hard surface is formed. Such roads are from six to twelve inches

Courtesy of the National Paving Brick Mfg. Ass'n, Cleveland, Ohio

FIG. 106. *Laying a brick road.*

thick. They cost from three thousand to six thousand dollars per mile, but intelligent farmers realize that such tax money is well invested.

Brick Roads. It is said that the best road material to resist the wear of automobiles is brick. Brick pavements cost considerably more than the macadamized road, but they are more satisfactory in many ways. They last longer, they require less repair, and they are not so dusty. In many places, as in Cleveland, Ohio, the brick pavements are being extended from the city limits to the county line, where the adjoining county is planning to take it up and extend the road to other cities. (Figs. 101, 102, 106.)

The Draft on Different Surfaces. How much a team can pull depends upon the firmness and smoothness of the roadbed and the grade. A load that three horses can just pull on level, hard asphalt, would require seven horses on smooth block pavement, fourteen horses on cobblestone, forty horses on an ordinary country earth road, and eighty on a sandy road. This shows the need of hard roads.

QUESTIONS

(1) In how many ways do good roads assist the farmer? (2) How do they encourage sociability? (3) What effect do roads have upon schools? (4) What advantages have centralized schools over the one-room country school? (5) Why are city people interested in good roads? (6) Should city people be required to pay taxes to build country roads? (7) How did the Romans build such fine roads? (8) In what two ways are road taxes usually paid? (9) Which way is the better, and why? (10) What is an inexpensive way to surface a clay road? a sandy road? a loam road?

CHAPTER XXIV

PRESERVING FOODS

Germs which Help and Hinder. The farmer's wife has her problems of canning fruits and preserving foods. It is a help to her to know the enemies she must fight and the harm they do. There are three living organisms that will cause animal or vegetable matter to decay. These are yeast, molds, and germs, or bacteria.

The Yeast Plant. In order to grow, the yeast plant must have warmth, air, moisture, and sugar. This plant grows and divides into two plants, and these divide again and so on. Thus this tiny plant multiplies amazingly in a short time. It will grow in fruit juice and in fruit slightly sweetened, but it will not grow in thick sirups or preserves. It is easily killed by a high or low temperature.

Making Bread. A small amount of yeast is put in the dough to make it "rise" for bread. When sugar is added, the plants increase in great numbers in a few hours. They start the decay of the mixture and create a gas which forms bubbles throughout the mass, and these make the bread rise. When the bread is baked the yeast plant is killed by the heat, and the gas escapes.

Mold. Mold is spread about by tiny spores or seeds floating in the air. When they lodge on a

warm, moist surface, such as foods, they readily germinate and spread over the surface. Molds may be destroyed by heating to a high temperature for about twenty minutes. Canned and preserved fruits are more liable to be injured by yeast and mold than by bacteria.

Canning Fruit. The important things to remember in canning and preserving are to keep all cooking utensils clean and to kill all germs. This we call sterilizing. The kettles, jars, strainers, covers, rubbers, and other utensils used in canning, must be scalded to kill the germs, or bacteria. When all germs in the jars and fruit are killed, the cans are sealed while hot so as not to permit other germs from the air to enter. If live germs are left in canned fruit, a gas will escape which means that decay or decomposition has set in, and the food has begun to spoil. Foods and other organic matter will not decay if germs are kept out.

Bacteria. Bacteria multiply rapidly in meat, milk, and legumes. They cannot grow without the presence of water. Dried fruits and meats will keep because there is no water in which the germs may grow. Neither can bacteria live in a strong solution of common salt. That is why we salt meat to preserve it.

Smoking Meats. Meats are also preserved from germs by smoking. Smoking leaves a thin coat of creosote on the surface of the meat, which not only kills all germs but gives the meat a good flavor.

Certain kinds of wood smoke give the best flavor, though any wood may be used for the purpose.

Cold Storage. Putting foods in cold storage does not kill the bacteria, but it keeps them from growing and multiplying. As soon as the temperature rises, they begin to act and the food soon spoils.

Preserving Fruits. Sugar is used somewhat in curing meats and very extensively in preserving fruits. When fruits are cooked for a long time the "boiling down" kills all germs and drives off the water so that other germs can not grow.

Souring of Milk. It is also germs that cause milk to sour. The air contains many germs, the dust of the barn is full of them, and there are some on the milk pail and on the hands of the milker. So it is impossible to keep germs from milk. All milk cans should be scalded after using and, if possible, placed in the sunlight, which is a powerful enemy of germs.

Bacteria in Butter and Cider. Germs or bacteria make butter rancid. This can be prevented by working out of the butter all the milk and water which bacteria need to thrive and by thoroughly mixing salt into it. It is bacteria that makes cider turn sour and ferment. The solid, slimy mass known as the "mother of vinegar" is merely a vast colony of bacteria. Sweet cider makes the best vinegar because it contains more sugar for the bacteria to work upon. The process of making vinegar from new cider may be hastened by introducing some "mother of vinegar."

CHAPTER XXV

FARM SANITATION

Location of the Farmhouse. The farmhouse should, if possible, be located near the center of the farm so as to save the farmer's time in going to and from his fields. But the health of the family must have first consideration, and the home ought to be on high, well-drained ground away from marshes, swamps, and stagnant ponds. If the country is hilly, the south slope may be chosen for the house, because it is somewhat shielded from cold north winds and because the south slope affords more sunlight, which is the greatest friend of health and the greatest enemy of germs.

Dry Surroundings. The yard should be graded in such a manner as to turn all surface water away from the house, not only for health's sake, but for cleanliness, as mud and dampness about the house make the task of cleaning, fall heavily on the housewife. Farmers can easily learn to make cement walks to connect the house with the other farm buildings. Damp cellars cause mildew, and the decay of vegetables stored there sends a moldy, disagreeable odor over the whole house. The cellar should be light and ventilated by open windows, covered in summer by coarse netting to keep out flies and mosquitoes. The mosquito that carries the

malaria germ will breed in any damp corner of the cellar unless it is screened.

Shade. Trees are very desirable about the home, but they should not be so dense as to shut out sunlight, nor should they be too close, because leaves will fall in the house gutters.

Water Supply. One of the richest blessings of any farm is good, pure drinking water. It is of the greatest importance that wells are carefully covered over and that no surface water is allowed to run in over the unguarded edges. Surface water is always more or less dangerous, because it may carry a small amount of sewage which contains the typhoid germ. After water has soaked through a few feet of earth it is said to be filtered and free from germs. Every well or cistern should be provided with a modern pump. The old-fashioned bucket is a danger to health, since careless people drink directly from it, perhaps leaving disease germs in the vessel which endanger others. Cistern water is more liable to contain disease germs than that from wells, because the water comes from house gutters, where in dry weather many germs are carried by the wind. Although many of these are killed by sunlight, those that escape are carried into the cistern.

Sewage a Source of Disease. Surface streams are most to be feared. If they have passed close to neighboring houses and their outbuildings, the water should never be considered drinkable without having first been boiled or filtered. Water may

look clear and pure and yet be dangerous to health. The thing that most often pollutes water supplies is sewage. Sewage is the term given to house refuse such as grease, soap, and human waste. It has in it millions of microbes or bacteria, some of which, if taken in drinking water, cause typhoid fever, others the cholera. Typhoid is one of the leading causes of death in our country, and it is caused by drinking water or milk polluted by sewage.

River Water. A river which has passed many towns in its course is not a safe water supply. Rivers will purify themselves if the water is allowed to run many miles without receiving a fresh supply of sewage, but when they have been the receiving place for the sewage of many cities the water becomes so laden with deadly bacteria that epidemics of typhoid have been known to break out in several towns along the stream at the same time.

Mosquitoes. Mosquitoes are troublesome and dangerous pests which carry the germs of human disease. Malaria is spread by mosquitoes, and in no other way. The malaria microbes are taken into the system of the mosquito with the blood sucked from people troubled with disease. In the body of the mosquito, the malaria microbe undergoes a change that is necessary to its life, so if all mosquitoes were destroyed, malaria microbes could not thrive and spread. When the mosquito attacks a well person, some of the microbes pass from it to the human system as the insect sucks the blood.

Yellow fever is also spread by a certain kind of mosquito which is common in our Southern states. By destroying the water breeding places, the yellow fever has been stamped out of such cities as New Orleans. Mosquitoes on the farm may be disposed of by draining pools of standing water so the pest cannot multiply. Large ponds may be covered with oil so the "wigglers" which hatch into mosquitoes can not get air at the surface of the water. Barrels or other vessels filled with water must be emptied or covered with oil.

The House Fly. The eggs of flies are laid in wet, decaying refuse, such as manure, slop, dead animals, garbage, and human waste. The eggs hatch into maggots which feed upon these materials and grow rapidly. Then they cover themselves with a leather-like case and are quiet a few days, after which they come forth as full-grown flies. It requires only a few days for the egg to grow into an adult fly. A few flies live through the winter, and these start broods in the early spring. By the end of summer there are flies without number.

Flies as Disease Carriers. Flies carry upon their feet and mouths the germs of disease. They visit all sorts of filthy places to lay their eggs and afterwards approach our kitchens in search of food, and wherever they crawl they scatter disease germs. The house fly has been called the typhoid fly.

Fighting Flies. There are two ways to protect the family from flies. One is to clean up all garbage

piles and filth where flies breed and to sprinkle diluted carbolic acid about such places frequently. Carbolic acid drives away the flies and kills many typhoid and other disease germs. The other remedy is to screen the house thoroughly, especially the

FIG. 107. *A sanitary dairy barn.*

kitchen and living rooms. No house is complete until it is fitted with screens.

Milk a Germ Carrier. It is known that milk spreads diphtheria and tuberculosis as well as typhoid fever. The typhoid germs are in the water in which the cans are washed. The ceiling of the cow stable should be dust-proof and the floor cement, so it may be washed often. Some apparently

healthy cows have tuberculosis and in many places where milk is sold to cities the cows are examined and tested for this disease.

Ventilating the Barn. The average barn is not very tightly built and plenty of air enters for the stock through the cracks, but the newer barns are now built tight and warm, and in this case some means should be planned to ventilate, because bad air is the cause of the spread of tuberculosis among cows as well as among the human family. Window ventilation is far better than none, but the cold draft should not strike the cows and other stock. (Fig. 107.)

Cold Air Heavier than Warm. Every boy and girl knows that cold air is heavier than warm air and so the warmest air in the room is always near the ceiling. One reason smoke goes up the chimney is because it is carried up by warm, light air, while heavy, cold air is crowding in to take the place left by the warm air.

Best Barn Ventilation. The best way to ventilate any building, home, school, or barn that must be kept warm is to take out the colder air near the floor instead of the warm air near the ceiling. For this purpose there should be an air shaft leading from near the floor to the roof to carry out the air.

Home Ventilation. The best way to heat and ventilate a home is probably the hot-water system, placing the radiators in each room near the wall. Behind each radiator is an opening through the

wall. The outside fresh air comes in through the radiator that warms it. Beside the chimney are air vents leading from points near the floor of the room to the attic. The cold air of the room enters these air vents near the floor and passes to the attic, where openings lead to the outside. The heat of the chimney keeps the air vents warm, causing them

Courtesy of the Smith Heating Co.

FIG. 108. *A well-ventilated country school.*

to draw the colder air out of the room like another chimney. The hot pipes that extend to radiators on the second floor might be arranged to extend up the other air vents, heating the air and sucking the cold air out of other rooms. Each bedroom should be well ventilated either by an air vent along the chimney or by an open window. Bedrooms ought never to be less than ten by twelve feet, with a ceiling not lower than eight feet.

School Ventilation. These same principles of ventilation apply to schoolhouses. Where the

schools are consolidated in one large central building the fan system to drive the air in and out is the best in use. There are now excellent ways of heating and ventilating one-room schools without opening windows, and no country schoolhouse can afford to be without such a moderate priced blessing. (Fig. 108.) The illustration shows a heating and ventilating system where the fresh outside air passes in near the furnace and is warmed. It then circulates as the arrows indicate. The cold, foul air near the floor is drawn out by the opening into a separate chimney flue at the floor level. The best way to prevent and to fight tuberculosis, either among cows or human beings, is with plenty of good, fresh fair. Keeping the house and the barn supplied with plenty of fresh air and sunlight is the greatest safeguard to health.

School Lighting. The only *perfect* way of lighting a schoolroom is from the top, which is nature's plan. (Fig. 109.) The children's eyes should be protected from the strong light from side windows, because the eye, like a camera, can adjust itself to but one intensity of light at a time. The strong glaring windows cause the pupil of the eye to close so much as to make all objects in the room look dim and the eyes are strained, trying to see clearly. The only way to secure a well-distributed, even light is from skylights, and country schools, being of one story, can easily be provided with them, and the protection to the children's eyes justifies the cost.

FIG. 109. *The first top-lighted school, River Forest, Illinois. A soft even light. No windows glaring into the children's faces and therefore no eye strain.*

CHAPTER XXVI

THE FARMER'S COLLEGE

Educating the Farmer. When the farmers have good crops, the whole country is happy, and business is good. A crop failure not only harms the farmer, but causes the wheels of industry and business to stop, and the result is hard times. Thus, you see, the entire country is interested in good crops.

The United States Government has become greatly concerned about the farmer's success and has established a college for farmers called the Department of Agriculture. This department is located at Washington, but it has branches in every state in the Union. It is not like the ordinary college, for farmers cannot leave their crops and stock to attend it. The Department of Agriculture has hundreds of learned men studying and experimenting all the time. They are finding out all about soils and farm crops, about animals, their care and diseases, about plants and their enemies. Everything that will help the farmer to raise splendid crops, this college is learning about. And they will send out to any farmer who asks for it, all the wonderful knowledge that has been discovered.

Learning the Best Way. Now, instead of guessing at what is best to do, or depending upon the advice of a neighboring farmer, who may be even

more ignorant than ourselves, we can just drop a one-cent post card in the mail box or post office addressed like this:

The Department of Agriculture,
Washington,
D. C.

We may ask about any crop, or about soils and tillage, or about farm stock and how to raise and feed them, or how to destroy insects. In a few days comes a little booklet to us with all the latest knowledge about the things we are interested in. This college, or department, will even advise about farm buildings, farm machinery, poultry, and many kinds of wild game. If you are planning to build a henhouse, you had better learn the best way, as it costs nothing to find out. For some of these thousands of booklets, prepared for the help of the farmer, a small price of ten or fifteen cents is asked, but the most of them are free. What a wonderful thing it is to have a real education in farming! The Government is spending millions of dollars each year to help the farmer, and thousands of intelligent farmers and their boys are becoming students of agriculture.

Not only will this department help the farmer and his sons with their problems, but the farmer's wife and daughters can get advice about milk, butter, and cheese, about canning fruit and how to preserve food, and about many other problems of the farm home.

Experiment Stations. Besides the Department at Washington, every state has experiment stations where learned men are making tests of crops, animals, and whatever the farmers of that particular state may wish to know. These experiment stations are also kept up with tax money, and the farmers

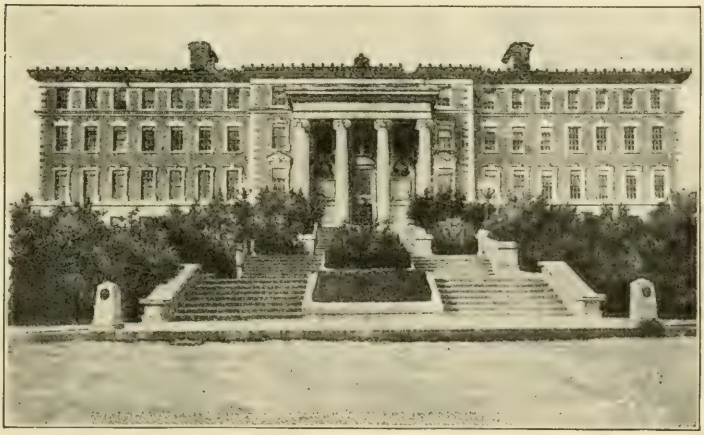


FIG. 110. *College of Agriculture, University of Wisconsin.*

have a right to the knowledge and discoveries made here. Booklets from the experiment stations are mailed free to any one engaged in farming. Should a disease of animals or plants suddenly break out in some community, a man will be sent upon request from the experiment station to advise and show the farmers how to fight the trouble. The farmers of Dakota have gained ten millions of dollars through the secrets learned at the experiment station about grain. We have learned that the Babcock test has

changed the dairy industry of the whole world. Dr. Babcock is one of the clever men who has spent his life helping to solve the farmer's problems in the Wisconsin Experiment Station.

Colleges of Agriculture. If a boy is plucky he will gain much useful knowledge about farming from these booklets. But every state also has its school of agriculture, a real college where farmers' sons gather by the hundreds to study the problems of the farm (Fig. 110). Every young man who is looking forward to the farmer's life should resolve to take a course in such a college, even if it is only for a few months in winter. The farmer of the future will have to know more than those of the past in order to be successful. So one had best prepare well by taking a full course. If, however, a boy cannot be spared from the farm so long, or if he has not the funds to pay his way through a long course, there are shorter courses for him. Many wise farmers, who need their sons through the crop season, are sending them to some College of Agriculture year after year for the winter terms, when they can be spared from the farm. A few winters spent in this way will open the boy's eyes to many interesting and important secrets of success. He will then no longer wish to leave the farm. The farm offers a delightful place on which to live, but in order to be successful one must have good training and good judgment. These, with industry, will bring happiness and prosperity.

CHAPTER XXVII

BOYS' AND GIRLS' CLUBS

More Food Needed. The population of our country is increasing very rapidly, much faster than the production of food; and so the cost of everything we eat is a great deal higher than formerly. Every citizen is, therefore, interested in increasing the farmer's crops by methods of scientific agriculture. Not only are the farmers anxious to improve crops, but business men, journalists, and statesmen are all helping along the movement. People are realizing more and more how closely their living, their prosperity, and their business success are linked with the work of the farmer who produces the nation's food.

The Whole Country Interested. Not only are farm journals teeming with suggestions and advice, but magazines and newspapers of all descriptions are spreading the great truths of scientific tillage and stock-raising. Business men's clubs are offering prizes to boys for the best acre crops, and the champion corn raisers are getting large money prizes and often splendid trips to the state or nation's capital with all expenses paid. President Roosevelt during his term of office appointed a commission consisting of eminent men to study country life and make such recommendations as seemed wise to them.

Agriculture in Schools. The principles of agriculture are rapidly being introduced into the rural schools as part of the course of study. Thirteen states now require the teaching of agriculture in the common schools. It is also encouraged and taught in thirty-one other states, which have not as yet required it by law. This makes in all forty-four states where agriculture is being taught in some measure. Many city schools are also attempting some work in connection with school gardens. (Fig. 97.)

Field Agents. The Department of Agriculture has been studying and investigating for a long time, and they have been sending out millions of copies of pamphlets to any one asking for them. But since so many farmers are not alive to their need for instruction and are not reading these pamphlets, the Department is now sending out expert men as field agents (Fig. 111) to meet the farmers and to encourage them to form for their own improvement such organizations as cow-testing associations and the like. For boys there are Cotton Clubs, Corn Clubs, and numerous others; while for girls there are such organizations as the Girls' Garden Clubs and Tomato Canning Clubs. (Fig. 112.)

Club Movement Spreads. The club movement among country boys and girls has grown in a remarkable way. At the close of June, 1913, there were 60,000 club members doing the regular club work of raising a crop under the special instructions

furnished by the Department of Agriculture. Aside from the clubs already mentioned are Good Roads Clubs, Poultry Clubs, Vegetable Garden Clubs, Sugar Beet Clubs, and Father and Son Clubs.

Boys' Corn Clubs. The Corn Club idea started in the South in this way. The boys of a county

Courtesy of U. S. Dept. of Agriculture

FIG. 111. *Mr. O. H. Benson, specialist in charge of National club work, conducting a School of Instruction in Home and School Canning Methods.*

were invited to join such a club and were assisted in forming the organization. During the winter they held meetings and studied the pamphlets received from the Department at Washington. These gave them information about selecting seed and fertilizer, and how to plant, cultivate, and harvest the crop.

Courtesy of U. S. Dept. of Agriculture

FIG. 112. *Play and contest a part of the game in National club work. (Grading: Skill, 30%; speed, 30%; weight of peeling, 40%; Total, 100%.)*

In the early spring the boys selected seed and tested its power to grow, or germinate, by taking a few kernels from each ear of seed corn.

The Crop. Then each boy was allowed an acre of ground and expected to keep a careful account of the money spent on his crop in labor and fertilizer. Even when he did the work himself he charged ten cents an hour against his crop and five cents an hour for each horse used. The rental value of the land was placed at $5 per acre and that, too, was charged against his crop, while for each load of manure another $2 was charged.

Net Profit. When the crop was sold, the lad deducted from the amount of money he received for

it, all the cost of raising, which included labor, fertilizer, and other expenses. What was left after this subtraction was clear gain or net profit, as business men call it.

Growth of Corn Clubs. Corn Clubs have been organized in large numbers in the Southern and Central states, and they are doing a splendid work for every county in which they are found. The boys are opening the eyes of their parents and neighbors to the wonderful increase in the crop when some attention is given to scientific culture. (Fig. 113.)

Courtesy of U. S. Dept. of Agriculture

FIG. 113. *A Wisconsin club winner and his prize bushel of seed corn.*

The 1912 Crop. For the season of 1912 the average yield of all the Corn Club members who reported to the Office of Farm Management was 74.5 bushels per acre. Fifteen club members made a yield of 140 or more bushels per acre. Sixty-one boys made over 120 bushels an acre. The average net profit an acre of all club members reporting was $25.55.

Illinois. The average yield of Corn Club members from Illinois was 79 bushels per acre, but eighty-six members made over 100 bushels an acre. There were more than 5,000 members in that state alone and $2,000 was given out as premiums to the high score boys.

Indiana, Kentucky, and Ohio. Indiana, with 3,000 members, grew an average of 78 bushels per acre. It is said that the work of the club members in Kentucky contributed $10,000,000 to the wealth of that state. One boy in West Virginia grew 140 bushels, while four others raised 120 bushels or more. Ohio members who reported averaged 94½ bushels per acre.

Father and Son Clubs. In Kentucky there are many Father and Son Clubs in which the father raises ten acres of corn alongside the son's one acre, and both follow the same careful instructions in selecting seed, planting, and cultivating. The champion father and son of that state in 1912 were Herman Gallrein and his son, Edward G. Gallrein, aged fourteen. The son raised 146 bushels and 36 pounds of white corn on his acre and his clear profit was $67.32. The father grew ten acres of the same kind of corn on land adjoining the boy's one acre; and his average per acre was 139 bushels and 45 pounds, which brought a net profit of $69.91 per acre. Both cultivated their crops eight times, the first being a rather deep cultivation, while the seven others were shallow.

Potato Clubs. Cumberland County in East Tennessee has a schoolboys' Potato Club, that has taught the farmers of that section an important lesson. It had been supposed that potatoes were not a profitable crop in that state. It was claimed that the cost of raising an acre of potatoes there, includ-

Courtesy of U. S. Dept. of Agriculture

FIG. 114. *Idaho boys and girls receiving field instructions on the diseases of the potato.*

ing labor, fertilizer, and the rent of the land, was about $75 per acre, while the crops raised hitherto at the rate of fifty cents a bushel brought a return of only $40 an acre. But the Boys' Potato Club told a different story. One lad raised on one acre 384 bushels and his net profit was $78. Another boy raised 379 bushels which gave him a net gain of

$111. Each of these lads received a $40 prize. There will now be more attention given to potato raising in East Tennessee. (Fig. 114.)

Tomato Canning Clubs. The Girls' Canning Clubs are also doing splendid work in many counties, especially in the Southern states. They are usually organized by women field agents from the Department at Washington. Each club member receives instructions about growing and canning vegetables, especially tomatoes. (Fig. 115.) They are learning to can this vegetable so it will keep; they are learning to make excellent catchup, chow-chow, chili-sauce, and other relishes. Many fine recipes are sent to them from Washington. They are also taught how to market their goods to the best advantage.

Girls' Profits. The Virginia girl who made the best record for high yield in tomatoes in 1912 obtained 5,928 pounds of tomatoes from her tenth of an acre plot in that season. Many girls have made a profit of over $100 from their tenth-acre plots with one crop. One Mississippi girl is paying her way through the State Normal School by canning work.

Prize Winning Girls in Washington. During four or five days of December, 1913, fifteen girls, one from each of the Southern states, had a free trip to Washington as a prize for high class work in tomato canning. They were the fortunate winners from 25,000 girls who were enrolled in the canning clubs during that year. The prizes and trips are not

furnished by the Government, but by public spirited people,—bankers, business men's organizations, and women's clubs.

Seeing the President. For several years the state champion corn raisers have had the free trip to Washington. The winners of the several counties had their exhibits displayed at the county fairs,

Courtesy of U. S. Dept. of Agriculture

FIG. 115. *An Ohio girl in her Tomato Club plot.*

and the county winners were met by the state governor and the high score boys were sent off with much applause to the nation's capital. They have usually visited the Secretary of Agriculture and called on the President at the White House. They have been everywhere treated as distinguished visitors. On one occasion they were invited to meet

the Committee on Agriculture of the House of Representatives, and the chairman of that committee declared the boys' and girls' clubs movement to be the best work the Department of Agriculture had ever attempted.

Getting Information. It is impossible in this short chapter to give all the information necessary to form any club, but all one wishes to know may be obtained from: Office of Farm Management, Department of Agriculture, Washington, D. C.

The Club and School. These clubs are the very best way of connecting the work of the country schools and the farm home. Parents and teachers are working together in this movement. Since the teacher is likely to be crowded with her work of teaching reading, arithmetic, and the other important subjects that the children must know, she cannot do very much experimenting in school hours in the way of agriculture. So the club which meets after school, in the evenings or on Saturdays, is the best means of teaching good practice in agriculture and home canning. In this way the entire neighborhood is receiving instruction. Our Government realizes that the future of American agriculture is largely dependent on the boys and girls of to-day, and it is the purpose of this club movement to assist in instructing and directing the youth of our villages and rural communities so that they will appreciate the fact that farming is a dignified, important, and profitable life work.

PART III

APPENDIX

EXERCISES—PROBLEMS—EXPERIMENTS

THE HORSE

(Chapter 1)

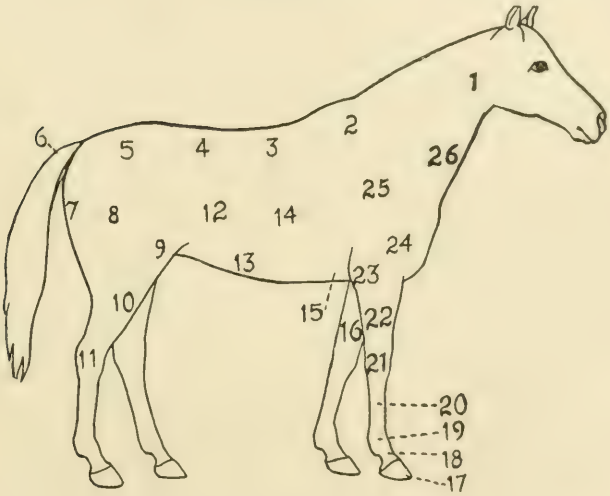


FIG. 116. *Diagram of a Horse*

1, *Neck; 2, Withers; 3, Back; 4, Loin 5, Hip; 6, Dock; 7, Gaskin; 8, Quarter; 9, Stifle;, 10 Thigh; 11, Hock; 12, Flank; 13, Belly; 14, Ribs; 15, Chest; 16, Wart; 17, Hoof; 18, Pastern; 19, Fetlock; 20, Cannon-bone; 21, Knee; 22, Arm; 23, Forearm; 24, Breast; 25, Shoulder; 26, Throat*

1. Copy the above figure.
2. Close your book and name the parts of the horse.
3. If possible, have a horse brought to the school grounds and have a contest in naming the parts of his body.

4. (a) Make a study of the horses of your neighborhood. (b) How many on each farm? (c) What breed? (d) How many farmers have horses from blooded stock? (e) Show what the increase of profits might be from breeding from pure bred sires over grade sires. (f) Make a list of the most common defects of horses. (g) Watch for them along the road.

5. Observe a number of horses to see if they have properly shaped legs. Note the proper forms in the illustrations below.

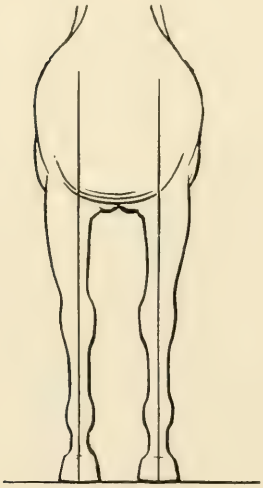


FIG. 117. *Front Legs*

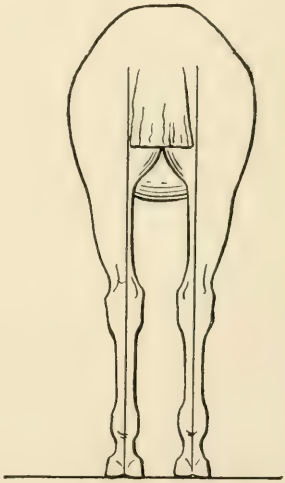


FIG. 118. *Hind Legs*

6. If a horse's steady pulling power is 1/10 of his weight, what is the steady pulling power of a team weighing 2,800 lbs?

7. The draught of a loaded wagon varies with dif-

ferent road surfaces and according to the width of the tire and the height of the wheels. The draught on hard, level dirt roads with high-wheeled wagons was found by test to be 69 lbs. per ton of load. How many tons could two 1,500 lb. horses draw steadily on such roads if the pulling power of each horse was 1/10 of his weight? Ans. —4.35 tons.

8. The draught of the same wagon on gravel roads with one inch of sand on top was 85 lbs. per ton of load. How many tons could the same team draw steadily over such roads pulling as in Exercise 5? Ans.—3.5 tons.

9. The draught of the same wagon on wet sod land was 170 lbs. per ton load. How much could the same team, pulling as in above exercise, draw over such ground? Ans.—1.76 tons.

10. Copy the drawings below. Examine horses until you find the wide and the narrow hock.

FIG. 119. *Wide Hock.*
This horse endures great labor with little fatigue.

FIG. 120. *Narrow Hock.*
This horse is easily fatigued.

11. Send to the Agricultural College of your state for score cards for judging horses. Ask some farmer who is a good judge of horses to appear at school with a horse and assist you in this matter.

12. Train for contest in knot-tying. See Pages 12-13.

Send to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: Principles of Horse Breeding, No. 170; Horse Shoeing, No. 179. Farmers' bulletins are mailed without charge.

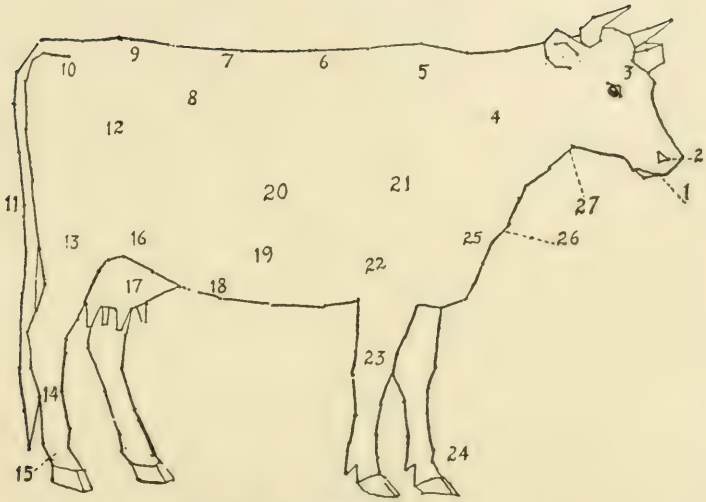


Fig. 121 Diagram of a Cow

1, Muzzle; 2, Nostrils; 3, Fore-head; 4, Neck; 5, Withers; 6, Back; 7, Loin; 8, Pinbone; 9, Rump; 10, Hips; 11, Tail; 12, Quarters; 13, Thigh; 14, Cannon; 15, Fetlock; 16, Flank; 17, Udder; 18, Milk Veins; 19, Belly; 20, Ribs; 21, Shoulder; 22, Fore Arm; 23, Knee; 24, Pastern; 25, Brisket; 26, Chest; 27, Throat.

1. Copy the above illustration.

2. Close your book and name the parts of the cow from your drawing.

3. Study the markings of different breeds and learn to name them at sight.

4. Do your state laws require the tuberculin test for dairy herds? Have the herds in your neighborhood had

the test? What are the symptoms of tuberculosis in cows?

5. Is your barn kept light, clean, and well ventilated?

6. Ask some farmer who is a good judge of cattle to show the class how to judge a fat steer or a dairy cow. Send to your state agricultural college for score cards for judging beef and dairy cattle.

7. Learn the parts or cuts of a side of beef as given in the illustration.

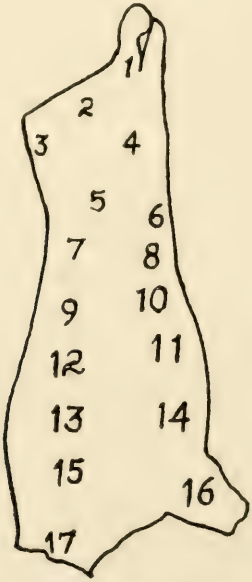


Fig. 122. A Side of Beef

1, Leg; 2, Mouse Buttock; 3, Rump; 4, Round; 5, Sirloin, 6, Veiny Piece; 7, Porterhouse (including tenderloin); 8, Thick Flank; 9, Fore Rib; 10, Thin Flank; 11, Brisket; 12, Middle Rib; 13, Chuck Rib; 14, Shoulder; 15, Clod; 16, Shin; 17, Neck, or sticking-piece.

The Babcock Milk Test

8. The value of a dairy cow may be known from two factors: (1) the amount of milk given and (2) its richness in butter-fat. The amount of milk is determined by weighing, while the butter-fat may be found from the Babcock test. Have some pupil bring a sample of milk taken immediately after the milking is done and after the milk has been poured two or three times from one vessel to another so as to mix it thoroughly.

For testing butter-fat you need the following:

(a) A Babcock Tester,
(b) Two or three milk test-bottles,
(c) A pipette to measure the milk,
(d) A small glass measure for acid,
(e) A pint bottle of Sulphuric Acid,
(f) Hot water,
(g) A few ounces of milk to be tested.

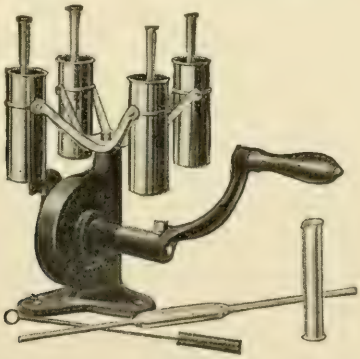


Fig. 123. *A Babcock Milk Tester*

[Equipment may be obtained from A. FLANAGAN COMPANY, CHICAGO. Four Bottle Milk Tester, $5.00. Four Bottle Milk and Cream Tester, $5.50. Weight boxed, 17 lbs. Transportation charges additional.]

Follow these directions carefully:

(a) Stir milk thoroughly before taking sample. This is best done by pouring milk gently back and forth several times between two vessels so the cream, or fat is evenly mixed.

(b) With the small end of a pipette suck up the milk above the mark on the tube. Then close upper end with your forefinger, releasing finger slowly to allow the milk to fall until it stands just even with the mark 17.6 cc., being careful to hold the pipette straight up and down.

(c) Empty the pipette into the test bottle and blow to drive out all the milk.

(d) Fill the acid measure with sulphuric acid to the mark shown and put this into the test bottle with the milk. Remember the acid must be handled with care. If any gets on hands or clothing it should be washed off quickly with water.

(e) Shake the bottle to mix milk and acid thoroughly.

(f) Place bottles (several tests may be made at once) in the machine and whirl five minutes. The bottles should be hot when whirled; they may be placed in hot water before being used. For whirling place bottles opposite one another in the machine to keep balance.

(g) With pipette or other means add hot water to each bottle until filled to the bottom of the neck and whirl two minutes.

(h) Add more hot water to bring the contents nearly to the top of the marks on the neck of the bottle, and again whirl one minute.

(i) Hold bottle upright on a level with the eye and read the marks at the extreme top and bottom of the fat

column. The difference between these readings is the percentage of fat in the milk. There are five small spaces between each two of the per cent marks. Each small space represents .2%. Thus, if the fat column runs even with the fourth short mark above 7, its reading would be 7.8%.

(j) Empty and wash test bottles.

9. The test will show the per cent of butter-fat. It should run between three per cent in poor dairy cows and six or seven per cent in very fine dairy stock. To find the amount of butter-fat in a gallon of milk, multiply 8½ lbs. by the per cent found in the test. (Milk varies in weight according to the amount of butter-fat.)

10. How many pounds of butter-fat in 4,000 lbs. of milk that tests 4%?

11. How much less butter-fat if the milk tests 3%?

12. A cow gives an average of 18 lbs. of 4% milk per day for 300 days each year. What income does she yield annually with butter-fat at 25 cents a pound?

13. A dairy farmer has two cows each producing 6,000 lbs. of milk a year. The Babcock test shows the milk of one cow to contain 3%, and the other 6½% of butter-fat. What is the difference in income from the two cows when butter-fat averages 27 cents a pound?

14. A certain farmer kept ten pure bred Guernseys, each of which produced daily, 30 lbs. of 6% milk. The production of this herd always declined during July and August on account of flies to an average of 25 lbs. daily. By spraying his herd regularly to ward off flies the farmer kept the herd up to its daily amount of 30 lbs. What was the money saved in the two summer months by spraying when butter-fat was 22 cents a pound?

Send to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: Some Essentials in Beef Production, No. 71; Dehorning of Cattle, No. 350; Exterminating the Texas Fever Tick, No. 498; The Babcock Milk Test.

MILK AND BUTTER

(Chapter 3)

1. Fat and Butter. The churn collects fat globules into butter, which is then worked and salted. Thus there is left in the butter some water, salt, milk, sugar, and casein. So the fat when churned and made into butter produces 1/6 more butter by weight than the fat content of the milk or cream. Add 1/6 of the weight of the butter-fat to the butter-fat to find the weight of the butter.

2. From 360 lbs. of butter-fat, how many pounds of butter can be made? Ans.—.420 lbs.

3. If 2 cents a pound would cover the expense of making butter, would it pay better to sell butter-fat to the creamery at 23 cents a pound or to make it into butter and sell it at 28 cents a pound? (Remember to add 1/6.)

4. A certain Jersey cow yielded in a year 6,000 lbs. of milk that tested 5.8% butter-fat. At 28 cents a pound what was the value of the butter (not butter-fat) which she produced?

5. Skim milk from setting in shallow pans or crocks, contains about .8% butter-fat, while skim milk from the separator contains about .05%. How many pounds of butter-fat are left in 1,200 lbs. of skim milk from shallow pans? From separator?

6. If a farmer produces enough milk daily for 110 lbs.

of skim milk from shallow pans, how much would he save in the year if he bought a separator costing $75?

7. If possible get a worn out cream separator and bring it to school. Each boy in the class should take it apart and put it together again.

8. If you live in a dairy section, visit a creamery and observe methods and machinery used.

Send to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: The Dairy Herd, Its Formation and Management, No. 55; Dairying in the South, No. 151; Buttermaking on the Farm, No. 241; Bacteria in Milk, No. 348; Tuberculin Test of Cattle for Tuberculosis, No. 351.

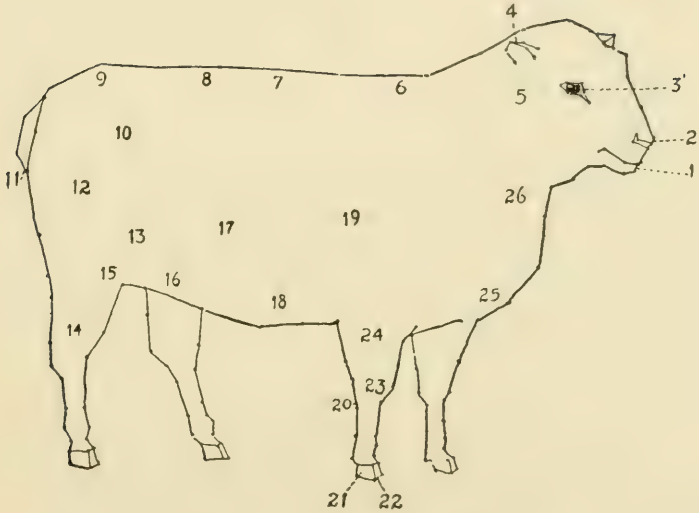


FIG. 124. *Diagram of a Sheep*

1, Muzzle; 2, Nostril; 3, Eye; 4, Ear; 5, Throat; 6, Withers; 7, Back; 8, Loin; 9, Rump; 10, Angle of Ilium; 11, Tail or Dock; 12, Hip Joint; 13, Flank; 14, Hock Joint; 15, Stifle Joint; 16, Belly; 17, Side or Barrel; 18, Girth Measure; 19, Forearm; 20, Shoulder; 21, Ankle; 22, Claw; 23, Knee; 24, Elbow; 25, Chest; 26, Neck.

1. Copy the above figure.

2. Close your book and name the parts of a sheep from your drawing.

3. If it costs 25 cents per rod to build a fence suitable for cattle, and 50 cents per rod to build a fence for

sheep, what is the additional cost to fence a square 10-acre field for sheep?

4. Mention some of the advantages, aside from the money income, in having sheep upon your farm?

5. A farmer buys 80 sheep at $6.25 each. What was the total cost?

6. At shearing time they average 7¼ lbs. of wool each. How much is the total amount of wool worth at 22 cents per pound?

7. From the eighty sheep the farmer raises 75 lambs worth $5 each. What is the total income from the herd for lambs and wool?

8. Study the sheep raising industry of your neighborhood as follows: (a) How many sheep on each farm on the average? (b) What breed? (c) Are they raised chiefly for wool or for mutton?

9. Compare the labor and profit of caring for five dairy cows with that for thirty head of sheep.

10. Debate: Resolved: That it would be profitable to extend the sheep raising industry of this community.

11. Collect a number of woolen fabrics for a contest in judging how many are all wool. Test by burning with a match threads of the warp and woof separately. Woolen threads fry and show grease oozing out while cotton threads blaze up brightly.

12. Show how to keep an account of a flock of sheep giving cost of food and care and also income.

Write to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: Raising Sheep for Mutton, No. 96; Sheep Feeding, No. 49; Angora Goats, No. 137; Scab in Sheep, No. 159.

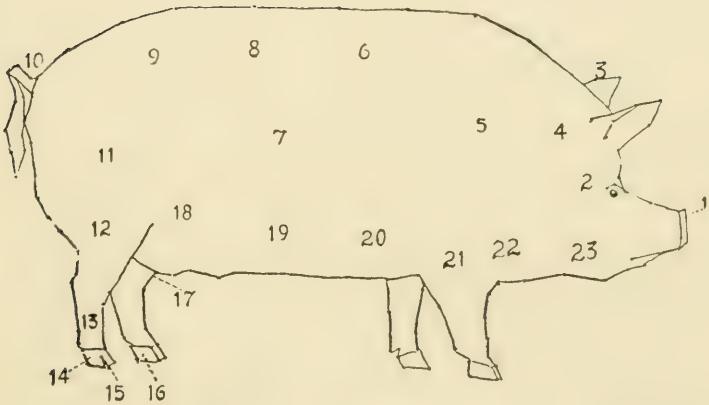


FIG. 125. *Diagram of a Hog*

1, Snout; 2, Eye; 3, Ear; 4, Neck; 5, Shoulder; 6, Back; 7, Side; 8, Loin; 9, Rump; 10, Tail; 11, Ham; 12, Hock; 13, Hind Leg; 14, Dew Claw; 15, Pastern; 16, Foot; 17, Stifle; 18, Hind Flank; 19, Belly; 20, Fore Flank; 21, Fore Leg; 22, Breast; 23, Jowl.

1. Copy the above illustration.

2. Close your book and name the parts of the hog from your drawing.

3. Make a list of the hogs on your own farm. Have your father give you the value of each. What different breeds are on your farm?

4. Do you try to feed balanced rations? If so, how do you mix the feed?

5. What are some of the advantages or disadvantages of raising hogs in your community instead of sheep or cattle?

6. Find the value of a hog weighing 245 pounds at $6\frac{1}{4}$ cents a pound.

7. A sow has nine pigs in a litter. When eight months old the pigs weigh 210 pounds each. What is the weight of all and what are they worth at $6\frac{1}{4}$ cents per pound?

8. If a bushel of corn costing 50 cents will produce 10 pounds of pork, how much does the feed cost for one pound of pork?

9. If it requires 8 pounds of ear corn to make one pound of pork, how many pounds of pork will 80 bushels of ear corn make? (70 pounds per bushel.) How much will the pork be worth at 8 cents per pound?

10. If the corn in the above problem costs 50 cents per bushel, find the profit from feeding.

Write to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: No. 100; No. 133; No. 205; No. 272.

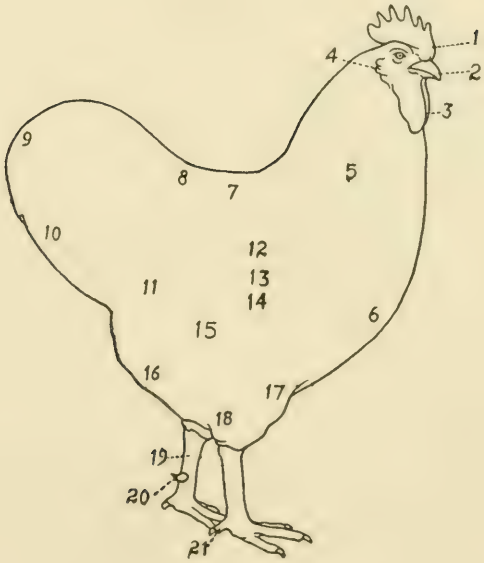


FIG. 126. *Diagram of a Chicken*

1, Comb; 2, Beak; 3, Wattles; 4, Ear; 5, Hackle; 6, Breast; 7, Back; 8, Saddle; 9, Sickles; 10, Main Tail Feathers; 11, Saddle Feathers; 12, Wing-Bow; 13, Wing-Bar; 14, Secondaries, wing-bay; 15, Primaries or flight feathers; 16, Fluff; 17, Thigh; 18, Hock; 19, Shank or Leg; 20, Spur; 21, Toe or Claw.

1. Copy the above illustration.
2. Close your book and name the parts of the chicken from your drawing.

3. How to test infertile eggs:

Place a small lamp or lantern in a box with a small hole in the top for draft. Cut another hole a little smaller than an egg in the side of the box, just opposite the flame of the lamp. Take this apparatus into a dark room and hold the egg against the opening in front of the flame. As the light shines through, the infertile egg—that is the one that will not hatch—will appear clear. The fertile egg will show a net work of threads running out from the center and floating about as the egg is turned. A number of hens should be set at the same time and after or about the sixth day all the eggs should be tested and the infertile ones removed; then one or more of the hens may be released and the fertile eggs distributed among the other hens.

4. Make a candler test apparatus like that above and bring to school. Bring fresh and stale eggs from home to be tested. If the eggs are fresh the air cell in the end of the egg should be no larger than a dime, the contents should look opaque, the yoke scarcely visible and free from any discoloring, the white should be thick and compact, and the yolk should be stationary—not floating about. In order to obtain the highest prices, eggs should be uniform in shape and color with a smooth shell that is free from spots and clean without having been washed.

5. Learn the U. S. Government's rules for profit in eggs as given below:

(a) "Keep the nests clean; provide one nest for each four hens.

(b) Gather the eggs twice each day.

(c) Keep the eggs in a cool dry room or cellar.

(d) Market the eggs at least twice a week.

(e) Market or confine all male fowls as soon as the hatching season is over.

6. If each of 100 hens averages 90 eggs a year, what is the income from the flock with eggs at 20 cents a dozen?

7. How many bushels of shelled corn will it buy at 45 cents a bushel? Of wheat at 70 cents?

8. If it takes 12 bushels of corn at 50 cents a bushel, 5 bushels of oats at 30 cents, and $7.50 worth of other feed to keep this flock for one year, what is the net profit?

9. At 18 cents a pound, what should be received for 80 hens weighing 6½ pounds each?

10. The farmers of a community market all their eggs together. If each farm produces 30 eggs per day, how many farms will be needed to fill 7 cases a week, each holding 30 dozen?

Write to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: No. 51; No. 64; No. 186; No. 200.

BIRDS

(Chapter 10)

1. Make a list of birds you can name at sight. What do you know of the feeding and nesting habits of each of these?

2. Make a list of the birds that remain over winter in your neighborhood. What birds migrate? Where do they go, and why?

3. Keep a watch for birds that you do not recognize and take notice of their habits. Get a bird book and see if you can identify them.

4. Make a list of birds that search for food on the leaves of trees; of birds that catch flying insects; of birds that search for insects in the bark of trees; of birds that eat weed seeds.

5. If the damage done by insects in your community is 30 cents an acre, how much would that amount to on your farm?

6. If there are four birds on every acre, how many birds would there be on your farm? In your township?

7. If each bird eats 50 insects a day, how many insects would be destroyed in your township during the months of June, July and August?

8. If 30,000 insects fill a peck measure, how many pecks of insects would the birds of your township eat during the three summer months?

9. Read Longfellow's poem entitled "The Birds of Killingworth."

[Colored pictures of all birds can be obtained from the publishers of this book—A. FLANAGAN COMPANY, CHICAGO. Size 7x9 inches. 2 cents each.]

Send to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: Some Common Birds and Their Relation to Agriculture, No. 54; Our Grosbeaks and Their Value to Agriculture, No. 456; Food of Some Well Known Birds of Forest, Farm, and Garden, No. 506; Fifty Common Birds of Farm and Orchard, No. 513.

SOIL

(Chapter 11)

1. Weigh a quart fruit can full of rich black soil. Dry thoroughly by holding over a fire, being careful not to burn, and then weigh again. The difference is the weight of the water content of the soil. What per cent of the soil is water?

2. Place the soil in a pan and burn it. Cool and weigh again. The loss in weight is the humus or organic matter of the soil. What per cent is organic matter? The portion remaining is the mineral matter. What per cent is mineral matter?

3. Fill three small flower pots with finely pulverized soil, one with clay, one with sand and one with loam. As you weigh these add enough to make them weigh the same. Pour water slowly into each pot until the soils are thoroughly wet and the water begins to run out at the bottom. Then weigh the pots of wet soil, and find which is holding the most water. Which soil took in the water the quickest? Which the most slowly? In case of heavy rain, which soil would absorb the greatest amount of water? Notice which flower pot continues to drip the longest and which drains the most rapidly. What bearing does this experiment have on farming?

4. Break bottoms from three large vinegar bottles of uniform size. Fill one with loam, one with clay, and one with sand. Tie a cloth over the mouth of each bottle and place in a rack as shown in Fig. 127 so that the ends

reach down into tumblers of water. Fill each tumbler to the same height. Note the rise of the water in the different soils, the height, and the time it takes. In which soil does the water rise most rapidly? In which to the greatest height? This power of soil to draw water from below is called capillarity and the water is called capillary water. What lesson on farming do we learn from this experiment?

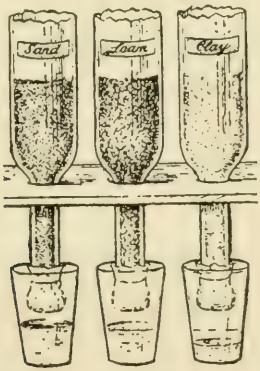


Fig. 127. *Action of Water in Soil*

5. Fill three bottles to the depth of about one inch with clay, sand, and loam. Then completely fill all three bottles with water and shake thoroughly. Set the bottles in a quiet place and let their contents settle. Observe which soil settles to the bottom most quickly, keeping a record of the time required for the water to become clear in each bottle.

6. Crumble a piece of clay into fine particles. Do the same with loam and with sandy soil. Which soil,

in your opinion, will be the most satisfactory under tillage?

7. Many soils contain acid, and so certain crops such as clover and alfalfa will not grow well in them. Bury a small piece of blue litmus paper, which you can secure from the druggist, in moist soil obtained two or three inches under the surface from different parts of your field. Allow it to remain five minutes. If the paper turns red the soil is acid and needs lime. Use this litmus paper test on the different fields of your farm.

8. Is the manure on your home farm collected under cover upon a water tight floor? What advantage has this method over that of leaving manure in the barn yard?

9. What fertilizers are used on your farm? How much is applied per acre and what is the cost? What is meant by 8-3-3 fertilizer?

10. Make a ball of wet clay and leave it to dry. Make another ball of clay mixed with sand and one of clay mixed with a little lime. How do these three balls compare? What lesson do we learn from this experiment?

11. Fill two large pails or cans with moist soil. Shake down well by jarring the vessel. Weigh each one and place in a dry place for a week. Leave one undisturbed, but keep a mulch on the other by stirring it well each day to a depth of two inches. At the end of a week weigh both pails. Which has lost the greater amount of moisture? What lesson do we learn from this?

Write to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: No. 44; No. 187; No. 192; No. 245.

PLANTS

(Chapter 12)

1. Place a moist blotter or cloth upon a plate containing several radish seeds. After a few days observe the delicate root hairs on the roots of the germinating seeds.

2. Place a few grains of corn on a piece of marble slab and cover them with soil two inches deep. After ten days remove the plants and wash the marble. Notice that the roots have dissolved a little of the marble. This is done by means of carbon dioxide, which is supplied from the roots.

3. Fill two tin cans with the same kind of soil after driving several small holes in the bottom of one of the cans. Plant seed at the same depth in each and add water until the soil is thoroughly moist. After several days observe in which can the seeds have germinated more quickly. What was wrong with the other can that the seed did not germinate so well?

4. In two tin cans with holes in the bottoms place the same amount of soil and plant seeds. In one can add much water and puddle the soil around the seeds. Moisten the soil in the other can and keep it loose and mellow. When the plants have begun to grow, what difference do you observe?

5. Plant tomato seeds in a small box of soil and keep it in a warm room. Fill a number of small paper boxes with soil at the same time, and plant two or three tomato seeds in each. After the plants come up in the paper

boxes remove all but one from each box. When the proper garden planting time comes, place the paper boxes in the ground without disturbing the tomato plants. At the same time, transplant an equal number of tomato plants from the wooden box. What differences do you notice in the results from the two methods?

Write to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: Testing Farm Seeds in the Home and the Rural School, No. 428; School Garden, No. 218; Tomatoes, No. 220; Home Vegetable Garden, No. 255; Celery, No. 282; Onions, No. 354; Canning Vegetables in the Home, No. 359; Cabbage, No. 433.

FARM MACHINERY

(Chapter 13)

1. Make a list of the different kinds of plows, harrows, reapers and planters. Which of each kind do you think the best, and why?

2. Have some farm machine or implement, such as a plow, brought to school. Take it apart and set it up again, examining construction of each part.

3. Learn these rules for the care of farm machinery:

(a) Never leave a machine or tool in the field to rust.

(b) As soon as you are through with a tool or machine for the season, clean, oil, and place under shelter.

(c) All implements and vehicles must be kept oiled.

(d) Every farmer should have a tool kit and should repair machines promptly.

CORN

(Chapter 14)

1. On a glass or cup of water place a blotter and over it place a small strip of cloth so that it extends down into the water. This acts as a lamp wick and draws up the water to keep the blotter moist. On the blotter place several grains of corn and cover with another blotter. Keep in a warm place and observe from day to day the sprouting of the corn. Observe the root hairs. How many temporary roots are there?

2. In a tall pot or jar, plant five grains of corn at each of the following depths: one, two, four, and six inches. Place them in a warm room and keep moist, but not too wet. From day to day note the growth at each depth, both the temporary and the permanent roots. Observe the time it takes for the plants to come up from each depth.

3. Test some seed corn as follows:

Fill a box three or four inches deep and a foot square with sand. Across the top place a cloth on which squares have been drawn three inches each way and numbered, 1, 2, 3, etc. Number several ears of corn, one for each square. Take six grains from each, and place them in the corresponding squares. Take the kernels from different parts of the ear, but not from the base or tip. Cover them with another cloth and two or three inches of sand. Keep moist and warm. If the grains of all the squares

do not sprout well within four or five days, the ears of the corresponding numbers should be discarded from your seed corn supply.

4. In testing your father's seed corn, a box thirty-six inches square and three inches deep will enable you to test much more rapidly.

5. Kernels for planting should be of uniform size so that the planter will drop the same number regularly. Shell the kernels from the tip, the butt, and some from the middle of the ear and keep them in separate piles. Place three grains from the middle of the ear on a sheet of paper close together. Draw a circle around them with a pencil as closely as possible. Remove the grains and place three from the butt or from the tip in the same circle. Do they fill the circle? What bearing does this have upon the corn planter?

6. If a farmer increases his crop of corn six bushels per acre by careful selection of his seed, how much more income would he get from 45 acres when corn sells at 50 cents per bushel?

7. If a bushel of seed corn will plant 7 acres, what is the cost per acre when seed corn is $2.00 per bushel?

8. If corn is planted in check rows 3 feet, 8 inches apart each way, how many square feet does each hill of corn occupy? How many hills on an acre?

Answers: 14 4/9 square feet; 3,240 hills.

9. If 6 of the 10 kernels taken from an ear of corn that is being tested grow, what per cent does the ear germinate?

10. Twenty full sized ears of corn will usually plant one acre. If 2 of the ears will not grow, what per cent of the corn will be missing in an acre? In your field?

11. An acre was planted with 20 ears of corn, five of which did not germinate. The acre produced 30 bushels of corn. What would it have produced if all the seed had grown?

12. A farmer increased his crop of corn 15 bushels an acre by testing the seed. What will be his additional income in 5 years on 40 acres with corn at 50 cents a bushel?

Write to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: Silos and Silage, No. 32; Production of Good Seed Corn, No. 229; Germination of Seed Corn, No. 253; Food Value of Corn, No. 298; Harvesting and Storing Corn, No. 313; Corn Harvesting Machinery, No. 303; Corn Cultivation, No. 414; Seed Corn, No. 415; Corn Culture in the South, No. 81.

WHEAT

(Chapter 15)

1. Make a collection of the most common kinds of wheat and place a sample of each in a small bottle, properly labeled.

2. Plant about thirty grains of wheat in a pan of earth. At the end of each week take out two or three of the sprouting grains and make drawings of the roots.

3. Mustard may be destroyed in grain fields with a 20% solution of iron sulphate, costing about 90 cents per hundred pound sack. 100 pounds dissolved in 50 gallons of water will make a 20% solution which is enough to spray 1 acre. What is the cost of solution needed to spray 60 acres of wheat?

4. If a team travels 15 miles a day drawing a spraying machine that covers a strip 16 feet wide, what will be the cost per acre for labor if the man, team, and machine are worth $4 per day?

5. How many pounds of wheat (60 lbs. to the bushel) are produced on 12½ acres yielding 20 bushels per acre?

6. If 7/10 of wheat is starch, how many pounds of starch are there in 30 bushels of wheat?

7. If it takes 4.77 bushels of wheat to make one barrel of flour, how many barrels of flour can be made from a 30 acre field of wheat, harvesting 15 bushels to the acre?

8. If wheat for seeding contains 1/20 weed seed how much land will a farmer sow to weeds if he plants 60 acres to wheat?

POTATOES

(Chapter 16)

1. Bring some sprouting potatoes to school and place them in a warm, moist place. Observe the sprouting of the eyes.

2. Cut a potato in about one-half as many pieces as it has eyes. Plant these in a box of earth or in the ground and pull up a plant every few days to observe the growth of roots and tubers. How long after planting do the young tubers start?

3. If it takes 200 gallons of Bordeaux mixture, costing $1.50, to spray one acre of potatoes once, and it takes two applications to cure the blight, what is the cost of the mixture for spraying 10 acres of potatoes for the season?

4. How many bushels of potatoes worth 60 cents a bushel will be needed to pay the extra cost of spraying?

5. If an acre of potatoes yields 110 bushels, what is the value of the crop at 40 cents per bushel?

6. If a potato farmer gave his crop careful attention it would cost him $25.00 per acre to grow potatoes. What is the net profit per acre if the yield is 110 bushels worth 40 cents a bushel?

7. Potatoes are usually planted in rows 3 feet apart with hills 16 inches apart in the row. How many square feet of ground does each hill occupy? How many hills will there be in an acre containing 43,560 square feet?

8. John Robbins raised 3,000 bushels of potatoes and was offered 40 cents a bushel for them in November. After storing them through the winter, he sold them at 75 cents per bushel. If the potatoes shrank 1/10, what was his gain by keeping them over winter?

9. At another time John stored his crop of 3,000 bushels rather than sell them for 50 cents per bushel. The following spring he was forced to sell his crop for 40 cents per bushel. What did he lose if they shrank 1/10?

10. Hold a potato paring contest among the girls of the class, weighing the parings and the peeled potatoes.

Write to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: Potato Culture, No. 35; Potato as a Truck Crop, No. 407; Potatoes and Other Root Crops as Food, No. 295.

FRUIT

(Chapter 20)

1. Visit a fruit grower if possible and ask him to show you how to graft a scion of one tree to the stock of another. Learn also how to remove a bud from a branch and attach it to the branch of another tree.

2. Bend to the ground a branch of a grape vine or of a black raspberry vine. Cover part of it with several inches of soil, but leave several inches of the end of the branch above ground. After a few weeks see if the buried branch has taken root. If so, separate it from the old plant by cutting.

3. Weigh two apples of about the same size separately. Peel one and leave the other unpeeled. Weigh each apple the next day. Which has lost more in weight, and why?

4. Have an apple paring and an apple coring contest among the pupils, weighing the apples before and after.

5. Try at home to can windfall apples as follows: "Peel, core, and slice; scald 1 minute in boiling water; plunge in cold water. Pack in glass or tin and add about one teacup full of hot thin syrup to each. Put on rubber and top and partially tighten. Sterilize 16 minutes in hot water. Remove, tighten covers, and invert to cool."

6. What will it cost to set out a young apple orchard of 10 acres square, with trees costing 25 cents each, if the trees are planted in squares 36 feet apart?

Write to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: No. 33, No. 113, No. 154.

OATS

(Chapter 21)

1. Make a collection of specimens of fine grades of oats and place them in bottles properly labeled.

2. Plant twenty-five or thirty grains of oats and after a week dig up a few of them and observe the temporary roots. How many are there? After another week has elapsed dig up other plants and observe the growth of permanent roots. Continue this observation at intervals of a week and make drawings.

3. A farmer threshes 1,200 bushels of oats. In each bushel there are 4 pounds of weed seed. What per cent of his crop is weeds? How many pounds of weed seed does he gather?

4. If it requires 4 pounds of twine per acre, costing 15 cents per pound, to tie up grain, how much does it cost to tie up the weeds in a 20 acre field, if 1/12 of the crop is weeds?

5. If formaldehyde costs fifty cents per pint and a pint will treat 40 bushels of oats, how much will it cost to treat the seed oats on 30 acres, sowing 3 bushels to the acre?

BOYS' AND GIRLS' CLUBS

(Chapter 27)

1. In 1913 Walker Dunson of Alabama led the corn club boys in the crop of that year. He raised 232 7/10 bushels on one acre at a cost of only 19 9/10 cents per bushel. What was the net profit on his acre with corn selling at 50 cents a bushel?

2. Jerry Moore, a former corn champion of South Carolina, raised 228 75/100 bushels at a cost of 42 cents per bushel. If each crop sold at 50 cents per bushel, which had the greater profit?

3. The ordinary yield of tomatoes is about 8 tons per acre. The best culture secures 18 tons per acre. If the canning factory pays $8.50 a ton, how much greater is the income from 3½ acres of tomatoes given the best culture than that from the same acreage given ordinary treatment?

4. Merle Hyer of Lewiston has the world's record potato yield—764 bushels per acre. It cost him $60.00 and his net profit was $398.00. What was the selling price per bushel?

Write to the Department of Agriculture, Washington, D. C., for the following farmers' bulletins: No. 104; No. 154; No. 155; No. 218; No. 255; No. 521; No. 803.

NOTE.—For Agricultural Club Organization Blank Forms, address
DEPARTMENT OF AGRICULTURE
Bureau of Plant Industry
Office of the Farm Management—Club Work
Washington, D. C.

EVERY GIRL SHOULD KNOW HOW TO REMOVE STAINS

Tar or Wagon Grease. Cold soapsuds will remove most stains if used before the garment is dipped in hot water. For pitch stains, grease with lard before using soap and water. Turpentine will remove all such stains.

Grass. Remove grass stains when fresh if possible. Alcohol, naphtha soap and water, or ammonia and water will remove grass stains.

Ink. Wet the spot with warm water, apply sapolio, and rub gently between the hands, or wash in a solution of hydrochloric acid and rinse in ammonia water.

Mildew. Mix equal parts of soft soap and starch, half as much common salt and the juice of half a lemon, spread over the spots and lay the article on the grass for twenty-four hours or until the stain disappears.

Blood Stains. Fresh stains may be rubbed out after soaking in cold or tepid water. If very dry, use javelle water or peroxide of hydrogen. Kerosene in water will remove obstinate stains. Articles that cannot conveniently be washed, may be cleaned by making a paste of bulk starch and cold water, spreading on thickly and drying in the sunlight. When dry brush off and repeat process.

Iron Rust. Apply salt and lemon juice to the dampened spots and place in the sun or near the fire. Rinse thoroughly.

Fruit Stains. Pour boiling water over the surface, having it fall from a distance of three feet, or wring article out of cold water and hang out of doors on a frosty night.

If obstinate, diluted muriatic acid, javelle water, or sulphur fumes are good.

Meat Juice. Hot water will set the stain. Soak in cold water, wash in suds of cold water, and rinse in cold water.

Paint Spots. Equal parts of ammonia and turpentine will remove paint stains of long standing.

Tea, Coffee, or Cocoa. Wash in cold water, cover with glycerine, and let stand two or three hours; wash with cold water and hard soap. If stains are fresh, pour boiling water through from a height after soaking.

Perspiration. Soak in cold water, wash with borax, and expose garment to sunshine. Stains under the arms require an acid, such as a weak solution of muriatic acid.

Burned Cooking Utensils. To clean granite ware where mixtures have been burned on. Half fill with cold water, adding any good soap or washing powder; heat water gradually to the boiling point.

INSECTICIDES AND FUNGICIDES

For Biting Insects—Poisons.

1. **Arsenate of Lead.**

   Arsenate of lead.....2 to 3 pounds
   Water, or Bordeaux, or lime-sulphur.....50 gallons

Arsenate of lead is found on the market both as a powder and as a putty-like paste. The paste must be worked free in water before it is added to the lime-sulphur mixture or to the Bordeaux mixture. The paste form of the poison is used at the rate of two or three pounds to each fifty gallons of the liquid and is added to it after it has been well dissolved in water.

2. **Wet Paris Green.**

Paris green	¼ pound
Lime	½ pound
Water	50 gallons

If the above amount of Paris green is to be used with fifty gallons of Bordeaux mixture the half-pound of lime should be omitted.

3. **Dry Paris Green.**

Paris green	1 pound
Powdered lime	20 pounds

For Sucking Insects.

4. **Kerosene Emulsion.**

Strong hard soap, shaved fine	½ pound
Water	1 gallon
Kerosene or crude petroleum	2 gallons

The soap should be dissolved in the water by boiling, remove from the fire while still boiling hot and at a safe distance from the fire add the oil, stirring violently until it is thick like cream. If it is well made it will keep indefinitely and may be diluted when needed for use. During the growing time of summer, for plant lice and other soft-bodied insects, dilute the emulsion with fifteen parts of water; for the red spider and other plant mites, the same, with the addition of one ounce of flowers of sulphur to the gallon; for scale insects, the large plant bugs, and larvæ, dilute with from seven to ten parts of water. Apply with a spray pump.

5. Bordeaux Mixture—Used as a Fungicide to Prevent Diseases.

Copper sulphate (bluestone)	6 pounds
Unslaked lime	4 pounds
Water	50 gallons

Dissolve the copper sulphate at the rate of one pound of copper to a gallon of water. Slake the lime until it is thick like cream. This is a stock solution and may be kept covered until needed.

6. Lime-sulphur—to Kill San Jose Scale and Prevent Disease.

Powdered flowers of sulphur	15 pounds
Burned lime	15 to 20 pounds
Water	50 gallons

Add the wet sulphur and the slaked lime to ten gallons of boiling water. Boil for an hour or until well dissolved. Add water to make fifty gallons.

FERTILIZERS FOR DIFFERENT CROPS

THESE FORMULAS MUST VARY ACCORDING TO THE SOILS

Field Corn.

Ground bone	250 pounds
Acid phosphate	500 pounds
Muriate of potash	250 pounds

Apply 200 to 300 pounds to each acre on manured soils; 300 to 500 pounds on medium soils without manure. Increase nitrogen for forage corn or ensilage.

Oats.

Nitrate of soda	150 pounds
Tankage	200 pounds
Acid phosphate	600 pounds
Muriate of potash	50 pounds

Apply on good soils, 200 to 300 pounds to an acre; 300 to 500 pounds per acre on medium soils with manure.

Wheat.

Dried blood	150 pounds
Tankage	100 pounds
Acid phosphate	700 pounds
Muriate of potash	50 pounds

Apply same as oats.

Early Potatoes.

Nitrate of soda	100 pounds
Sulphate of ammonia	100 pounds
Tankage	100 pounds
Acid phosphate	500 pounds
Sulphate or muriate of potash	200 pounds

Apply from 500 to 1,200 pounds per acre.

Sweet Potatoes.

Tankage	300 pounds
Dried blood	100 pounds
Acid phosphate	400 pounds
Muriate of potash	200 pounds

Apply from 500 to 800 pounds per acre.

Early Tomatoes and Market Garden Crops.

Nitrate of soda	250 pounds
Ground bone	100 pounds
Acid phosphate	550 pounds
Muriate of potash	100 pounds

Apply 800 pounds per acre.

Timothy Hay, Top Dressing.

Nitrate of soda	500 pounds
Ground bone	200 pounds
Acid phosphate	200 pounds
Muriate of potash	100 pounds

Apply 200 to 300 pounds per acre.

REFERENCE BOOKS FOR TEACHERS

First Principles of Soil Fertility. A. Vivian ($1.00), Orange, Judd Co.

Bacteria in Relation to Country Life. J. G. Lipman ($1.50), Macmillan.

Cereals in America. T. F. Hunt ($1.75), Orange, Judd Company.

Forage and Fiber Crops in America. T. F. Hunt ($1.75), Orange, Judd Co.

Manual of Gardening. L. H. Bailey ($2.00), Macmillan.

The Principles of Fruit-growing. L. H. Bailey, ($1.50), Macmillan.

The American Apple Orchard. F. A. Waugh ($1.00), Orange, Judd Co.

The Potato. S Frazer ($1.75), Orange, Judd Co.

Feeds and Feeding. W. A. Henry ($2.00), W. A. Henry, Madison, Wis.

Types and Breeds of Farm Animals. S. C. Plumb ($2.00), Ginn and Co.

AGRICULTURAL BULLETINS

Each school may secure a good library of agricultural bulletins at small expense. Write to the Secretary of Agriculture, Washington, D. C., asking that your school be placed on the mailing list to receive the monthly list of bulletins. Ask also to have sent one copy of each of the following:

Circular No. 4, Division of Publications.
Farmers' Bulletin Subject Index.
List of Publications for free distribution.
List of Publications for sale.

Those pamphlets on the list for free distribution will be sent to any one for the asking. Those listed for sale may be purchased at slight cost, or perhaps some of them may be secured through your Congressman. Write to your State Experiment Station (See p. XXV) for the list of state bulletins for free distribution and ask to have your name placed on their mailing list. A few of the many farmers' bulletins to be obtained from the Secretary of Agriculture are given below.

Horse, Nos. 170, 222; Cattle, 106, 71, 233; Milk and Butter, 55, 42, 63, 251; Swine, 100, 133, 205, 272; Poultry, 51, 186; Turkeys, Ducks, and Geese, 64, 200; Insects, 127; Bees, 59, 397; Birds, 54; Soils, 44, 187, 192, 245; How Plants Grow, 157; Corn, 199, 229, 253, 313, 409; Potato, 35; Hay, 89, 339; Orchards, 87, 113, 283; Gardens, 154, 218, 255; Sanitation, 155.

Quantity of Seed per Acre and Legal Weights per Bushel

Alfalfa	30 lbs.	60 lbs.
Barley	8 to 10 pks.	48 lbs.
Blue Grass	20 to 25 lbs.	14 lbs.
Buckwheat	3 to 5 pks.	48 lbs.
Clover	10 to 15 lbs.	60 lbs.
Corn, shelled, check row	6 to 8 qts.	56 lbs.
Corn, ensilage	10 qts.	
Cotton, upland	4 to 8 pks.	32 lbs.
Cowpea	4 to 7 pks.	60 lbs.
Oats	2 to 3 bu.	32 lbs.
Potato	6 to 18 bu.	60 lbs.
Rye	3 to 8 pks.	56 lbs.
Timothy	10 to 20 lbs.	45 lbs.
Wheat	6 to 9 pks.	60 lbs.

Weights in second column vary slightly in some states.

Distances Apart for Planting Fruit and Vegetables

	Feet		Feet
Apples	30-40	Cabbage	2-3
Apricots	15-20	Carrot	1.5-2
Cherries	15-25	Corn, sweet	3-3.5
Oranges	25-30	Celery	3-4
Peaches	15-20	Lettuce	1-2
Pears	20-30	Onion	1.5-2
Plums	15-20	Parsley	1-2
Quinces	10-12	Peas	1-3
Blackberries	4.5-7	Potato	2.5-3
Currants	4-4.5	Radish	1-1.5
Gooseberries	4-4.5	Rhubarb	4
Raspberries	3.5-5	Salsify	1.5-2
Strawberries	1-4	Squash and pumpkin	6-8
Asparagus	3-4	Turnip	1.5-2
Beans, bush and pole	2-4	Tomato	3-4
Beet	1.5-2		

LOCATION OF STATE EXPERIMENT STATIONS

Any letter addressed to the "Experiment Station" with proper post-office address will reach the institution.

Alabama—Auburn or Uniontown or Tuskegee.
Arizona—Tucson.
Arkansas—Fayetteville.
California—Berkeley.
Colorado—Fort Collins.
Connecticut—New Haven or Storrs.
Delaware—Newark.
Florida—Gainesville.
Georgia—Experiment.
Hawaii—Honolulu.
Idaho—Moscow.
Illinois—Urbana.
Indiana—Lafayette.
Iowa—Ames.
Kansas—Manhattan.
Kentucky—Lexington.
Louisiana—Baton Rouge.
Maine—Orona.
Maryland—College Park.
Massachusetts—Amherst
Michigan—East Lansing.
Minnesota—St. Paul.
Mississippi—Agricultural College.
Missouri—Columbia or Mountain Grove.
Montana—Bozeman.
Nebraska—Lincoln.
Nevada—Reno.
New Hampshire—Durham.

New Mexico—Agricultural College.
New York—Geneva or Ithaca.
North Carolina—Raleigh.
North Dakota—Agricultural College.
Ohio—Wooster.
Oklahoma—Stillwater.
Oregon—Corvallis.
Pennsylvania—State College.
Rhode Island—Kingston.
South Carolina—Clemson College.
South Dakota—Brookings.
Tennessee—Knoxville.
Texas—College Station.
Utah—Logan.
Vermont—Burlington.
Virginia—Blacksburg.
Washington—Pullman.
West Virginia—Morgantown.
Wisconsin—Madison.
Wyoming—Laramie.

The United States Department of Agriculture is located at Washington, D. C. Address the Secretary of Agriculture.

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All figures refer to pages; heavier type is used for the more important references