AGRICULTURE

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A modern farm scene and community with consolidated rural school and principal's home in the foreground.

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A Text for the School and the Farm

By

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and

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BETTER RURAL SCHOOLS, ETC.

WITH ILLUSTRATIONS, CHARTS AND DIAGRAMS

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"I know of no pursuit in which more real and important service can be rendered to any country than improving its agriculture."

George Washington

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PREFACE

The present volume attempts what has not yet been accomplished in elementary texts on agriculture—to give not only class-room lessons and instruction but definite suggestions and outlines in both methods and agencies of extension education by *combining practical information with concrete home and school projects to be carried out by the pupils.* Agriculture, of all subjects, can not be taught wholly from within a text-book. Nor, on the other hand, can it be well taught by the teacher who is not a specialist without a *good text-book* by means of which to unify the instruction and lead to an intelligent interest in the farm and its problems. Unless the pupils busy themselves with actual agricultural activities, the study becomes mere theory and of doubtful value. This text is a guide to concrete work and interests of farm, garden and the home.

Yet the text is more than a laboratory guide. It gives a large amount of practical, scientific information wholly without technical terms. Further, this information is always so immediately related to definite farm projects as to have meaning and application. Scientific facts and their use go hand in hand. Theory and practise are never divorced. The old maxim, "Learn to do by doing," is constantly followed, and the doing made natural and worth while to the child by being connected with his home interests.

Hardly a day's assignment occurs in the book, therefore, that does not present some real project for the pupils to carry out in connection with the farm or home life. Nor are the problems assigned the child without the information or guidance necessary to their intelligent solution. The required facts, principles and descriptions are always at hand, and the problem or project made the means of teaching some valuable lesson in concrete form. No other subject now taught in our schools needs more definite direction and assignments than does agriculture.

The authors believe that the elementary features of agriculture can be successfully taught without technicalities. It has been their aim to present a treatment so clear that children from fourteen to sixteen years of age could read and profit if necessary without a teacher. They have also tried to make the subject-matter so vital and helpful that all who are interested in agriculture, even practical farmers, will *care* to read it, and desire to carry out its lessons in practise.

Teachers will recognize and welcome the attempt to use the study of agriculture in bringing about a closer relation between the school and the home. Not only teachers, but county superintendents and agricultural agents and leaders will appreciate the many helpful suggestions concerning Demonstration Days, Play Contests and Agricultural Club Projects; for these are coming to occupy an important place in agricultural education. The great amount of care given to make the lessons *teachable* through the outlining of many definite and practical laboratory, field and home projects will appeal to all who use the text, and save much time for the busy teacher.

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PART I. FARM CROPS

CHAPTER I

CORN CULTURE

IN the middle western states corn has long been king of farm crops, while cotton has been called the king of crops in the South. The recent extension of the corn belt into the South and even into the West adds still further to the importance of corn. The corn crop of the United States equals in value that of cotton, wheat and oats combined, and totals over a billion dollars a year.

The greater corn belt of the United States consists of Illinois, Iowa, Nebraska, Missouri, Kansas, Indiana and Ohio. These seven states have up to the present raised about half of the world's crop of corn. The average yield in these states is about 40 bushels to the acre, while the average yield for the entire country is less than 30 bushels to the acre.

1. *Corn Culture in the South*

During the last ten years the cultivation of corn as a staple farm crop has made rapid advance in all the southern states. The subtropical climate, the favorable soil, the long seasons for maturing, and the copious rainfall make the southern states admirably adapted to the growing of corn.

Corn an aid to diversified farming.—Corn is perhaps the most favorable crop to use as a basis for diversified farming and crop rotation. First of all, it pays. It also encourages the raising of stock. And its cultivation serves to clear the soil of weeds and other plant enemies.

Success of southern corn club boys.—The wonderful opportunities for profitable corn growing in the South are seen in the success of corn club members in various states. In all cases the corn has been raised under actual field conditions, but in accordance with scientific methods of farming. Each of five hundred southern corn club boys has made over 100 bushels on his acre. Sixteen of these boys who lived in the cotton states made their acres yield more than 200 bushels. The same year 65 boys in Mississippi averaged 109.9 bushels to the acre. In Alabama 92 boys raised 5,791 bushels of corn on 92 acres. In North Carolina 100 boys averaged 99 bushels to the acre. In the same state 432 boys averaged 63 bushels. In Virginia 16 boys averaged 82 bushels. In Georgia the 10 highest boys in the club averaged 169.9 bushels. In Tennessee 15 boys made an average yield of 127.4. The same year the champion corn grower of Arkansas made 141⅝ bushels to the acre. The champion in Oklahoma made 80⅞ bushels. The champion corn club boy of South Carolina made 228 bushels of corn to the acre. The champion of West Virginia made 150 bushels to the acre. One of the champions of Florida raised over 100 bushels to the acre. The champion of Texas made 110½ bushels. All of these yields were made at a substantial net profit per acre. Surely with such records as these it is clearly evident that corn can be made a highly profitable crop in the southern states.

Corn roots at time for last plowing. The stalks are about 5 feet high and stand 3½ feet apart. Note how all the intervening space is filled with roots.

2. *The Corn Plant*

Corn belongs to the "grass" family; that is, it is a member of the same group of plants as timothy, wheat, rye, or blue-grass. In order to study the corn plant itself, each member of the class will secure from a near-by field, or bring from home, a complete stalk of corn, taking care to save as much of the root system as possible. Then use the text as a help in studying the plant.

The roots.—Examining the roots, do you find them tough and fibrous, or tender? Do the roots branch, or is there a central tap root? At earing time the roots of a vigorous plant may extend down several feet, and spread out so that they meet the roots from other hills.

The stem and leaves.—How long is the stem? What is its girth just above the root? How many leaves has it? From where do these start? How are they attached? Are the edges of the blades longer than the center? What proof have you?

The leaves are important in the growth of the plant, since in them the plant food is worked over and assimilated, and through them the respiration, or breathing, of the plant is done. The leaves are large, and hence have to stand much tugging in the wind. Are they stronger because of their sheath-like form of attachment? Will they tear as easily in a strong wind if the outer edges are slightly longer than the center?

Tassel and silk.—Strip the husks carefully from an ear in the milk stage, without injuring the silks. How many silks are there? Where are the silks attached to the ear?

While tassel and silk are borne on different parts of the plant, yet it takes both together to make the complete flower of the corn and produce the ear. The tassel represents the male part, and the silk the female part of the flower.

The work of the tassel is to produce *pollen*. This sifts off in fine grains just as the corn is silking. A particle of pollen lodges on the tip of a silk, and a growth is carried through the center of the tiny thread to its root, where the kernel forms. The pollen in this way *fertilizes* the silks, one silk for each kernel of corn. If for any reason no fertilization occurs, no kernels will be formed.

Record of Stand of Corn

PLOT NO. ——

The pollen grains are very light, and may be carried by the wind for many rods, thus fertilizing the silks of other plants than their own. This is called *cross-fertilization.*

Have you ever seen an ear with part of the kernels white and the rest red or yellow? How is this to be explained? A small patch of popcorn planted near field corn turned out badly mixed, although the seed used was pure. How do you account for the mixture?

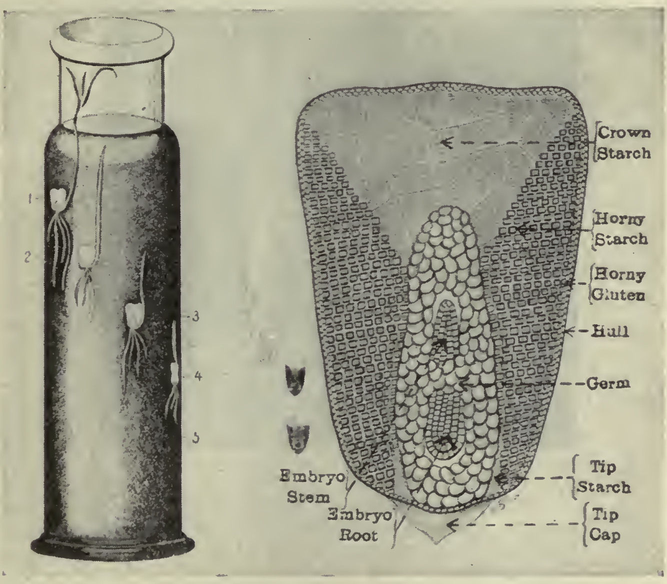
3. *Good Seed*

The first thing necessary to a profitable crop of corn is good seed. Poor seed means a poor stand of corn and many barren stalks. And it requires just as much time and labor and rental for a field of corn that has a quarter

A sample of corn showing good tip ends.

or a third of the hills missing or without ears as for the same field with a perfect or one hundred per cent. stand.

Loss from poor seed.—Let us see what a poor stand means in waste. Corn planted $3\frac{1}{2}$ feet in the row each way has 3,556 hills to the acre. One 10-ounce ear to the hill will therefore yield nearly 32 bushels to the acre (figure this up and prove). But an ear weighing only 10 ounces is considered a small ear. Two medium-sized ears, each weighing 12½ ounces, from every hill, will produce 80 bushels to the acre. Most of the large yields in the South have been made by planting from 3½ to 4 feet apart and then drilling a distance of from 8 inches to 24 inches in the



Demonstrations showing results of planting corn at different depths. Diagram of kernel of corn.

row, planting three or four kernels to the hill and thinning to a stand of two stalks.

Selecting the seed.—Seed corn should be selected in the field and not from the wagon or crib. This is in part because as soon as the seed ear is picked it should be hung where it can dry out well. It is also because in selecting seed much besides the ear itself must be taken into ac-

An illustration of the prolific corn common in the southern states. It will grow 2 to 8 ears of corn on each stalk. It requires a subtropical climate, copious rainfall and a long season.

Stringing seed corn,—the first step. The second step. The string completed.

count. The entire corn plant, stalk, leaves, roots and husk, as well as environment, should be considered. It is plain that ears grown on stalks that stand but one in a hill, or next to missing hills, have a better chance than those that grow in full hills. A large ear grown under such favorable conditions might not produce so well as somewhat smaller ears grown under less favorable conditions. We want to be sure that the ear is good size because of something in *the nature of the ear itself*, rather than from what has happened to it while growing. Mature good ears from stalks with several ears and hills having two or three stalks are desirable, for this condition promises a good yield. The stalk should be good color, short jointed, sturdy, not too tall, and have plenty of broad full leaves.

Caring for the seed.—Caring for the seed after it is picked is as important as its selection. The great thing in caring for seed corn just picked from the field is to keep it free from insects and to give it a chance to dry thoroughly. To do this, it must be where it can get plenty of circulating air. The ears should not touch one another, for then they will not dry evenly. Seed corn should therefore never be stacked in piles or thrown into a crib after it is gathered, but should be hung up in some open place sheltered from the direct sun, and from all rain or other forms of moisture.

4. *Testing the Seed Corn*

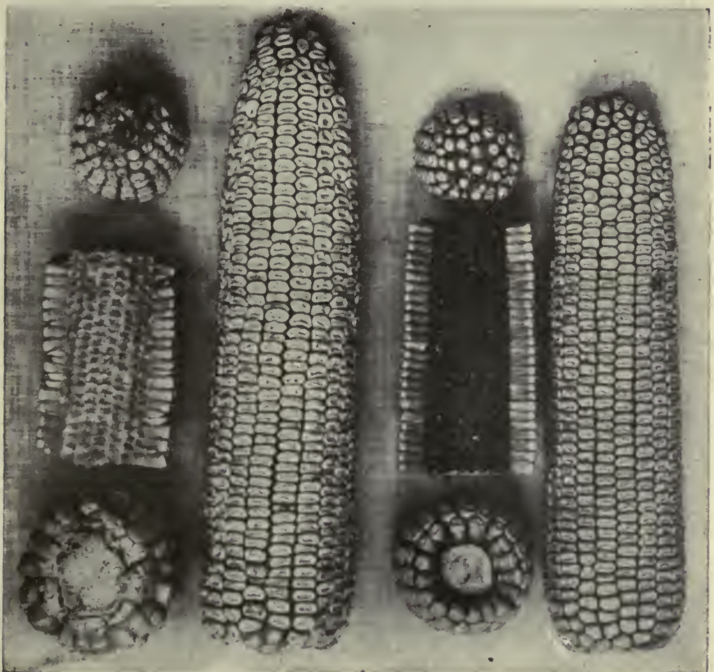
No seed corn should ever be planted that has not been tested ear by ear to see whether it will germinate and produce a strong growth. For, even if the seed is carefully selected and cared for, there are always some ears that will fail to grow, or else produce plants so weak as to be barren or raise but worthless nubbins.

Since it takes but a dozen or fifteen ears to plant an

The blotter seed tester. An excellent type for school use.

Boys and girls bringing corn to school for judging and testing in a Cook County rural school.

acre, and since an acre of average ground should yield at least sixty bushels, each ear of seed represents from four to five bushels of crop. The farmer's time can be spent in no more profitable way than in making sure that every ear of seed corn planted is sure to grow. The testing



A good ear and a poor ear of corn.

should be done late in the winter, or in the early spring before the farm work opens.

Preparing for testing.—Testing the seed corn costs practically nothing but a little time, care and attention. For, while there are several excellent seed corn testers on the market, none is superior to the several types that can easily be made at home. The rag-doll tester can be easily made, takes up but little space and is very convenient for school work in testing of all kinds of seeds.

Another practical tester is the *sawdust germination box.* This tester may be prepared as follows: Construct a box 30 inches square and 4 inches deep. Put some sawdust in a bag and soak it in warm water until it is well saturated. Fill the box half full of the sawdust, packing it in well. Take a piece of good white cloth and rule it off in $2\frac{1}{2}$-inch squares, making 100 squares in all, and numbering them from 1 to 100. Place the cloth on the sawdust so that there will be a margin of at least two inches between the sides of the box and the squares. Tack cloth to the edges of the box.

Now take 100 ears of the corn to be tested and lay them out in a row on a table or planks. Drive a nail into the table every tenth ear, separating the entire lot into 10 groups of 10 ears each. Number the ears from 1 to 100 to correspond with the squares in the tester. This may be done by numbering the places on the edge of the table if care is taken not to change places with the ears.

Making the test.—Remove one kernel from near the butt, one from near the middle, and one from near the tip of the ear; turn the ear over and remove three kernels from corresponding positions on the other side of the ear. These six kernels are to be placed, germ side up and tips all toward one side of the box, in the squares over the sawdust, those from ear No. 1 in square No. 1 and so on, until six kernels have been taken from each of the 100 ears and placed in the tester.

After the kernels are all in position, thus filling the 100 squares, lay a piece of cloth over them, taking care not to disturb their positions. Sprinkle this cloth well with warm water. Now lay over this another cloth about twice the

School testing seed corn in sawdust germination boxes.

Putting the rag dolls into a bucket, which is then wrapped in old newspapers and kept in a safe place until the kernels of corn have sprouted.

size of the box. Fill in on top about two inches of damp sawdust, packing it down very firmly. Then fold the edges of the cloth over the sawdust, covering it so that it will not dry out.

Reading the test.—At the end of the germination period the cover must be removed without disturbing the kernels. This can be done by carefully rolling up the top pad of sawdust in its cloth. The sprouts will be some two inches long, and may in some cases have grown through the first cloth covering.

It is easy now to tell which are the strong, weak or dead seed ears. All ears should be rejected if even *one* of the six kernels failed to sprout. For a loss of one out of six means 16 2-3 per cent. of the crop gone if all ears were of this kind.

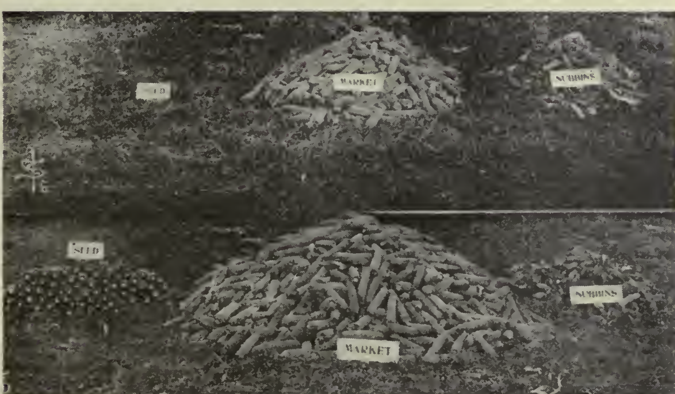
Ears whose six kernels may all sprout, but which start weakly, should also be thrown out. For it is these weak plants that later turn out to be barren, or prove an easy prey to dry weather or some insect enemy. If only those ears are planted whose six kernels all produce strong vigorous sprouts in the germination box, the greatest obstacle in the way of a perfect stand will have been removed.

5. *Seed Bed and Cultivation*

Corn in the South requires a deep and well-prepared seed bed as well as a rich soil. In western and northern states the plowing need not be so deep, chiefly on account of the winter snows, freezing, and a more virgin soil.

Plowing.—Plowing for corn in most southern regions may with profit be prepared in the fall and should reach a depth of from 8 to 12 inches. In many cases it will pay to use a subsoil plow set to even a greater depth. Fields that have had but shallow plowing should not, how-

Corn club boys gathering seed corn.



This shows crop results of good seed and poor seed. Each picture shows the yield from one acre in adjoining fields. Upper picture, poor seed: yield, 22.8 bushels; marketable, 73.9%; nubbins, 26.1%; seed, none. Lower picture, good seed: yield, 66.5 bushels; marketable, 86.7%; nubbins, 6.3%; seed, 7%.

ever, be plowed to full depth the first season, but should be gradually increased from year to year, as too large a mass of subsoil may be turned up at one time.

Deep plowing brings to the surface comparatively new and unused soil, admits air and moisture to a greater depth, and allows the roots to penetrate farther into the soil. The turning under of organic matter also provides a supply of *humus* and makes the lower strata of the soil more porous.

Why corn needs to be cultivated.—Corn is to be cultivated after planting for three main purposes: (1) To kill the weeds, (2) to admit air to the roots, and (3) to form dust mulch and preserve the moisture of the soil.

From the time germination begins the growth of the plant must be unchecked if a full crop is to be secured. When corn has become yellow and spindling from being choked by weeds, or from the baking of uncultivated soil around it, it is permanently injured and will never fully recover. Only the rich green color and sturdy stock of the rapidly growing plant give promise of a full yield.

When to begin cultivation.—Cultivation should begin early. Under average conditions, disking and harrowing before planting and two harrowings after planting should be given before the corn comes up. This will keep the soil from baking, and keep the weeds down until the plants are large enough to cultivate. The time to kill weeds is just as they are starting. Let them once get well rooted, and they are hard to manage.

The shovel or disk cultivator should be started as soon as the corn is well up, so that the rows can be easily followed. Even if the weeds do not seem to be starting, they are surely taking root. Cultivation will also break up the crusted soil, and admit air to the growing roots. And this must be done or their growth will be checked.

Methods of cultivation.—Four or five cultivations may be enough after the corn comes up, though this must depend on the character of the soil, the weeds, and the amount of moisture. The common tendency among our best farmers is toward *shallow* cultivation. This must depend on whether the soil seems to pack heavily and become hard underneath. If it does, the earlier plowings may well be of some depth. The important thing is not to break or injure the growing roots. For a broken root always means loss of vitality and food to the plant.

Shallow cultivating of corn with riding cultivator.

It is evident that deep cultivation after the roots are well spread is a mistake. The old method of setting the shovels deep and "hilling up" the corn the last two times through is no longer followed in scientific farming. The last cultivations should be shallow. Cultivation may continue with advantage up to the time the corn is tasseling if care is taken not to break the roots. In dry seasons, the late cultivation is of very great advantage, because it keeps a loose soil mulch, which does much to prevent the evaporation of the sub-surface moisture.

Topics for Investigation

1. Examine three different farmers' corn-fields, and see if you can tell whether the plowing was deep or shallow. What was the character of the cultivation of the crop? Are the fields weedy? If so, what was the cause?

2. Suppose that next season proves to be hot and dry. How should the corn in your vicinity be cultivated? Suppose the season should be wet. How, then, should the corn be cultivated?

3. Why does keeping the soil pulverized and loose on top prevent loss of moisture? What causes the corn to look yellow and stunted when the ground becomes baked?

4. Suppose a careless boy covers up five hills out of every hundred in plowing a field of forty acres of corn. The crop yields 38 bushels to the acre. How much would it have yielded if he had covered up none? How much did his carelessness cost if the corn is worth 50 cents a bushel?

6. *Corn Enemies*

Plants, like animals, are subject to certain diseases. Corn is usually a healthy plant, and not affected by so many diseases as some of the other crops. The most serious enemies of corn are various insects, such as the corn root-worm, the corn-root aphis or louse, the wireworm, the cutworm, and the ear-worm.

The corn root-worm.—This pest is responsible for greater loss to the corn crop than any other cause except poor seed, and probably inflicts more damage than all other insects put together. Because the root-worm is very small and does its work underground, it is seldom seen, and probably could not be identified by many farmers to whom it has caused a loss of thousands of dollars. It is present in some degree in almost every corn-field.

At full size the root-worm is about one-third inch in length, and as large around as a pin. It is whitish in color, with its head and the first segment of its body brown. As soon as the young worms are hatched out they enter the roots of the growing corn, burrowing back and forth just under the outside covering. Half a dozen worms are sometimes found in the one root, and as many as 200 in a single hill. The worm destroys the tender part of the root, which turns brown and rots off, leaving only the stubs of roots. As a result, the stalk of corn is deprived of its means of securing moisture and nourishment. The yield is greatly reduced, the ears are light and chalky, and many stalks are barren.

There is as yet no way of stopping these pests once they begin on a field of corn. But the remedy is simple for the next year—*change the field to some other crop.* For this will leave the young worms with no food, and they will all die. Later the field can again be planted in corn, and be free from root-worms for at least the first year.

The corn-root aphis or louse.—After the root-worm, the worst insect enemy of corn is the corn-root aphis. This is a small louse, no larger than the head of a pin, and of a bluish-green color. These lice are found in groups on the roots of corn, from which they suck the juices intended for the growth of the plant.

The worst damage by the aphis is done while the corn is very young. The lice sometimes destroy the roots even before the plant comes up. Their work on the corn roots causes the plant to turn yellow and take on a sickly appearance. If they are very severe in their attack, the tips of the leaves become purplish, and the stem slightly reddish in color. The yield of the crop is greatly reduced, and its

(A) The corn-root aphis. (B) The winged female. (C) The common ear-worm moth. (D) The corn ear-worm. (E) The corn root-worm. (F) The beetle.

ripening delayed. Rotation of crops is one of the surest remedies against this pest.

Wireworms.—Wireworms also make their home in sod, and hence are worst in newly broken ground. They are the larvæ of the click-beetle, whose eggs are laid in meadows and pastures in the fall. They hatch out as small reddish-brown worms in the early spring. The worms attack the sprouting kernel, and also bore holes through the young plant. Fall plowing and rotation of crops are the best remedies against the wireworm.

The corn ear-worm.—The worm often found working in the tips of corn ears has a wide range of appetite. It attacks not only corn, but cotton, tobacco and many other plants.

The corn ear-worm lives through the winter in the pupa state, and comes out in the spring as a moth. There are several broods each season. The harm done by the ear-worms is often most noticeable on sweet corn intended for canning. There is no certain remedy known, though fall plowing is thought to reduce their number.

Topics for Investigation

1. Go into a corn-field and secure several of the beetles of the corn root-worm. They are green, and about twice the size of a pinhead. Learn to recognize the insect at sight.

2. If possible secure a number of the pupæ of the corn root-worm. They can be found in great numbers around the roots of corn in a field where the worms have been at work. Keep the pupæ in warm moist soil in a box covered with netting or glass and watch for the beetles to come out.

3. Find hills of corn which have suffered from the corn root-worm. How do you discover where they have been at work? Does the hill pull up easily as compared with a good hill? What is the condition of the ear?

Corn ear injured by corn moth during storage. One of the South's greatest enemies to stored corn.

4. Observe several fields that have been in corn for a number of years in succession. Do they show signs of the root-worm? Compare with fields on which a rotation of crops has been grown.

5. Secure several ears of corn in which the ear-worm has been working. How does the worm proceed in its attack? Make a study of the worm, and become able to identify it at sight. Would you want to eat canned sweet corn from a field which had suffered from these worms?

6. If possible, secure samples of the corn-root aphis, the cutworm and the wireworm. Learn to identify all these surely and quickly.

7. Other such enemies to be noted are: the corn moth or caterpillar, the white grub, and the corn hill bug. If possible, secure specimens of these, learn to identify them, tell how they damage the crop, and how to control them.

7. *Corn Play Contests*

Play contests are one of the most interesting means of learning certain facts connected with agriculture. The games and contests in connection with various farm activities add interest, develop skill and furnish real fun besides.

Suitable play contests.—The teacher and pupils can organize such contests as the following in connection with the regular school activities, for the playgrounds at recess, or at public events, such as literary programs, fairs, and corn club festivals.

1. Seed corn stringing contests.
2. Variety or strain naming contest.
3. Corn bread baking contest.
4. Corn judging contest.
5. Corn guessing game.
6. Corn husking contest.
7. Corn spelling contest.
8. Oral corn recipe-giving contest to determine who

can give the largest number of corn recipes in a period of five minutes.

All of these contests should be judged in general on speed, skill, condition of finished product, accuracy, etc. (See Circular 104, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C., for further instruction and score-cards on all corn contests.)

8. *Corn Demonstrations*

"Demonstrations" are now becoming common in extension work. The purpose of a demonstration is to teach some definite and well-known truth, by means of the concrete example. While an *experiment* seeks to discover a truth concerning the work of the farm, a *demonstration* seeks to show others how to put this truth into practise.

Demonstrations by the school.—Such demonstrations as the following may be conducted by the school for special exercises, evening programs, club meetings, district, county or state fairs, or special farm and club festivals:

Demonstrations in the preparation of a seed corn test box, a rag-doll tester, and how to make the test.

Demonstrations of how to make a seed tray, a seed drying rack, and how to hang or place the seed corn.

Seed corn stringing demonstration.

Field demonstrations in plowing, cultivation, seed selection, hand pollenizing, etc.

Home economics demonstration showing how to make corn food products, valuable dishes, such as hominy, corn mush, bread, etc.

9. *Corn Club Work*

A great many thousand farm boys and girls are now enrolled in agricultural and home-economic clubs, most of which are connected with the schools. Club work is the performance of a definite farm, garden, or home enterprise, and is based on the best known farm and home practises; it is an effort to extend the work of school and classroom to the home. It is a back-to-the-home movement in which theory is translated into successful practise. Club work in connection with the school may consist of a number of enterprises or club projects such as corn, garden, market garden, poultry, sugar beet, cotton, alfalfa, the home garden and canning club work.

The corn club.—One of the most interesting club projects is the growing of an acre of corn on a business basis. Boys and girls ranging in age from ten to nineteen years are eligible, and pupils may be divided into two classes, an A class from ten to fifteen years inclusive, and a B class from fifteen to nineteen. The basis of school credits for corn club work may be:

1. Greatest yield per acre	30
2. Best showing of profit on investment	30
3. Best exhibit of ten ears	20
4. Crop record and story of "How I Made My Crop"	20
Total score	100

Plan of work.—The following plan should govern the conduct of the work: It should be considered a legitimate means of *extension service* for the school,—a part of regular school work by which plants, soils, insects, plant diseases, crop management, labor income, farm management, etc., may be studied systematically for an entire cropping season. This necessitates making use of the district, state and national club leaders, who always stand ready to help organize clubs and assist in the work. Always consult them about rules, requirements and available awards, prizes and educational trips.

Report blanks.—Every club member should have a crop report blank making a record of observations, receipts and expenses at the beginning of the season, and another on which to make a complete report at the close of the season. These blanks are furnished free by your state college of agriculture and the United States Department of Agriculture. Definite credit for this club work may be given in connection with the class work in agriculture and in connection with other related subjects of the school. A corn club member who has made an average grade of ninety per cent., as determined by the basis of award given on page 25, has given undisputed evidence that he has not only agreed to do the work, but has studied carefully the follow-up, organization and cultural instructions; put them into practise; kept a careful record or cost accounting of all observations, expenses, receipts, etc., and is ready for scholastic recognition at the hands of his teacher.

CHAPTER II

AGRICULTURE IN THE SOUTH

AGRICULTURE is the chief of southern industries, and the South and Southwest are favored above many other regions of the United States in agricultural conditions. They have an excellent climate, long seasons, and, in most regions, a naturally rich, productive soil. Almost every crop that can be raised in the North will grow successfully in the South, and many others besides. The South has no long hard winters to close the soil to cultivation and enforce idleness upon the farmers.

Almost every class of farm animal thrives throughout the South. Cattle, horses, hogs and poultry can be grown more cheaply here than in northern regions, for forage is available most of the year; warm and expensive barns are not required. Nor must a large amount of feed be stored against the long winter months, hence the profit on live stock is greater.

1. *Diversified Farming in the South*

By diversified farming is meant the growing of a number of different crops instead of devoting practically the whole farm to one crop, such as cotton.

Tendency to one-crop system.—Not only in the South but in many regions of the North and West as well, there has been a tendency to a one-crop system. Great areas of the North have been devoted to corn or wheat, while many new regions of the West raise wheat almost exclu-

Single cropping and "Dixie" plow-horse power responsible for much of poverty of both soil and population. (Insert) A one-horse farmer.

sively. The principal crop of many regions of the South has been cotton, which has in some places been grown successively on the same soil for twenty-five or fifty years.

Several causes have led to a one-crop system of agriculture. In certain cases the soil is better adapted to some one crop than to others and will therefore yield a larger profit to the farmer. The natural tendency therefore is to plant chiefly the crop that will bring the largest immediate returns. Again, where but one crop is raised a smaller assortment of tools and implements is required, hence less expense needed for equipment. It is also easier to learn the art of farming where but one crop is used than where a number are grown, each requiring a different system of planting, cultivating and harvesting. Certain crops may also find a more ready and constant market than others, thus encouraging farmers to grow the product that can be most easily turned into cash.

Disadvantages of the one-crop system.—There are great disadvantages, however, connected with the one-crop system. These disadvantages are felt more in the South than in any other region of the United States, largely because cotton was practically the only crop raised.

First, any one-crop system is sure to wear out the soil. This is easily seen from the fact that the crop must remove the same elements from the soil year after year. And, without the return of sufficient fertilizer to make up this loss, the soil is depleted until only a fraction of its original fertility remains. Northern and western regions where upon virgin prairie soil they easily produced 40 to 50 bushels of wheat to the acre found that after some years of wheat growing without any rotation of crops the yield had been reduced to a half or a quarter of what it was upon the new soil. In a similar way, thousands of acres of southern land that originally produced large crops of cotton have now become so impoverished as to yield only a small part of what the soil is capable of producing.

Second, a one-crop system encourages the growth of plant enemies in the soil. The insects that feed upon the crop one season are left upon the field ready to reproduce their kind and attack the next season's crop. Various bacteria and fungous enemies also have a tendency to multiply when the same crop is produced from year to year. Let the crop be changed, however, and the insects and fungi, not finding the necessary food, die and the field is in a measure cleared of their danger. Weed enemies disappear in a similar way in the presence of the new crop.

Third, a one-crop system always leaves the farmer at the mercy of weather conditions. If the season turns out too dry or too wet, or in any other way unfavorable so that a failure of the crop results, the farmer is left without resources and faces financial failure. If, on the other hand, he has a variety of crops, seasonal troubles which affect one crop may not affect others, so that the farmer does not suffer an entire loss. If he raises but one crop and the insect enemies or other reverses prove strong enough to ruin the crop, he is left in poverty. But these plant enemies require different seasonal conditions for their best thriving, hence when they attack one crop they are not so likely to injure others.

Fourth, one of the most serious disadvantages of a one-crop system is the changing market conditions. If for any reason the market happens to fail for the particular crop raised, no matter how good the yield may have been, the farmer is helpless with the crop left on his hands. This was well illustrated when in the season of 1914 the South had hundreds of thousands of bales of cotton for which there was no market because of the European war. Thousands of southern farmers found them-

Blue Ribbon Boy and his poultry. Hogs and forage are a fine combination in American agriculture.

selves almost bankrupt with a large cotton crop on their hands. The farmer who produced several different crops instead of one could not be caught in this condition.

Fifth, diversified farming produces an income for the farmer at different seasons of the year, whereas a one-crop system brings in all its returns at one time, leaving the remainder of the year practically without income. In this case the running expenses of the home must often cause the farmer to go into debt, and his crop is not infrequently mortgaged before it is harvested, and must be sold even at a low price in order to meet the debt.

Sixth, no one-crop system affords a wide enough range of forage and grains to enable the farmer to raise the stock which every farm should have. Successful farmers everywhere are coming to depend more and more on farm stock as a large part of the profit from agriculture.

Advantages from diversified farming.—From these facts it is easy to see some of the chief advantages of diversified farming. Through raising a variety of products and thereby rotating the crops the farmer can build up and renovate the soil. He can free his crops from the worst dangers of insects and other enemies. He can relieve himself of the danger of entire failure coming from an adverse season or other conditions threatening the success of one particular crop. He can become relatively independent of poor market conditions affecting any one crop or can secure for his farm an income that is distributed throughout the year so that he need not go into debt for the current expenses of his farm and household. Diversified farming includes the raising of a variety of stock as well as a variety of crops, and thus adds to the income while at the same time it reduces the danger of failure through the loss of any one crop.

2. *Crops Suitable for Southern Farms*

Frequent failure of cotton to find a profitable market and the ravages of the boll weevil have induced many southern farmers to add crops which they had not previously raised on their farms.

The cereals.—Corn can be raised in most regions of the South as profitably as in the North. Indeed the long growing season makes it possible to produce a much more

Field of cow-peas ready to plow under as green manure.

prolific variety of corn than is possible in northern states. Under right cultural conditions much of the land now used for growing cotton can be more profitably employed in the raising of corn. It is evident that this will give an opportunity for rotation and thereby secure all advantages. Oats can also be grown in most regions of the South and prove almost as profitable as corn. Wheat may also find a larger place in southern agriculture, especially when the right variety for this region can be found.

A stalk of prolific corn well adapted to southern agriculture.

The vegetables.—The South is the great vegetable region of the United States and can more profitably produce most varieties than can any other section. Potatoes can be grown to good advantage in many of the states. Cabbages, tomatoes, melons, sweet potatoes and nearly every other garden vegetable will thrive in most states, and will, on good soil, produce two or even three crops a year.

Forage crops.—While certain of the forage crops most successful in the North are not adapted to the South, there is a wide range of both grasses and legumes suited to southern conditions. Alfalfa, Johnson grass, cow-peas, soybeans, Bermuda grass, lespedeza and the vetches are freely grown in their respective regions.

3. *Animals Adapted to Southern Farming*

Cattle.—Cattle can be more cheaply and profitably produced in the South than in any other part of the country. This is because of the mild climate making it possible to use pastures for the greater part of the feed, and also because of the absence of the long period of cold which not only requires more expensive feeding but often reduces the amount of beef or milk. Both dairy and beef cattle should be raised more extensively through the southern states than is now the case.

Hogs.—The South can also raise hogs to excellent advantage. The southern people are more extensive meat eaters than those of the North and yet raise a comparatively small proportion of their meat. Hogs can be grown very largely upon forage, using grain feeds only for fattening. Pork can be produced more cheaply pound by pound, therefore, in southern regions than elsewhere.

Horses and mules.—The same conditions that make it profitable to raise cattle and hogs in the South also make

A Tennessee club girl and her pure-bred Jersey herd. Won as premiums for achievement in garden and canning club work. Club member for five years, then appointed county agent in charge of club work by state and federal authorities.

profitable the production of horses and mules. Pastures are available almost the entire year and crops of forage can be raised following grain or cotton crops, so that the income from horses or mules can, on many farms, be made almost clear profit.

Poultry.—Probably no more important and profitable extension of farm products in the South can be made than through the raising of more poultry. The feed required can be grown very cheaply, while the shelter may also be inexpensive. Southern farmers could add many millions of dollars to the income of their farms every year by raising more chickens, as well as turkeys, ducks, geese and squabs.

4. *Soil Management in the South*

The management of the soil in the southern states needs careful study with reference to the long growing season, the open winters, lack of winter rest periods, and the thin and rather depleted condition of a great deal of southern soil.

Use of fertilizers.—There are two important methods of fertilizing the soil. *First,* and most important, is to enrich the soil by deep tillage, the growing of legumes, following a carefully planned system of crop rotation, and the adding of natural barnyard manures. *Second,* these methods should be supplemented by adding commercial fertilizer such as experience and experimental investigation prove practical.

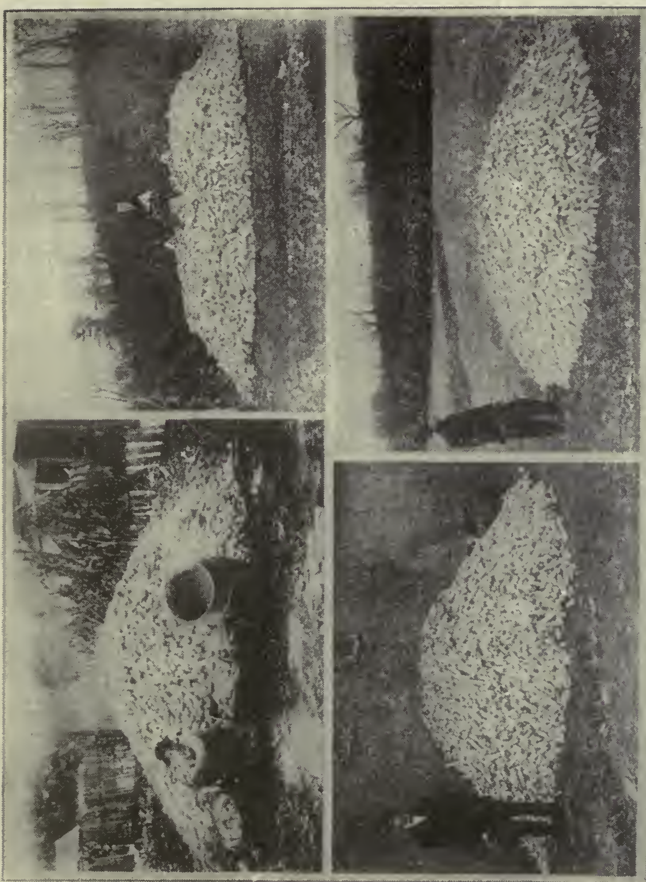
Fall plowing.—Most of the southern land should be given fall plowing from 8 to 14 inches in depth. This will enable the soil to "breathe," taking the place of the freezing of the soil in the North. It also permits the seed bed to absorb the rains of the fall and winter and conserve them for the next season's crop. On deep fall-plowed land southern crops flourish in dry winters, because the plants are strong and have great feeding areas for the root systems. They also do better on deep-plowed soil during the rainy winters because of improved drainage. Fall plowing prevents washing and leeching of the soils during the winter, and lessens the burden of work during the rush of spring farming.

Winter cover crops.—In the southern states the winter *cover crop* is one of the important factors in good farm management. This is because the soil needs to be covered to protect it from the winds of the winter months and to save it from washing and leeching. The cover crop also furnishes forage for stock. In the spring of the year the forage crop can be plowed under to fertilize the soil.

Terracing of hillsides.—Thin clay soils or sandy rolling land should be protected against washing rains. Terraces are usually arranged so as to break the long slope of the hillside. All hillside land should be plowed deep and cultivation should all be done on a parallel with the base. A great deal of hillside land now being used for the production of grains might better be used for pasture, wood-lot, and the growing of legumes. The roots of grasses and trees bind the soil together and prevent erosion.

Topics for Investigation

1. Why are fall plowing and the preparation of the seed bed by deep plowing more important in the South than in the northern states?
2. Why are cover crops needed in the South and not in many of the northern, central and western states?
3. Do you know of farms in your vicinity which have long been used to grow one crop? If so, has this crop diminished in yield? Why?
4. What crops might be added to the list now raised in your vicinity? Do you know the methods of planting,



A QUARTETTE OF CORN CLUB CHAMPIONS

North Carolina, South Carolina and Virginia corn champions. Lowest yield of four champions is 150 bushels of Boone County white corn to the acre.

cultivating, and harvesting the new crops available to your community?

5. What plans are now under consideration for further diversification of the farm crops or animals on your home farm? Compare with the reports from other pupils in the school. Talk with your father about the possibility of further diversification.

6. What bearing does rotation of crops, clean culture, and careful seed selection have on the elimination of plant insects and other enemies?

5. *Demonstrations*

1. Show by use of pile of soil how to terrace hillsides.

2. Demonstrate manner of plowing and cultivating hillsides to prevent washing.

3. Show how to mix a commercial fertilizer adapted to your region.

4. Demonstrate the use of a subsoil plow.

5. Show two methods of combating ravages of cotton boll weevil.

6. At some farm home demonstrate how to dip cattle for fever tick. Also other methods of eradicating them.

6. *Club Projects*

Boys' agricultural clubs are being organized in all the states of the South in connection with the agricultural agent and the schools for the purpose of demonstrating the best practises in agriculture. Girls' home economics clubs, garden and canning clubs are also being organized to encourage a wider use of the home garden and secure a larger supply of vegetables for the daily diet. Every school should if possible organize and promote one or more such clubs. Consult the state college of agriculture and the United States Department of Agriculture with reference to clubs suitable for your school, and send for the system of follow-up instruction to be had for the asking.

CHAPTER III

AGRICULTURE IN WESTERN STATES

1. *Western Farming Conditions*

AN almost infinite variety of climatic conditions abounds in the western states. From the Canadian line on the north to the Mexican boundary on the south are to be found nearly every range of plant life from sub-arctic to sub-tropical. Here also exist many types of soils from the thin, gravelly or volcanic ash covering the mountain ranges to the richest silt of river valleys. The rainfall varies so greatly that while it is possible to farm in many regions under normal humid conditions, either irrigation or dry-farming methods must be employed in other places to secure and maintain sufficient moisture. Added to these conditions are great differences in altitude, so that all ranges of climate from arctic to warm temperature may be found in traveling a few miles from mountain slope to valley. Great ranges of slopes subjected to north or south, east or west exposures also affect both climate and crop conditions.

Wide range of crops and animals.—Almost every crop known to man will thrive in some parts of the great West. Here we find the richest yields of the cereals, cotton in California, Arizona and New Mexico, the most abundant forage crops, potatoes, sugar beets, sorghum, vegetables, and a wider variety of fruits than is grown in any other country in the world.

Farm animals thrive throughout the West and on the great plains in no less variety. This region was the original home of great herds of cattle, horses and buffalo, which ranged the endless prairies and mountain slopes. For many years the eastern markets secured a large portion of their beef and many of their horses from range-fed stock. These immense ranges are now being cut up into smaller farms, put under tillage, and farm stock kept under more domestic conditions.

Soil management in the West.—So great is the variety of climate, soil and moisture in the West that it is impossible to treat all the conditions fully in any one text. Only the more general and fundamental principles can be stated. The local conditions will require study for each particular crop and region.

For convenience in the study of western agriculture we may divide farm practise into three classes: (1) farming under *humid* conditions, (2) under *irrigation*, and (3) under *dry-farming* conditions. Farm practise under humid conditions in the West should not differ sufficiently in method from good farm practise elsewhere to require separate treatment. Farming under arid or semi-arid conditions, however, requires special methods and very careful management. This phase of agriculture is so important in the West that the present chapter will be given principally to its discussion. Hundreds of thousands of acres are now being farmed and managed as dry-farming land, while millions of acres are available for similar purposes just as soon as good farming methods are employed, suitable crops adapted, and good business methods devised and applied to the new conditions. Every student will do well to consider entering some club project, developing a home garden or growing a field crop of one or more acres, to earn money with which to buy some of this low-priced semi-arid land of the West. By starting early in life one

"Round-up" from arid and semi-arid lands of New Mexico.

Horse power in the wheat-fields of the Northwest.

can easily hold a clear title to a farm by the time one is of age and have it well improved before middle age.

2. *Dry-Farming*

By dry-farming is meant the management and carrying on of agriculture, such as the production of field crops, vegetables and fruit, and the raising of stock, in regions where the rainfall is not sufficiently heavy for successful plant growth and crop production under the common methods of farming—especially the careless methods followed in some sections of our country where rainfall and soil conditions are more encouraging for profitable crop production.

The use of terms.—Territory that has an annual rainfall of above 30 inches is called *humid* and will do well under ordinary agricultural practises. Regions that receive less than 10 inches of rainfall annually are called *arid,* and can not be successfully farmed by the methods now known without irrigation. Regions that receive from 10 to 20 inches annually are called *semi-arid,* and those that receive from 20 to 30 inches, *sub-humid.* By the best methods now known to dry-farming practise, most semi-arid and sub-humid land may be successfully and profitably farmed. Some of the common methods will not serve where the annual rainfall is less than 30 inches.

A surprisingly large proportion of the land surface of the earth is either arid, semi-arid, or sub-humid. The following table gives the proportions of the earth's surface receiving varying amounts of precipitation: (Widtsoe, *Dry Farming.*)

Annual Precipitation	*Earth's Surface*
Under 10 inches	25 per cent.
From 10 to 20 inches	30 per cent.

From 20 to 40 inches	20 per cent.
From 40 to 60 per cent	11 per cent.
From 60 to 80 inches	9 per cent.
From 80 to 120 inches	4 per cent.
From 120 to 160 inches	0.5 per cent.
Above 160 inches	0.5 per cent.
	100.0 per cent.

It is seen from this table that the tillable portion of two-thirds of the land surface of the earth receives less than 30 inches of precipitation annually, and must therefore be reclaimed by the best known dry-farming practise if at all. What a gigantic problem for scientific agriculture!

Dry-farm areas of the United States.—Almost half of the area of the United States receives less than 30 inches of rainfall annually, and more than three-fifths receive less than 20 inches. All of this great region is therefore dependent on either dry-farming or irrigation for its agricultural success.

Eighteen states, most of them of large area, comprise this territory. For convenience in study they may be classed in groups as follows:

Arid to semi-arid group: Arizona, California, Colorado, Idaho, Nevada, Utah, Wyoming, and part of New Mexico.

Semi-arid to sub-humid group: Montana, western part of Nebraska, New Mexico, North Dakota, Oregon and Washington.

Sub-humid to humid group: Western half of Nebraska, and sections of Minnesota, Oklahoma, Texas and Kansas.

Note: Send to the United States Department of Agriculture, Washington, D. C., and ask for *Farmers' Bulletin* entitled "The Effects of Cultural Methods of Crop

Production in the Great Plains" written by E. C. Chilcott, Agriculturist in Charge of Dry Land Agriculture, J. S. Cole, Assistant, and W. W. Burr, Assistant. This bulletin contains the results of a number of years' experimenting in cultural methods at several of the dry-land farming stations.

3. *Dry-Farming Practise*

The careless and shiftless methods employed in some humid regions will not return a profit to the operator from his dry-farm. The adoption of the best known methods of managing the soil, planting, cultivating and determining the crops to be produced are required. The dry-farmer should be thoroughly trained if he would succeed.

Principles involved.—The success of dry-farming depends on the use of methods that will eliminate unnecessary and unprofitable labor, store moisture in the soil, keep it there until needed by the growing crops, and then release it to the roots of the plants. It is evident first of all that the soil must be of such nature as will allow it to retain water. Hence a gravelly soil is not well adapted to dry-farming, while a clay loam is. The cultivation must be directed chiefly toward preventing evaporation. The crops to be grown must be selected (1) for their adaptability to dry-farming conditions and (2) for their economy in the use of water during the growing period.

Plowing.—Dry-farm land, many maintain, should as a rule be plowed early in the fall, and to a depth of 8 to 10 inches. In case the subsoil is lacking in plant food the ground should be plowed more shallow at first, then a little deeper each year until a depth suitable to the locality is reached. Some consider fall plowing to be important as it allows the soil more readily to take in the winter moisture and permits winter weathering, which improves the physical condition of the soil. There is, also, considerable evidence as to the necessity of deep plowing when we consult the results of continued experiments of the experiment stations of the Great Plains.

Providing the dust mulch.—Dry-farming requires, on the whole, more thorough and frequent cultivation than humid farming. Land that is soon to be planted to crops should be disked and harrowed immediately after the plow. This tends to produce a loose soil mulch and will do much to prevent evaporation. Fall plowed land that is to lie fallow through the winter should be left in a rough condition and without cultivation, as this will favor the taking in of winter rains or snow. If the winters are dry the ground should be well pulverized after the plowing. Disking should be started as early in the spring as possible and followed by harrowing.

Crop cultivation.—As soon as the crops are planted harrowing should be started, and continued as long as possible without injuring the crop. Every rain that falls is so much treasure added to the soil. After each rain therefore, the ground should be cultivated as soon as possible in order to break the crust, establish a new mulch and so prevent evaporation. All crops should be cultivated as far into the season as possible. Weeds must be kept down at any cost, for they both hinder the growth of the crop and rob the soil of water which belongs to the cultivated plants.

As soon as the crop is removed the ground should be plowed, disked and harrowed. The farmer who is not willing to follow out the intensive tillage and careful management required for dry-farming conditions ought not to engage in this type of agriculture.

Summer fallowing.—In a large part of the semi-arid region it is found necessary to store up the moisture of two seasons in order to produce a single crop successfully. This

Clean cultivation. Summer fallow.

is accomplished by what is known as *summer fallowing.* The process consists of plowing the ground as if for immediate planting, and then keeping it well cultivated without a crop during the season, thus conserving most of the moisture that falls.

Fallowing is usually practised every second year in regions having less than fifteen inches of rainfall. Where the rainfall is from fifteen to twenty inches the fallowing may be limited to every third or even every fourth year. The fallowed soil should be kept wholly free from weeds as they use up moisture, encourage insects, and make the ground foul. In various regions of the Great Plains increased frequency of cultivation has been found to take in some degree the place of fallowing. Wherever this system can be successfully used it should, of course, be adopted, as it saves the loss from idle land during the fallowing period. Fallow fields also often lose fertility through the blowing of loose soil in high winds.

4. *Management of the Dry-Farm*

Dry-farm crops.—A great degree of the success of dry-farming depends on the selection of crops that are capable of growing with a minimum supply of moisture. While many of the crops grown under humid conditions can be successfully produced by dry-farming methods, yet certain varieties are better adapted to resist drought than others and should therefore be used.

A second factor to be taken into account is that plants have the power of adapting themselves to the conditions under which they grow. Varieties that have become accustomed to dry-farming regions and methods of cultivation should be selected. This also suggests that home grown seed should generally be used rather than seed brought from humid territory.

A good stand of wheat in the Northwest. Result of good management of semi-arid land.

Wheat as a dry-farm crop.—Wheat is at present the most important dry-farm crop, and will probably retain this preeminence. Experimentation is still going on to determine the best varieties for dry-farming conditions. Among the hard spring wheats, *Common* or *Durum* is at present regarded the best, while among the winter wheats the semi-hard and the soft wheats take the lead.

Other grains.—Oats, especially such varieties as *Sixty-day, Kherson, Burt* and *Swedish Select,* are a profitable dry-farm crop. Barley, rye and emmer are also successful cereals for dry-farming regions. Corn can be profitably grown under semi-arid conditions if proper varieties are selected, as can the sorghums, feterita and millet.

Alfalfa and other legumes.—On account of its deep rooting system alfalfa can be made a successful forage crop where the rainfall is as much as twelve to fifteen inches. Field peas, beans and other legumes are also adapted to dry-farming.

Potatoes.—Potatoes are one of the most promising of dry-farming crops. They can be profitably raised with a rainfall of fifteen inches. The following varieties have been recommended as dry-farm varieties: *Ohio, Mammoth, Pearl, Rural New Yorker* and *Burbank.*

Conserving soil fertility.—Dry-farming areas possess soil of unusual fertility. Nor does the fertility exhaust as fast as under humid conditions. Dry-farms in many sections that have been continuously cropped for many years show but little loss of fertility or decrease in the yield of crops. Yet this fertility will finally be exhausted if care is not used to maintain it.

Intelligent dry-farming will therefore plan from the first to conserve fertility. The farm should be stocked and the manure returned to the soil. Straw left from the header, and stubble, should be plowed under. Legumes should be grown to aid in maintaining the supply of nitrogen. A careful system of rotation of crops should be adopted and carefully followed.

Dry-farm machinery.—Dry-farming usually employs a large acreage of tilled land. It also demands frequent and thorough cultivation. These facts suggest the need of plenty of good machinery, adapted to the work required. Plowing is often done by the gang-plow drawn by a steam or gasoline tractor. Grain is cut by a combination header and thrasher. Large disks, harrows and drills are used. The intelligent dry-farmer will not so much seek to economize on necessary machinery, as to save by giving it the required care for its up-keep.

Water for the home.—The dry-land farmer's home should be provided with an abundance of clean pure water. The barns and the stock should have plenty of water, and a supply is needed for the irrigation of the vegetable garden, shade trees and fruit. The most progressive dry-land farmers provide a reservoir which is continually kept full of water pumped by a windmill, gasoline engine, or other power. If this reservoir is elevated it may easily provide for a running system of water, thus supplying the home, its kitchen and bathroom, with some of the modern conveniences not otherwise available.

Topics for Investigation

1. Locate on the map the regions adapted to dry-farming in the United States. Estimate the amount of land in your state not now under tillage that may be profitably farmed by this method.

2. Work out a practical system of crop rotation for several different regions where dry-farming is practised.

3. Make a list of all crops adapted to dry-farming in

Machine power at work in the vast fields of the West.

Typical scene in the Southwest, showing sage-brush in the foreground.

your state and locate the territory where each may be profitably produced.

4. Write a description of how some of the important dry-farm crops are produced, from the plowing of the land to the harvesting and marketing of the crop.

5. Write a brief history of dry-farming in the United States.

6. Give an account of dry-farming in your own state; in Canada; in Mexico; in Brazil; in Russia; in China.

7. What is the average annual rainfall for your state? How does this compare with other states of your region? With the United States? Does the rainfall of your state come chiefly during the growing season, or during the fall and winter? What bearing has this on the methods of farming required?

8. Make a list of all crops, such as cereal, forage, garden and orchard, that will thrive in your state. Compare with crops available to middle western or eastern states. Do the same for animals.

5. *Demonstrations in Dry-Farming*

1. Demonstrate by use of sand, soil and water what is meant by arid, humid and sub-humid land.

2. Show how to make soil mulch for the arid land found in the vicinity of your school. Use soil on table or in boxes; if this is impracticable demonstrate to the class in the out-of-doors.

3. Show upon the map or by the use of the blackboard the reasons for lack of rainfall in certain areas in your section of the state.

4. By the use of boxes and various types of soil make demonstrations on a miniature scale of farming some one crop such as wheat under the three conditions, arid, semi-arid and humid, by the application of moisture, packing, cultivation, stirring of the soil. Plant the same seed in each of the three divisions. You will be able to show the dif-

ference in growth and appearance of your crop during the same period of time, etc.

6. *Play Contests*

1. Soil sample contest. Select all of the different samples of soil found in your dry-land farming section.
2. Soil variety naming contest.
3. Dry-land farming essay writing contest.
4. Geography study contests such as the location and naming of arid sections and reclaimed arid land.

7. *Club Projects*

No section of the country is in greater need of demonstration club work than is the dry-land farming section. Here are needed the encouragement, leadership, and direction usually given in the boys' and girls' club projects. The same basis of award suggested for the crops outlined in connection with the other chapters can be used in the club work in dry-land farming. It is possible that the acreage, when the project is in connection with a forage or cereal crop, should be twice as large as is usually taken with humid land. This is in order to make it possible for a greater net profit on the investment for the club member.

CHAPTER IV

FARMING UNDER IRRIGATION

ABOUT 300,000,000 acres in the United States of otherwise tillable land have been unproductive because of lack of moisture. This area, which is approximately as large as Iowa, Illinois, Indiana, Ohio, Missouri, Minnesota, Wisconsin and Michigan, comprises what is known as the arid and semi-arid region of the United States. The soil in most cases contains abundant plant food and has been found highly productive when the necessary amount of moisture is supplied. Much of the arid West formerly called the "Great American Desert" can be transformed into a veritable garden spot by proper irrigation and management.

This territory extends from the Canadian boundary to the Gulf of Mexico and includes large tracts of practically all of the states in the West, such as Washington, Montana, North Dakota, South Dakota, Idaho, Wyoming, Utah, Colorado, Oregon, Nevada, California, New Mexico, Arizona, Texas, Oklahoma, western Kansas and Nebraska, as well as a part of Florida.

1. *Causes of Aridity*

There are three chief reasons why much of the western dry territory is deprived of normal rainfall. The *first* is that the Rocky Mountains rob the ocean breezes of their moistures before they have reached the tillable lands. The *second* is the altitude of a great portion of this territory; millions of acres are at an altitude which makes the production of rain impossible. The *third* is the lack of vegetation and forests, which encourages the evaporation of moisture and its loss after rains by rapid surface drainage.

Seasonal distribution of rainfall.—In considerable portions of the arid territory there is sufficient rainfall within a year's time to produce crops. Yet irrigation is necessary because the distribution of the moisture is not seasonable, but irregular or at the wrong time. In most cases the rains come during the time of the year when the crops are not in the ground. In some parts of Florida where the annual rainfall is from 60 to 70 inches it is impossible to grow a crop without irrigation because the precipitation comes during the winter months.

Regions of late summer droughts.—In the central west and eastern states there is considerable territory that suffers more or less during the months of July and August, for want of sufficient rainfall to set and mature the grain, fruit, or trucking crops. In a very large number of cases irrigation could be supplied without great expense to protect the farmer, fruit grower, or truck gardener against failures of crop and so prove highly profitable.

Even in the fruit sections of the Allegheny and Blue Ridge Mountains where irrigation has not been seriously considered many farmers would profit greatly by planning systems of irrigation and by so doing extend the growing season. Where now they are producing but one crop in trucking, with the aid of irrigation and a carefully planned system of rotation, it would be possible to produce two and in some cases three crops. Much of this land could be fed from the mountain streams and rivers with but little cost.

2. *Reclamation of Arid and Semi-arid Land*

Reclaimed land.—By reclaimed land we mean land that otherwise would be unproductive and of little or no

"Checking back" to avoid waste of irrigation water. California.

Regulating gates and inverted siphon. Chestnut Valley, Missouri River, Montana.

value because of its arid or semi-arid condition. This land is reclaimed by some system of *irrigation* making it possible for the farmer to supply water in sufficient quantities and at the proper time. The United States government, through its reclamation service, has reclaimed millions of acres of land in the West which formerly were a bleak desert, or at best covered with sage-brush, mesquit and cacti, and populated largely by prairie dogs and rattlesnakes. In this region are now beautiful and thriving orchards, grain and alfalfa fields, and a great variety of truck crops. Some of the most beautiful farming sections of the West can be found on these reclaimed lands and on what is known as territory under irrigation. Millions of dollars are being spent annually, not only by the federal government, but also by the states and by private reclamation companies to reclaim this land.

Practise of irrigation not new.—While irrigation has only recently been developed into an important agricultural science and received the attention of statesmen and men of affairs, it is by no means a modern invention. It was very commonly practised in Egypt, India, Spain, Mexico and Peru thousands of years ago. When the Spaniards first came to America they found irrigation fairly well developed in both Mexico and Peru. The Indians were the first to irrigate land in the United States. Even at the present time can be found a number of Indian tribes practising the same arts of irrigation followed by their forefathers hundreds of years ago. In many of the western arid plains from which the Indians have long since been driven there are still remaining signs of their irrigation systems. The first white people in America to develop and organize definite systems of irrigation were the Mormons, who located in the Salt River Valley of Utah.

Sources of water supply.—Water for irrigation purposes is secured from a variety of sources, such as artesian wells, canals, reservoirs, streams, lakes, and sometimes from the regular wells from which the water is pumped by windmills, electricity, steam or other power.

Topics for Investigation

1. What is the acreage of irrigated land in your state? What are the possibilities for profitable extension of irrigation to include additional territory?
2. If there is aridity in your region what is the cause—location of mountain ranges, elevation, direction of prevailing winds, and other unfavorable seasonal distribution or rainfall?
3. Make a study from state and federal sources of the reclamation projects of your state, and write an account of the same, giving area affected, cost, and methods pursued as to supply and distribution of water.

3. *Systems of Irrigation*

There are now in use in various sections of the country three different systems of irrigation. These are known as the *surface, sub-surface* and *overhead* systems.

Surface irrigation.—This is the system in most common use, not because it is always the most satisfactory and efficient, but because it can be installed with the least labor and expense. Where water is scarce, or the rental is high, surface irrigation is wasteful, since a large amount of water is lost by evaporation and by running off into fields, lowlands or streams where it is not needed. And in irrigation territory water has a direct money value and should be handled as economically as possible.

Application of water in surface irrigation.—The method to be followed in surface irrigation depends on the source of water supply, the physical condition of the soil,

Flooding from cement ditches.

Method of making small irrigation ditches.

the topography of the field, and the kind of farming to be undertaken. Two principal methods of applying the water are (1) by *flooding,* and (2) by the use of *furrowing,* or *corrugation,* of the field.

When flooding is used, the water is spread from the source of supply over the entire field at regular or necessary intervals. It seeps into the soil and around the root systems of the plants from every point of the surface. When furrowing is employed the water is turned into the furrows from the head lateral ditches. From the furrows it seeps through the soil to the roots of the plants. It is evident that for the successful use of either of these methods the fields must be relatively level and only a trifle sloping.

Saving the water.—The only methods known to prevent lavish waste of water through surface irrigation are (1) by economy in the application of water, and (2) by keeping a light surface mulch and by frequent and shallow cultivation. This system will produce a greater amount of plant products at less water cost. For most of the fruit, trucking and grain crops the furrow, or corrugation, method is conceded to be more practical and economical than flooding.

Sub-surface irrigation.—Under favorable conditions sub-surface irrigation proves most satisfactory, chiefly because there is little or no waste of water, and because the supply can be more easily controlled.

In this system the water is applied by means of pipes placed beneath the surface. The pipes are full of small holes through which the water enters the soil. A serious objection to this method is that clay soil and small plant roots are likely to clog up the holes. Hence the sub-surface pipes are adapted only to light open soils. Another subsurface method is by a system of tile or drainage pipes from

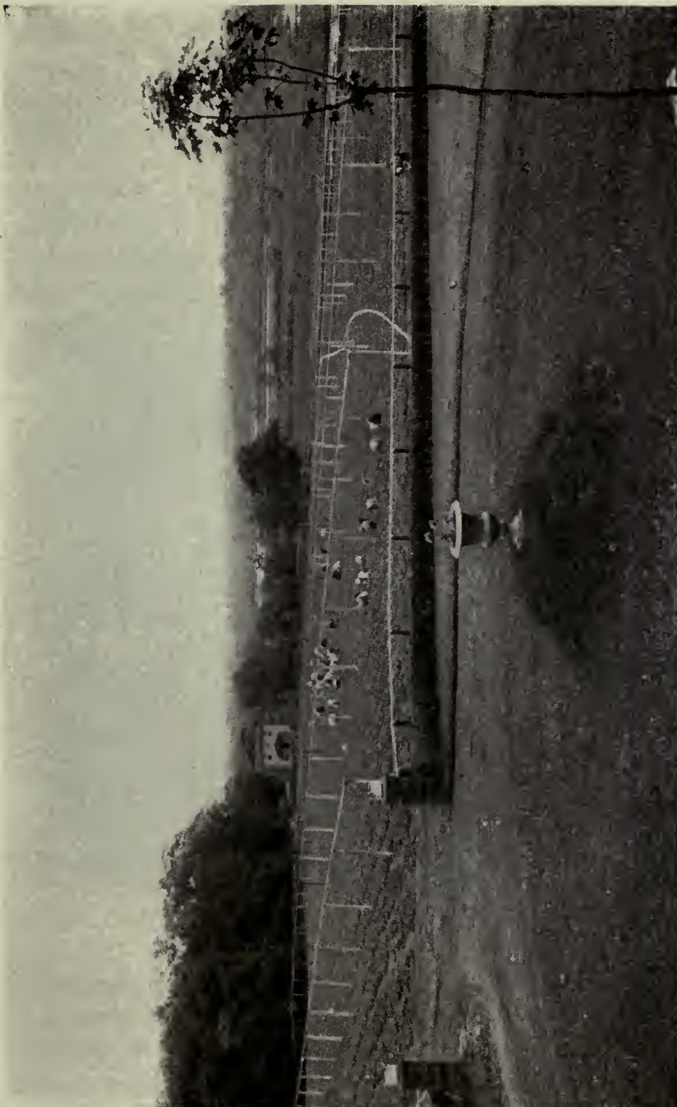
Sub-irrigating method. Continuous piping system.

which the water is forced up through perpendicular pipe outlets or holes.

A third method of sub-surface watering is employed where the land has a natural slope and *a clay subsoil of hardpan.* The water is applied by the head ditch and allowed to seep down through the soil to the hardpan. It then rises to the surface by soil capillarity, where it is available for the use of the plants. This method is practical only in a few localities where the source of water supply and the physical conditions of the field are adapted to its use.

Overhead irrigation.—Overhead irrigation is accomplished by a system of overhead piping so placed that water can be applied to an entire field or garden at one time. The pipes are perforated with many small holes through which are forced fine streams or a spray of water. This method is very effective, but its expense limits its usefulness principally to gardening and trucking. Not only is the cost prohibitive for large fields, but the piping is in the way for cultivation when using horses and machinery.

Determining the method of irrigation.—What method of irrigation is best must be decided by certain important factors. Among these are (1) the available water supply, and its expense, (2) the location and level of the water table, (3) the nature of the soil, (4) the variety of crops to be irrigated, (5) the size of the field. Irrigating small grain, forage crops, alfalfa, etc., is usually best accomplished by the surface corrugated methods, though flooding may prove satisfactory if the land is well drained. Orchard and trucking crops are most economically served by the furrow method.



Overhead spraying system, showing pressure gage, Rancocas, New Jersey. Strawberries.

4. *Crop Management under Irrigation*

The application of water.—Water is usually applied as needed from seed time to harvest in from two to six applications. A few irrigations from June to September

Shoshone project, Wyoming. Wheat on the farm of James Walsh.

as a rule insure better results than many. Too much water is the cause of many irrigation difficulties and is quite as harmful to the crops as not enough. The time of application is more important than the quantity of water applied.

Care of the crop.—The general management of crops under irrigation, as to planting, tillage and harvesting, is very little different from the management of the same crops under humid conditions, except in three particulars. *First,* all work must protect the irrigation system, such as ditches, furrows and piping, being careful not to damage them in cultivating the crop. *Second,* the tillage must be performed with a definite view to conserving the moisture in all possible ways. *Third,* the management of the farm must be more carefully planned as the cost of production is greater on irrigated land than on humid land, and a material increase of production per acre must result if a substantial profit is to be assured.

Rotation.—The desire for immediate cash returns makes the tendency to single cropping as pronounced on irrigated projects as in the central states or the cotton territory. Yet the fact that the land is new makes diversification and a carefully planned system of rotation even more desirable than in most other regions. For not a little of the new land which is being brought under irrigation is almost entirely devoid of organic matter. This is due to the fact that for many years it has been entirely without vegetation. For this reason and for the purpose of keeping up the natural fertility and the enriching of the soil, it is important to plan a practical system of crop rotation from the start.

Every irrigation farmer should keep in close touch with the state college of agriculture and state experiment station of his state by visiting the institution and reading its bulletins. In this way he can secure guidance and information from experts who have been provided with both time and money to investigate and experiment in order to discover the safest and best methods for the farmer.

5. *Dangers from Over-irrigation*

The dangers from over-irrigation need to be guarded against as carefully as those of shortage of moisture. The Utah Agricultural College and the Utah Conservation Commission have jointly issued the following suggestions to irrigation farmers:

OVER IRRIGATION IS A MENACE TO UTAH, BECAUSE

1. Smaller crop yields are obtained for each unit of water used.
2. More plant food is taken up by the plant for each pound of crop.
3. The quality of the crops is greatly reduced.
4. Straw is produced at the expense of grain.
5. Plant food is washed out of the soil.
6. Lower-lying lands become water-logged.
7. Other dry lands are cheated of irrigation water.
8. The extension of the irrigated area is hindered.
9. A wholesome community spirit is lowered wherever water is wastefully used.

The same authorities have set forth the following irrigation rules, which are worth the attention of all who are interested in irrigation.

1. **Store the rainfall in the soil.**—Deep thorough plowing enables the soil to absorb and retain most of the rain and snow water. The more rainfall is stored in the soil the less irrigation water will be needed.

2. **Use the spring and fall water.**—Where the winters are dry, fall irrigation or early spring irrigation will reduce the irrigation water needed during the growing season.

3. Cultivate frequently and thoroughly.—Water is easily lost from soils by evaporation. The soil should be thoroughly cultivated early in the spring, as soon as possible after irrigation, and usually once or more between irrigations. Thorough cultivation will reduce the water needed in irrigation.

4. Keep the soil fertile.—The more fertile a soil is, the less water is needed to produce a pound or ton of the crop. Plow deeply, cultivate thoroughly, use barnyard manure, and less irrigation water will be needed.

5. Plant in well-moistened soil.—Well-moistened soil at planting time permits better root development, and delays the time of the first irrigation, and thus saves irrigation water during the summer. If rains and snow do not moisten soils sufficiently for planting, irrigate in fall, or in early spring, before planting.

6. Don't irrigate too early.—By postpoining as long as possible the first irrigation after planting, a better root development is secured and less irrigation water is needed to produce the crop.

7. Irrigate by the correct method.—Where water is plentiful, the flooding method may be used; where water is scarce, the furrow method only should be employed. Lead the waste water from the furrows to other fields.

8. Irrigate at the proper time.—Withhold water until the crop is in real need. When irrigating, apply enough water to supply the crop for at least ten days. Irrigate thoroughly, when potatoes are in bloom; corn in tassel or silk; lucerne just beginning to bud, and grains forming seed.

9. Use water in moderation.—The acre yield of a crop increases as more water is used, up to a certain limit, beyond which more water causes a decrease in the yield.

10. Spread the water over larger areas.—The yield of crop per unit of water always becomes smaller as more water is added. The less water is used in irrigation, the more crop is obtained for the water used. In Utah, land is plentiful, water is scarce; it is more important to get a large crop for each *acre-foot of water* than for each *acre of land.*

11. Kill the weeds.—Weeds use up as much water as do many profitable crops. It costs usually 2,000 pounds of water to produce one pound of weeds. Killing the weeds will leave more water for our crops.

12. Repair the leaky ditches.—Tremendous quantities of water seep from most of our canals and ditches. Stop the leaky places! It will often pay to cement the whole canal.

13. Measure the water.—Land is measured carefully, but water, more valuable than land, is seldom measured. Great progress will be made by Utah as soon as farmers faithfully measure and keep an account of the water used on the land. *This is one of Utah's greatest irrigation needs.* The *Cippoletti Weir* may be used by any farmer for the measurement of water.

Topics for Investigation

1. What systems of irrigation are used in your state? Is the one most commonly used the best? If not, suggest any changes that would bring better returns.

2. What method is used for securing water and bringing it to the state and local projects? Make a drawing showing the system of distribution from the water source.

3. How are the water rights determined? By state laws? By federal laws? By private companies? How are water rentals determined? Name and explain the principal irrigation acts, both state and national. Write to your congressmen and state legislators for copies of the laws.

4. Locate on the map the leading reclamation projects of the western states. Name them. How do they differ as

to source of water supply, and laws creating and governing them? What restrictions and limitations are placed on land ownership on the government projects?

5. Name and explain the distinctive irrigation tools and machinery in use not common to the other types of farming. Bring pictures of different kinds not commonly known in your section. Explain how they are used and whether they are practical for your locality.

6. Name and explain the different kinds of gates, locks and dams used in irrigation work. What kind of power have you seen in use for irrigation purposes? What important part does gravity take in all irrigation plans?

7. Where in your community can other irrigation projects be profitably located? Show source of water supply, and recommend the method of irrigation most economical and efficient.

8. What new legislation by both state and nation would you recommend for the increased efficiency of present projects and for the reclamation of other tillable lands in the county and state?

6. *Irrigation Demonstrations*

1. Demonstrate how to make a surface corrugation to be used in irrigating small grains, forage crops or alfalfa.

2. Show three methods of furrowing an orchard. Demonstrate by drawing how to make a furrow irrigation system showing the location of water reservoir, main ditch, laterals and furrows.

3. Demonstrate with drawing how to make a "ridger," a "leveler" and a "dammer."

4. Demonstrate by use of soil and water on ground out-of-doors or on a table an irrigation system for a 40-acre farm, which is to be used for trucking, fruit and forage crops. Show, if possible, the effect upon plants by giving them too little, too much, or just enough water.

5. Show how to lay out fields for a 40-acre farm on a 4-year system of crop rotation, including location of dif-

ferent crops, pastures, etc., which will do well in your locality.

7. *Irrigation Play Contests*

1. Drawing contests of irrigation plans, projects and methods of distributing water.

2. Tool making contest, making levelers, corrugators, V shaped drag, and ridger.

3. Irrigation spelling contest, using terms or words common to irrigation methods, tools and practises.

4. Table or out-of-door soil construction of irrigation plans and systems, a contest to see who can make out of soil, clay, putty, or paper pulp, the best miniature irrigated farm, illustrating source of water, locks, dams, ditches and field distribution methods.

5. Arithmetical problem-making and solving contest: all problems must concern costs, measurements, water rentals, etc., as directly related to irrigation.

8. *Irrigation Club Projects*

Club projects on any or all of the crops outlined in the other chapters can be undertaken on the irrigated land with great success. The cultural methods used, rental of land, and kind of crops will of necessity be recommended and outlined on a different basis.

It is quite possible that a Reclamation Club would be a good thing in localities where there is much adjoining land unused and a possible water supply. This project should be based upon the method and economy of reclamation, management of plot, yield, cost, exhibit of products, and records kept.

CHAPTER V

WHEAT

BREAD is the staff of life. Whatever else we may have on our tables we usually have bread. It is so common and necessary an article of food that we describe poverty by saying, "Not a crust of bread in the house."

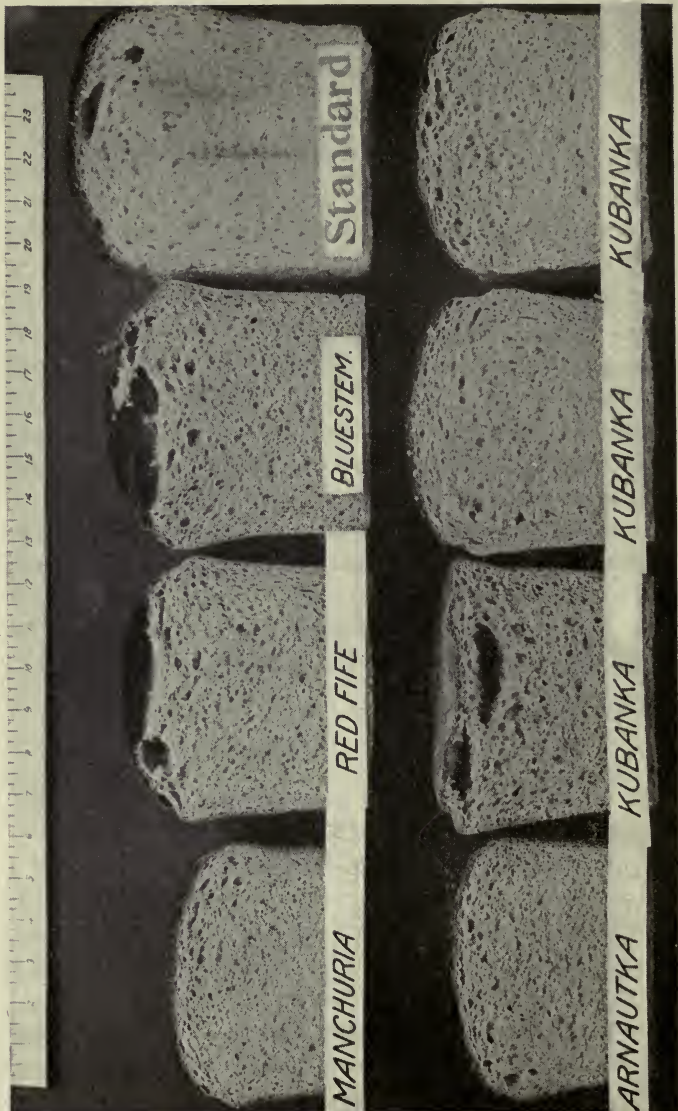
Yet the bread that you and I eat—wheat bread—is really a rather recent addition to the world's food. True, wheat has been known for many centuries,—so long that no one knows when or where it originated. But not until the last few generations has it been found possible to raise enough so that the great mass of people can have it daily for food.

But even yet wheat as a common article of food is almost unknown in many nations. Probably more than half the people living in the world to-day have never tasted wheat bread such as we eat daily. Either wheat is not grown, or it costs more than other foods and can not be afforded by the common people. In its stead they eat rice, barley and vegetables.

1. *Importance of Wheat as a Crop*

The United States raises more wheat than any other nation, and approximately half as much as all Europe combined. We supply about one-fifth of all the wheat grown in the world. Our annual crop is nearly 700,000,000 bushels, enough if loaded into cars to make two solid trains, one reaching from New York to San Francisco, and the other from Regina to New Orleans.

The wheat belt of the United States.—The best wheat producing regions are in the Middle West and North. Kan-



Samples of bread made from different types of wheat.

sas, North Dakota and Minnesota produce not far from one-third of all the wheat grown in the United States. If to these we add the following twelve states, Nebraska, South Dakota, Washington, Indiana, Illinois, Ohio, Missouri, Pennsylvania, Oklahoma, California, Michigan and Oregon, we shall have the fifteen states that produce more than four-fifths of all our wheat.

The yield of wheat.—The average yield of wheat for the entire country is about half what it is for corn, or fourteen bushels to the acre. The states that produce the largest amount of wheat are not necessarily the ones that show the largest yield per acre. Taking the average for ten years, the ten states producing the largest amount of wheat rank in the following order in the yield per acre: Washington, first; Nebraska, second; Ohio, third: Illinois, fourth; Indiana, fifth; Missouri, sixth; Minnesota, seventh; Kansas, eighth; South Dakota, ninth; North Dakota, tenth.

The average yield of wheat is gradually increasing, but all too slowly. With still better methods of farming and with better selection of seed and improvement of the soil much larger crops of wheat can be raised. And this means cheaper bread, and more profit in farming.

2. *Types of Wheat*

Wheat is classed as *winter* wheat or *spring* wheat, depending on whether it is planted in the fall or the spring. It is also classed as *hard* or *soft* in accordance with the quality of the grain.

There are three or more distinct types of winter wheat, and three of spring wheat, as follows:

1. Soft winter wheat.
2. Semi-hard winter wheat.
3. Hard winter wheat.

1. Soft spring wheat.
2. Hard spring wheat.
3. Macaroni wheat.

These types furnish a great many different varieties, so many that it would be a hopeless task to try to learn them all. The United States Department of Agriculture and the state experiment stations have tested as many as one thousand different varieties since 1895.

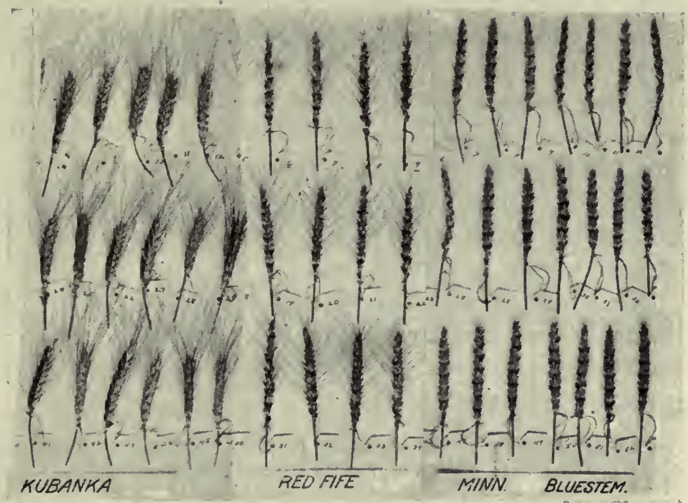
Climate and type.—In general, the more humid climates produce the soft wheats and drier climates the hard wheats. The introduction of hard wheats has opened up vast western regions to wheat raising which were too dry for the soft varieties.

Better flour is made from hard than from soft wheat, though a very excellent grade is made by mixing the two. Macaroni wheat is the hardest type, and is chiefly used in the manufacture of macaroni, though some of this type is now being used for flour. Macaroni can not be successfully made from the soft wheats.

Winter wheat.—Winter wheat is planted in the fall, lives through the winter, and ripens the following summer. It requires about one hundred days to mature after growing weather has come in the spring.

About two-thirds of all the wheat grown in the United States is of winter varieties. In regions where winter wheat will withstand the extremes of temperature it is preferred to spring varieties, since it (1) yields more, and (2) is more free from disease and from injury by the various insect pests.

Kansas and Nebraska are the great centers for the hard winter varieties, while east of the Mississippi River the softer winter varieties are chiefly grown. More than sixty per cent. of all the winter wheat grown in the United



Common varieties of wheat.

Harvesting wheat with a modern binder.

States is raised in the states of Kansas, Indiana, Nebraska, Illinois, Ohio, Missouri, Pennsylvania, Oklahoma and Texas.

Spring wheat.—Spring wheat is adapted to localities where climatic conditions are not favorable to winter varieties. About one-third of our wheat comes from the spring-sowed crop. Most varieties of spring wheat require from one hundred to one hundred and twenty-five days from the date of planting to mature them.

Minnesota, North Dakota and South Dakota are the principal spring wheat regions of the country. These three states supply seventy per cent. of all the spring wheat grown in the United States.

Topics for Investigation

1. What proportion of the tilled land of your vicinity is devoted to wheat? Is this proportion increasing or decreasing?
2. What type of wheat is chiefly grown, winter or spring? Hard or soft? Do you know what are the chief varieties to be found in your neighborhood? Are the varieties bearded or beardless?
3. What is the average yield of wheat to the acre in your region? How does this compare with the yield for the state? (Consult your state agricultural college for the yield of the state.)
4. It is estimated by the United States Department of Agriculture that the average cost of producing an acre of wheat in the United States is about eleven dollars, including rental or interest value of land. Talk with your father about what the different items of expense cost in your vicinity (such as fertilizer, preparing land, seed, planting, harvesting, thrashing, marketing, rental). Make a detailed list of these expenses, and compare with the average cost for the country.
5. In a similar manner figure what it costs to raise an acre of corn. Then find the market value of the grain

from an acre of corn and from an acre of wheat, based on the average yield for your vicinity. Which crop pays the better, and by how much per acre?

3. *Growing the Wheat Crop*

Wheat grows best on virgin soil, or on land that has been renewed by means of forage crops, such as clover, alfalfa, manure, or some other form of fertilizer. The new regions opened up in the West at first produce large crops, but soon fail in yield if wheat is raised continuously without a plan of rotation with other crops.

Preparing the seed bed.—Since wheat is one of the crops that can not be cultivated after planting, the seed bed should be prepared with especial care. The ground should be plowed, and then disked or harrowed until it is well packed and finely pulverized. The preparation for the fall and spring seeding is essentially the same. If the ground is new, the plowing may be shallow. The older soils require deeper plowing.

Spring wheat is sometimes disked in on corn land without first plowing the ground. This, however, is a careless method of farming, and has been proved by careful experiments not to secure so large a yield as from plowed land.

Selecting and preparing the seed.—As in the case of corn, the best seed for wheat is usually that grown near home. New varieties and seed grown at a distance should not be used for the general crop until carefully tested by agricultural experiment stations and found adapted to the climate and soil of your locality.

Wheat selected for seed should possess the following qualities: (1) A plump bright grain of good wheat; (2) a stiff straw, able to withstand adverse weather; (3) a compact head, ripening early, and not easily shattered; (4)

good bread qualities; and (5) ability to resist insect enemies and diseases.

Once the type and variety selected for seed are decided upon, the wheat should be run through a fanning mill. This will select the heaviest and plumpest grains, as well as remove the seed of noxious weeds. If care is taken thus to secure the best of the crop for seed each year, there need be no fear of the seed "running out." On the contrary, the variety may actually be improved.

Methods of planting.—The method formerly used in planting wheat was to sow it broadcast on the plowed ground, and then harrow it in. This is a very wasteful way of planting, however, since some of the wheat fails to be covered, and is picked up by the birds; some of it is just barely covered, and fails to secure good roots; and some of it is covered too deeply, and grows imperfectly.

The method now used in all successful farming is to plant the wheat with a drill. This sets the seed at a uniform depth, and gives it a moist fine bed of soil. Numerous experiments have shown that the best depth to plant wheat for average years is from one and a half to three inches. Wheat, like corn, loses both time and strength by being planted too deeply.

Wherever possible, wheat should be drilled in rows running east and west. In dry regions, the prevailing winds then blow snow and dirt into the drills instead of out of them, as is the case when the rows run north and south. In east-and-west rows the drill also tends to shade the roots of the plant, and so protect them from the frequent thawings and freezings which occur in the case of winter wheat when the sun shines directly into the drill. Because of these uses of the drill ridges, the ground should not be harrowed after the wheat is sown.

Harvesting the wheat.—Except in the great plains or semi-arid regions of the West where practically no rain falls during the harvest season, wheat should be cut as soon as it is ripe enough. Many farmers allow their wheat to become so ripe as to shatter, and much loss results. It may be cut while the grain is still soft, so that it can be crushed between the thumb and finger. This will not injure very much the quality of the grain, and the straw will be of much greater value if cut slightly green. Early cutting also reduces the risk of storms.

In regions where the grain can be allowed to stand without shattering until it has become fully ripe and dry, the cutting and thrashing are often accomplished in one process. This is done by a combination harvester and thrasher drawn by from twenty to thirty horses, or by a tractor engine.

Wheat cut with the harvester should be carefully shocked, usually in nine-bundle shocks, eight bundles standing firmly on the ground in the form of a circle, and the ninth used for a cap-sheaf. Careless shocking is responsible for much loss from weathering.

When the wheat is well dried in the shock, it should at once be thrashed, or else stacked in well-built stacks. Wheat is too valuable to leave standing long in the field waiting for a thrashing machine. If once put in stacks, it should be allowed to stand for several weeks before thrashing in order that it may "pass through the sweat."

4. *Diseases and Insect Enemies of Wheat*

Wheat is the prey of many different diseases and insect enemies, which sometimes almost totally destroy the crop. Many of these are coming to be better understood, and remedies for them devised. Three principal diseases attacking plant organism that grows upon some other plant, or on wheat are *scab, rust* and *smut*. These are all caused by the growth of *fungi* on the wheat plant. A fungus is a tiny

A good stand of wheat, raised by a Georgia club boy.

animal tissue, and draws its living from its host. We call any organism that gets its living off another organism in this or a similar way a *parasite*.

Scab in wheat.—Scab is the least common of the three diseases mentioned, yet it sometimes causes much loss in certain localities. It attacks the *glumes,* or chaff, which surround the kernels of wheat in the head. The entire head is seldom destroyed, only a few of the glumes being affected. Scab results in a shrinkage of the kernels, and hence a reduction in the yield and an injury of the quality of the wheat. No cure has yet been discovered for wheat scab. A second crop of wheat should not follow wheat that has been affected with scab. If this is necessary, however, the stubble of the first crop should be burned to destroy as much of the scab as possible.

Rust in wheat.—Rust is one of the most serious enemies of the wheat crop. It is nearly always present in some degree, and has at times almost wholly destroyed the crop over considerable areas. There are two kinds of rust, one attacking the leaves and the other the stems of the plants. The stem rust is much more destructive than the leaf rust.

Rust may in some cases live over winter on the old plants, and be ready to attack the new crop if wheat is again planted on the field. Wheat rust also lives on other plants, especially the barberry, and is spread from them by birds or insects to wheat-fields. Laws have been passed in some states requiring the destruction of barberry hedges because of their part in spreading rust.

Moist seasons are more favorable to the ravages of rust than dry. Rust results in weakening the stem of the wheat plant, and reducing the size and quality of the grain. In some cases the heads even fail to fill, and the crop is a total failure. There is no known cure for rust, though certain varieties of wheat are better able to resist it than

Stinking smut of wheat; smutted head and smut balls at right; sound head and kernels at left.

others. The earlier varieties are usually safer than the later.

Smut in wheat.—There are two kinds of smut that attack the wheat plant, *loose smut* and *stinking smut.* Loose smut usually destroys both the glumes and the kernels, leaving only the bare stem. Stinking smut grows inside the glumes, destroying the kernel only, and taking its place. The spores from which stinking smut grows attach themselves to the kernels of wheat, and are therefore often sown with the seed. This fact makes it possible to combat this type of smut by treating seed wheat in such a way as to kill any smut spores that may be present.

One of the surest and cheapest ways of treating the seed for stinking smut is by the application of a solution of *formalin.* One pint of forty per cent. formalin mixed in forty-five gallons of water will treat one hundred bushels of wheat. The wheat may be spread out thin on a tight floor and sprinkled with the moisture, shoveling it over so that each grain is sure to become dampened.

After it is well sprinkled the wheat should be covered with sacks or blankets to keep it from drying out too rapidly. After a few hours, it may be spread out, or stirred, to hasten the drying in preparation for sowing. Ten pounds of *copper sulphate* dissolved in twenty-five gallons of water may be used instead of the formalin.

Loose smut may be prevented by what is called the *hot-water* treatment of the seed. The wheat is put into sacks and immersed in tubs of water warmed to a temperature of one hundred and twenty degrees Fahrenheit. When the wheat has become thoroughly warmed, it is taken out, drained, and again dipped in water, this time heated to a temperature of one hundred and thirty-five degrees. The sacks may now be dipped at once in cold water, which will serve to keep the kernels from swelling. The wheat should then be spread where it will dry quickly. The general use of these well tested remedies should make smut of rare occurrence.

Chinch-bugs.—Chinch-bugs are among the worst of the insect enemies of wheat. They are easily recognized as a small dark-colored insect, with white wing covers. Chinch-bugs damage the wheat by sucking the sap from the plant, and thus checking its growth. The mature bugs live over winter, lay their eggs in the spring, and the young are soon hatched out, showing at first a reddish color.

No effective way of controlling chinch-bugs has yet been discovered. It is, however, helpful to burn the rubbish of any infected field in the fall, as this will destroy large numbers of the bugs, and leave many of the remainder to perish during winter without hiding-places.

The Hessian fly.—The Hessian fly is a small, mosquito-like insect that lays its eggs on the growing wheat. These eggs soon hatch, and the larvæ begin at once to suck the juices from the young plant.

One method of handling these pests is to turn under the first planting of wheat that has been attacked, and then sow another crop on the ground. This, however, is an expensive method of getting rid of them. The burning of fields in the fall, fall plowing and rotation of crops are all helpful in checking their ravages.

Grasshoppers.—Grasshoppers are less to be dreaded now than in earlier years, though they occasionally do great damage to the wheat crop. The grasshopper lays its eggs in the summer, and they do not hatch until the following spring. It is possible greatly to reduce their number by late, deep fall plowing, which buries the eggs so deep that the young when hatched do not find their way to the

Loose smut of wheat. Sound head at left; different stages of smutted development at right.

surface. Poisonous sprays are also used to destroy the young hoppers.

Topics for Investigation

1. If winter wheat has been sown in your neighborhood, visit two or more fields and note (1) whether the seed was sown broadcast or drilled, (2) the direction of the drill rows, and (3) the evenness of the stand.

2. Make a collection of all the different types of wheat available, and learn to identify them, (1) from the grain, and (2) from the head and straw.

3. Obtain samples of unthrashed wheat, and search for leaf rust; for stem rust. Compare the heads and kernels on the rusted stalks with those on healthy heads.

4. Find examples of stinking smut, of loose smut. What is the condition of the straw and grain in each case as compared with healthy plants?

5. Go out into fields of wheat and oat stubble and look under bunches of straw or rubbish for chinch-bugs. Bring specimens to school and examine them so that you can quickly identify them.

6. Secure a score-card for wheat, and judge from twenty-five to one hundred grains of wheat.

7. What is the best method for the testing of wheat for vitality? Look up instructions on the blotter tester and a few of the commercial tray testers. Make a test of one hundred wheat seeds and judge for vitality, dividing the seed after germination into three classes, strong, weak and dead.

8. How would you keep a record or bookkeeping account of a field of wheat? Make out a debit and credit account covering a season's expenses and receipts with one acre of wheat. (See *Farmers' Bulletins,* 511 and 572.)

9. Sketch a map of the United States and locate the wheat producing states and sections. Insert the last census reports of wheat production for each state. Where are the leading wheat mills of the country?

10. Compare wheat bread with bread made from other products such as corn, rye, etc. What differences do you note?

11. How much wheat is exported annually from this country? How much wheat is imported?

12. What foreign countries produce wheat? Locate them on the map.

(See end of chapter on "Oats" for suggestions as to wheat demonstrations, play contests and club projects.)

CHAPTER VI

OATS

OATS are one of the world's most important grain crops. Though not so old as wheat, oats have been grown in Europe for centuries. They were brought to this country by the early settlers, and are now raised in every state. The United States produces about one-fourth of all the oats grown in the world. Oats are chiefly valuable as a food for animals, yet they are also widely used as a human food.

1. *Importance of the Oat Crop*

Our oat crop is slightly more than a billion bushels a year, or a total yield of about one-third more than wheat. Because of the higher price of wheat, however, the value of the oat crop is only about half that of wheat. Among all farm crops, oats rank fifth in value, being surpassed only by corn, cotton, wheat and hay.

The oat region.—The great oat producing region of the United States extends from New York and Pennsylvania westward to Nebraska, Kansas and the Dakotas. Each state in this great chain plants more than a million acres of oats annually.

The following chart shows the thirteen states that produce about four-fifths of all the oats raised in the United States, with the per cent. of the total crop grown in each:

Iowa	15%
Illinois	14%
Minnesota	8%
Wisconsin	6%
Ohio	6%
Indiana	5%
North Dakota	5%
Nebraska	5%
Michigan	4%
Kansas	4%
New York	3%
South Dakota	3%
Pennsylvania	3%
All others	19%

The yield and profit.—The average yield per acre throughout the United States is about thirty bushels. The highest yields are in the far Northwest, where the rainfall is heavy during the growing season, or where irrigation is used. Here the crop not uncommonly runs from one hundred to one hundred and twenty-five bushels to the acre, and sometimes reaches one hundred and fifty bushels.

In the corn belt, oats are usually a less profitable crop than corn. The yield is less per acre, and the market price lower, while the cost of production is about the same. Iowa and Illinois are the two leading states in the amount of oats produced. The cost of growing an acre of oats if we include the rental value of the land, will average from ten to twelve dollars. When oats are thirty-five cents a bushel, it is evident that a crop of thirty bushels to the acre leaves no margin of profit.

While oats do not pay so well as corn, it is necessary, nevertheless, to raise them, even in the corn region. For oats are needed, (1) to make possible the rotation of crops, and (2) as a food for stock, especially working horses. This crop, like corn and wheat, can easily be increased in

Two types of oat heads: spreading or panicled on the left; side or horse-mane on the right.

yield and profit by improving the soil and employing better methods of seed selection and tillage. It is not impossible to secure an average yield of from fifty to seventy-five bushels to the acre throughout the oat region.

2. *Types of Oats*

Two general types or classes of oats are easily distinguished—the spreading, or *panicled,* and the side-bearing or *horse-mane.* The former has a spreading, bush-like head, branching from all sides of the central stem; the latter carries the grains on short branches, all of which are attached to one side of the stem.

Varieties for different regions.—It is impossible to tell how many different varieties of these two types exist. As in the case of wheat and corn, new varieties are being developed from year to year. Several hundred different varieties are now shown in the seed lists.

In New England, the northern tier of states and the Rocky Mountain region, white oats of rather late-maturing, large-grained varieties are usually most successful. Examples of these varieties belonging to the *spreading* type are: Clydesdale, Big Four, Swedish Select and Lincoln; of the *horse-mane type,* White Russian and Tartarian are well known.

In the Missouri, Mississippi and Ohio River regions, extending as far south as Kansas, Missouri, Kentucky, Tennessee and Texas, and as far east as Ohio, small-grained, early, yellow varieties have proved the best. The Kherson, Silvermine, Big Four and Sixty Day are examples of these varieties.

Successful fall seeding of oats is possible only in the southern states. For southern fall seeding, Winter Turf and Red Rustproof are the varieties most used. For spring seeding in this region the Burt and Red Rustproof are quite satisfactory.

Topics for Investigation

1. How many acres in your father's farm? How many acres are cultivated this year? How many acres in grass

A .. C D

(A) Sixty Day, grain medium-sized, slender, yellow; (B) Red Rustproof, grain large, plump, reddish-brown; (C) North Finnish Black, grain medium-sized, plump, black; (D) Swedish Select, grain white, large and plump.

land and pasture? How many acres in garden, orchard, lawn and barnyard?

2. How many acres are devoted (1) to corn; (2) to wheat; (3) to oats; (4) to other farm crops? What percentage is the acreage of each crop to all the land cultivated? To the whole farm?

3. Find how many acres altogether in the farms represented by the pupils in the school. Then answer each of the four questions asked in number "2" for all these farms summed together. How do the percentages for each

crop raised on your father's farm compare with the percentages for the entire school district?

4. What was the yield of oats per acre on your father's farm this year? What is the yield of corn? Learn the market price of each grain, and figure the value per acre for each. Now ask your father to help you determine the cost of raising and harvesting an acre of each crop. Which is the more profitable crop, and by how much to the acre?

5. Which of the two types of oats is raised on your father's farm? What variety?

6. Make a collection of five or more different varieties of oats, study the kernels, and the entire plant if possible, and learn to identify quickly the chief varieties grown in your region.

3. *Raising the Crop*

Oats are usually planted with less care than any other crop. Where they follow corn in the rotation of crops, they are often sown broadcast on the corn land without previous cultivation or preparation of the ground. The field is then either disked or gone over with a cultivator and harrowed. This is a careless method of farming, and undoubtedly results in a diminished yield.

Preparing the seed bed.—When oats are sown after corn the seed bed should be prepared by plowing or two thorough diskings before seeding. The oats may then be covered by harrowing. The corn stalks should be broken down before disking. This can easily be done by means of a heavy pole dragged broadside across the rows when the ground is frozen. A still better method is to cut the stalks with a corn cutter. If the growth of stalks and weeds is especially heavy on the field, it is best to rake and burn the rubbish to get it out of the way of cultivation.

It sometimes may not be necessary to plow the ground for oats following a well cultivated crop. Especially is this true if the plowing can not be done in the fall. One of the things most necessary in growing oats is to get the seed into the ground as early as it can be worked in the spring. And the seeding can be done more quickly by disking than by plowing. There is little or no danger to oats from freezing after they are sown, and the seed will sprout and

Two common varieties of oats.

grow in a much colder temperature than that necessary for corn.

Methods of seeding.—Oats are sown by two methods, (1) scattering the seed *broadcast* over the ground, and (2) *drilling*. The old method of broadcast seeding was to scatter the seed by hand from a sack slung over the shoulder. Machines for seeding have been devised which can be attached to the end-gate of a wagon. The seeder is driven by one of the rear wheels of the wagon by means of a sprocket and chain.

Drilling has been found to result in a larger yield than broadcast seeding. The drill plants the seed uniformly over the field and covers it well. The drilled crop comes up more evenly, and ripens more nearly at the same time than that from broadcast sowing. Less seed is required when the planting is done with the drill, since practically all the seed is covered and given a chance to grow. This is impossible with broadcast seeding.

A mistake is often made in planting oats too deep. The ground is usually moist when the planting is done, and depth is not required to secure moisture to start growth. Many agricultural experiment stations have tested different depths of planting, and recommend about one inch as the best depth for most regions.

Preparing the seed.—Seed oats should never be taken directly from the bin and sown, no matter how promising the grain looks. For oats ordinarily contain more dirt, weed seed and light grains than wheat.

The seed should always be run through the fanning mill. The current of air blows out the light grains and much of the rubbish, and the smaller grains are removed by the sieves. This process of cleaning should generally exclude one-third or one-fourth of the oats run through the mill. If the seed is very light a still larger proportion will need to be rejected.

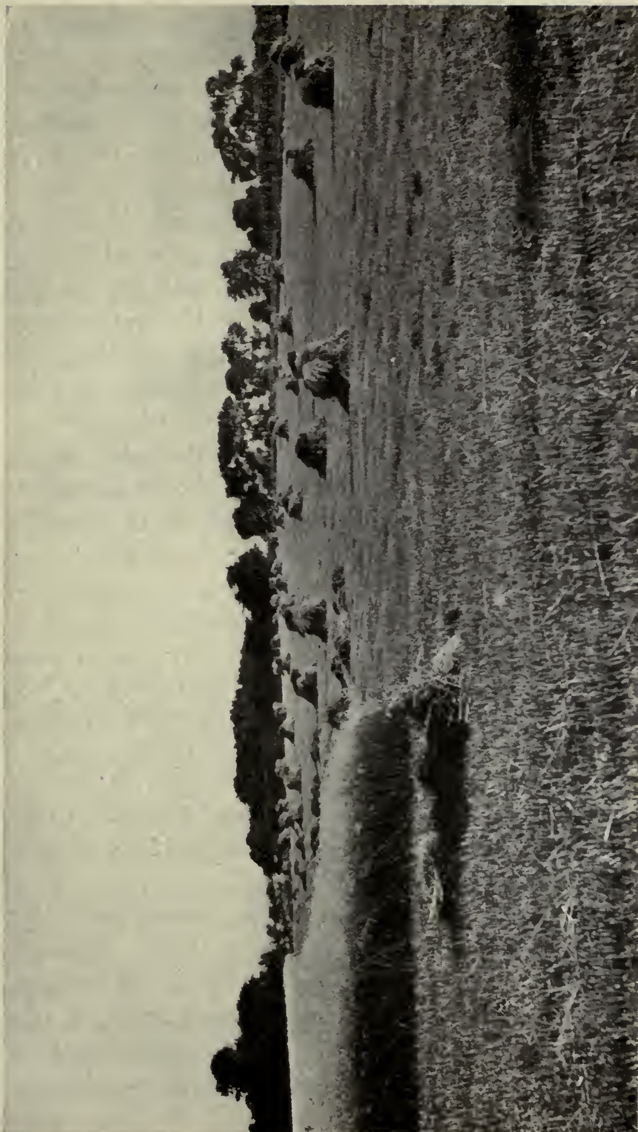
Careful tests have shown that seed prepared in this way will yield several bushels to the acre more than if sown directly from the bin. Many of the light grains fail to sprout, and most of those that grow produce weak plants that yield little or nothing. It will well pay every farmer to take time in the winter to prepare his seed oats.

Improvement of the seed.—It is possible greatly to improve a variety of oats by careful selection of the seed. This may be done by going into the field just before the crop is harvested, and gathering, head by head, the strongest, largest grained and best yielding plants, also giving preference to those that are freest from disease. From a peck to a bushel or more thus selected is thrashed out, the small, light or imperfect grains rejected, and the choice seed sown on a special seed plat to raise seed for the coming year's crop.

Harvesting the crop.—Oats are harvested with the grain binder, the header, the mowing machine, and the combined harvester and thrasher. By far the greater part of our oats crop is cut with the binder.

The best time for cutting oats is just as they are passing out of the hard-dough stage of ripening. On account of the fact that they shatter rather easily when ripe, it may be necessary, especially if the acreage is large, to begin when the grain is passing out of the milk stage. Cutting too early leaves the grain slightly lighter and of a greenish color.

The best method of shocking oats depends on the ripeness of the crop when harvested. If the oats are in the hard-dough stage when cut, they should be shocked in well-built, round shocks. If the grain is green and the straw heavy or full of weeds, the long shock is better, since it allows freer curing. Either type of shock should be capped, except in regions where the winds are usually strong enough to blow a cap sheaf off, in which case it takes damage from lying on the ground.



A fine crop of oats, showing the result of well prepared seed bed, careful seed selection, cleaning and treatment.

Thrashing.—Oats may be thrashed from the shock, or stacked and thrashed any time during the fall. A somewhat better grade of oats is obtained by stacking and allowing the oats to "go through the sweat" before thrashing. The straw is also worth more for feed when the oats have cured in the stack.

The custom followed by careless farmers of leaving grain standing for weeks in the shock exposed to the weather while waiting for the thrashing machine can not be too strongly condemned. A period of hot wet weather is almost certain to start the oats to molding, or sprouting in the shock. On the other hand, if the weather is very dry, the oats shatter, and many bushels are lost in handling. If the thrashing machine can not be secured as soon as the oats have dried sufficiently to thrash, they should be stacked in well-built round stacks so constructed as to turn the rains.

4. *Insect Enemies and Diseases*

Oats are, on the whole, subject to fewer diseases, and the prey of fewer insects than wheat. The crop is, therefore, less liable to total failure from these causes.

Insect enemies.—Chinch-bugs attack oats, as well as wheat, though they usually do much less damage to oats than to wheat. They can be controlled only as already described in the case of wheat.

In some seasons the army worm has caused much loss to oats, but usually not over extensive areas. There is no satisfactory method known of controlling its ravages. What is known as the *green bug,* a grain aphis, is one of the most prominent enemies of oats. Grasshoppers occasionally consume the greater part of the crop in relatively small areas.

Diseases of oats.—The chief diseases attacking oats are rusts and smuts. These are of the same general character as the rusts and smuts of wheat, fungous growths feeding on the growing plant.

The rusts are of two chief types: (1) *leaf rust,* which is of a reddish-brown color, and attacks the leaves, and in some degree the stems, of oats shortly before ripening time; and (2) *stem rust,* which is to be recognized as black spots appearing on the stems and leaves of oats just before they ripen.

Stem rust is less common than leaf rust, but when present is far more injurious to the crop. The rusts are more serious as an enemy of oats in the South than in the North, appearing in the South almost every year, and greatly reducing the yield. Rust is more common in moist hot seasons than in dry seasons. No sure cure has been discovered for rust in oats, though some varieties are more able to resist its attack than others.

Smut ordinarily causes more injury to oats than any other disease. It has been estimated that from two to three per cent. of the entire crop is destroyed every year by smut, causing a loss of from $6,000,000 to $10,000,000.

The smut of oats is easily recognized a little time before the crop is ripe. Instead of the kernels are found small masses of smut dust which have taken the place of the grain. Sometimes these smut balls are covered by the chaff, much as the kernel should be, and other times the chaff is lacking and the smut fully exposed.

While there are two kinds of smut in oats, both will yield to the same treatment. Smut may be wholly prevented by treating the seed with formalin, as described for the treatment of wheat. It will also be effectually prevented by the hot-water treatment. In either treatment

Smut of cats: smutted head at right; sound head at left.

the method is practically the same as for the seed wheat. With so simple and sure a remedy for smut, every farmer who lives in a smut region should treat his seed before sowing. It costs very little, and may result in an increase of several bushels of oats to the acre.

Topics for Investigation

1. How did your father prepare the ground for oats last fall or spring? Were they sown on corn land? If so, were the stalks broken down, or pastured close? Was the ground disked before the oats were sown? If so, how many diskings? If more than one, was the second disking across the first, or by lapping? Which is the better way? How many harrowings did the oats receive?

2. At what date are oats usually sown in your region? When does harvest begin? How many days, then, are required for the crop to mature? How much seed does your father use to the acre?

3. Collect samples of unthrashed oats, and examine (1) for each kind of rust; (2) for each kind of smut. If it is not possible to find unthrashed oats, examine straw for rust and evidences of smut.

4. Did rust or smut damage the crop in your region last season? Does your father treat his seed oats for smut? If so, by what method? Suppose your crop was reduced two per cent. by smut, how much did you lose per acre? How much on the entire crop? Would this not more than pay for treating the seed?

5. Does your father always run his seed oats through a fanning mill to select the better grains and remove weed seed? How long will it take to run one hundred bushels through a fanning mill? Suppose it results in an increase in yield of two bushels per acre, how much profit would there be from the cleaning?

6. Have you seen oats left in the shock until they were damaged, either by wet weather, or by shattering? About how much per acre does it cost to stack oats? Suppose there is a loss of one bushel to the acre by allowing

the grain to stand in the shock; will it pay to stack? (Consider also the better quality of grain and straw.)

7. Make out a debit and credit sheet showing the proper method of keeping an account with a crop of oats covering the entire season, beginning with plowing and closing with harvesting, thrashing and marketing of the oats.

8. Test one hundred grains of seed oats for vitality by the use of the rag-doll tester or blotter tester, and estimate the percentage of strong, weak and dead seed. From this base your estimate on the loss of crop if all the oats sown in your home field are of the same standard of vitality.

9. Secure a copy of a score-card for oats and judge twenty or thirty grains of oats.

10. Sketch a map of the United States and locate the oat producing states. From the last crop census record the number of bushels of oats produced in each state. What foreign countries produce oats?

5. *Wheat and Oat Demonstrations*

1. Demonstrate the making of a vitality test for wheat and oat seed.

2. The method of separating chaffy wheat or oat and weed seed from the better grade seed.

3. How wheat and oats may be used for the table. The girls can work out a number of recipes.

4. In the field demonstrate the proper method of seeding and, when equipment is available, the methods of preparing seed bed, disking, fertilizing, etc.

5. Demonstrate how to select individual wheat and oat heads for seed.

6. *Wheat and Oat Play Contests*

Plan and carry out the following contest games:

1. Variety naming contest.
2. Wheat and oat judging contest.

Minnesota State Fair Bread and Home Canning Contest, conducted by the state leader in charge of club work.

3. Recipe giving contest.

4. Bread baking contest.

5. Oral descriptions by class members of a thrashing day at home.

7. *Wheat or Oat Club Project*

A wheat or oat club makes an interesting method of studying the economic production of these cereals. The members of the club should arrange to grow from one to five acres, studying carefully the system of "follow-up" instruction provided by the leaders of such clubs in the county and state, and keeping a complete record of all observations, receipts and expenditures.

The girls can grow a small plat, of not less than one square rod, with a view to studying the life history of the plant, its cultural methods, milling processes and its use for food products. In connection with domestic-science work, the girls can prepare for exhibit purposes the various dishes possible from oats and bake a loaf of wheat bread for the school exhibit each month. This makes an interesting demonstration for Friday afternoon programs.

The following basis of award may be used in connection with the small grain growing club work:

1. Yield and quality of production	30
2. Net profit on investment	30
3. Exhibit both grain and cooked products	20
4. Crop records and story of work	20
Total Score	100

Note: A different basis of award should be given in case of bread-baking club work, based, first, on number and variety of loaves or product baked; second, on average score of nine loaves exhibited; third, on club plat work; fourth, on record and illustrated story of the bread club work.

CHAPTER VII

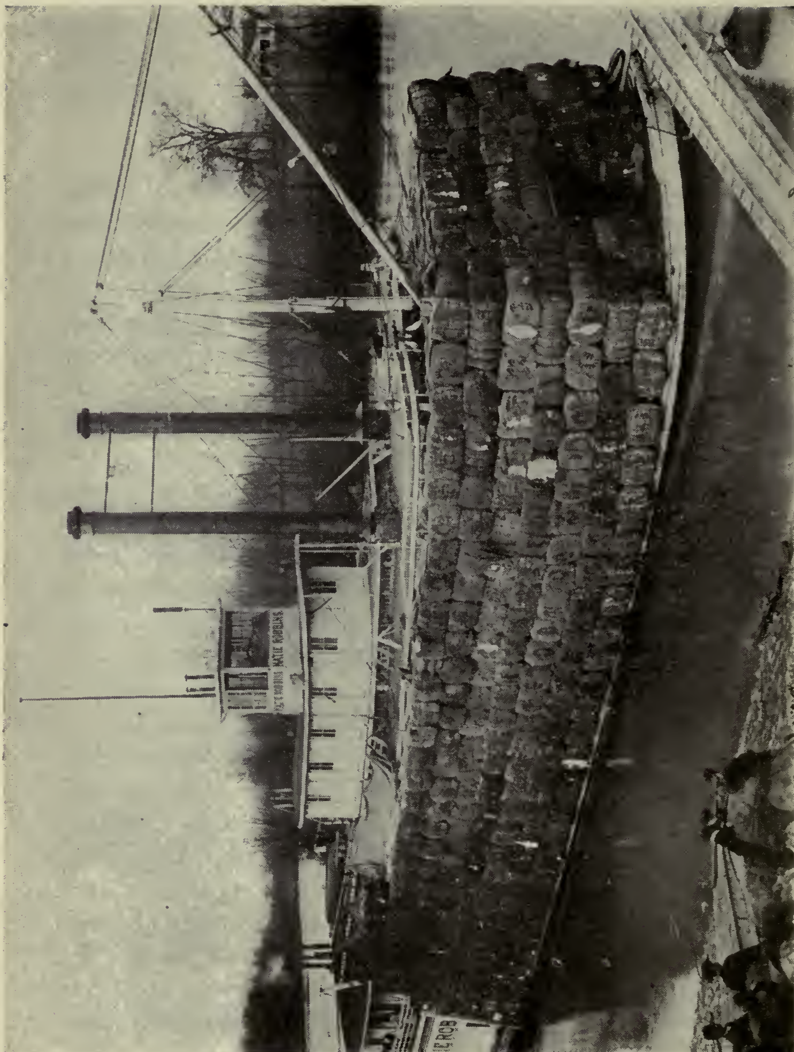
COTTON

COTTON is supposed to have been a native of India, though Columbus found it growing here when he came to America. Cotton ranks next in value in the United States after the cereals and the forage crops. In many of the southern states it outranks all other crops put together both in acreage and value. The annual crop is worth about three-fourths of a billion dollars.

The cotton plant is raised chiefly for its fiber, though other parts of the plant are also useful. The seed furnishes valuable oils for lighting, cooking and other purposes. The hulls and meal left from the manufacture of the oils are used for stock feeding and fertilizers. The root barks are sometimes used for medicine while the stalk fiber is employed for the manufacture of coarse cloth bags. Some paper manufacturers are also using the stalk.

1. *The Cotton Region*

Most of our cotton is raised in the following twelve southern states, which are named in the order of the amount of cotton they produce: Texas, Georgia, South Carolina, Mississippi, Alabama, North Carolina, Arkansas, Louisiana, Tennessee, Florida, Oklahoma, Missouri. Cotton is also profitably raised in southern Virginia and in parts of Kentucky. It has recently been introduced with success in Arizona, southern Utah, New Mexico, and in southern California, where the long staple variety is especially successful.



Shipping cotton to foreign markets through Panama Canal.

Proportion of land in cotton.—Mississippi, Texas, Alabama, Georgia and South Carolina devote approximately one-half of their tilled land to the raising of cotton, the remainder of the list, from twelve to about twenty-five per cent. The tendency at present is to diversify the farming in the cotton states, raising a smaller acreage of cotton, and adding corn, oats, legumes and other forage crops. With better methods of growing cotton, this can be done without reducing the amount of cotton produced.

Kinds of cotton raised.—The two leading varieties of cotton are the *Sea Island,* so called because it requires the salt sea air for its production, and the *Upland.* The Sea Island cotton is considered the best produced, because of its long and strong fiber. It is also finer than the other varieties. The Upland cotton has green seeds while the Sea Island cotton has black seeds. Upland cotton is grown in the states away from the Gulf and along the Atlantic seaboard. This variety is largely manufactured in our own cotton mills, while Sea Island cotton is exported in large quantities to foreign markets.

2. *Raising the Crops*

Soil requirements.—Well-drained clay or sandy loam soil is considered best for cotton. As a rule, bottom lands are not well adapted to the growth of cotton, because most of the fertility of the soil goes into the production of stalk rather than bolls. There are two important reasons why cotton should be planted only on fertile soil, and given the best of cultivation: (1) A better quality of cotton and larger yields are produced; (2) an earlier crop is secured and the danger from the boll weevil and other insect enemies is greatly reduced.

Preparation of the seed bed.—The ground in most parts of the South should be plowed deep for cotton. This

Baled cotton in storage ready for shipment.

brings to the surface new soil, and opens up deeper levels for the roots of the plants. Many successful cotton farmers plow not less than eight or ten inches deep, and then follow with a subsoiler that breaks the bottom of the furrow open to an additional depth of four or more inches. It is usually advisable to plow the land in the fall, and then disk or harrow well just before the planting season. Cotton grows better on a well bedded soil than on newly prepared land.

Applying fertilizers.—Cotton land should be rich in humus or vegetable matter. This keeps the soil from packing, increases the capacity for water, and adds to the fertility. Barnyard manure should therefore be added whenever possible. Legumes should be grown, alternating with cotton, and an occasional crop of soy-beans, cow-peas, or clover plowed under.

Commercial fertilizers will pay on certain soils. It is well to secure the advice of an expert as to what fertilizing elements are most needed. Acid phosphate is commonly used to increase the yield and hasten maturity. Cottonseed-meal may be used especially to stimulate stalk growth.

Planting.—Cotton should be planted as early as the season will permit. Not only will a better grade of cotton result, but the danger from the boll weevil will be greatly lessened, as the weevils do not become very numerous before the latter part of July. In Texas the cotton is planted in March; in North Carolina not until May. The plant requires about six months to mature, hence it is easy to see why the cotton territory is so limited. In some sections it is considered good practise to plant the seed on ridges thrown up about four feet apart. On very dry soils the ground should be kept level. About four feet is the proper distance between rows and the plants should be set from twelve to twenty inches apart in the row. About thirty pounds of good seed are required to the acre.

Thinning and cultivation.—To yield the best results, the cotton plants must have a steady and vigorous growth. As soon as the plants are up and all danger of frost is past, the cotton should be thinned with the hoe to a uniform and perfect stand. Cotton requires good cultivation to kill the weeds, keep the soil loose, and preserve a dust

Field injured by cotton worm. (Insert) cotton worms.

mulch to conserve the moisture. Cultivation should begin with the harrow before the young plants come up. When the cotton is about five days old the cultivation should be repeated. Disk and shovel cultivators are suitable for the later cultivations. Deep plowing should be avoided late in the season, so that the roots may not be injured.

Cotton picking.—The greatest labor connected with cotton production is the picking of the crop. It is a very slow and costly operation and has been performed entirely

Typical cotton-picking scene in the South.

by hand labor. The invention of the cotton gin by Eli Whitney for the ginning of the cotton or the removal of the seed from the lint was one of the greatest boons to cotton culture that has come to the South. After the cotton has been ginned it is made up into large bundles called bales, each weighing about 500 pounds. These bales are shipped to the mills by train or boat, after which they are manufactured into thread and all kinds of cloth.

Topics for Investigation

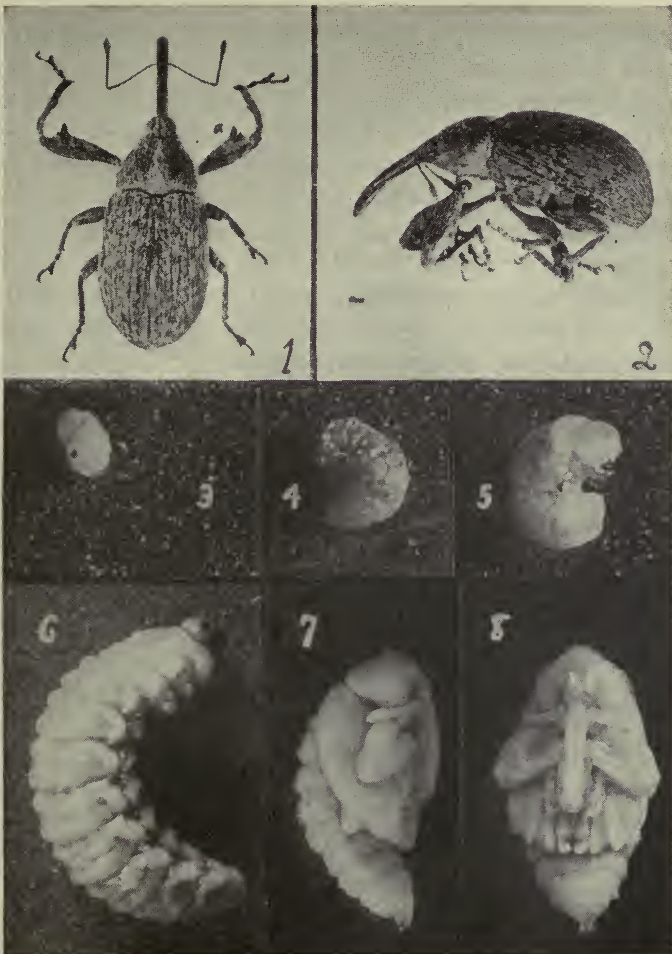
1. Secure samples of the cotton plant at various stages of growth, and make a study of all parts.
2. What different varieties of cotton are grown in your region? What measures are being taken to improve the quality?
3. What proportion of the cotton growers in your vicinity practise rotation of other crops with cotton? What crops are used?
4. What fertilizers are employed for cotton by the most successful farmers in your neighborhood?

3. *Enemies of Cotton*

Cotton, like other farm crops, is subject to attack by various insects and diseases.

The boll weevil.—The boll weevil is said to be the most harmful insect known to agriculture in this country. It came to the United States from Mexico about 1892, first beginning its ravages in Texas. Since that time it has spread over most of the cotton area, and caused the loss of millions of dollars to cotton growers.

Life history of the boll weevil.—The worst enemy of cotton is the boll weevil. In the spring and throughout the fruiting season eggs are laid in small holes made by the female in the cotton square or boll. In about three days the egg hatches into a grub, which at once begins feed-



THE BOLL WEEVIL AND ITS STAGES

Fig. 1, Adult boll weevil, viewed from above; *a*, two teeth on fore femur; fig. 2, adult weevil, side view; fig. 3, egg of weevil; fig. 4, grub about two days old; fig. 5, grub at entrance to second stage after shedding first skin, about three days old; fig. 6, grub fully grown, about ten days from egg; fig. 7, transformation or pupal stage, side view, snout, legs and wings forming; fig. 8, pupal stage, front view of fig. 7. Figs. 1, 2, 6, 7 and 8 enlarged about ten diameters; figs. 3, 4 and 5 enlarged about twenty diameters.

ing on the plant. In a little more than a week the grub passes into the pupa stage, which lasts from three to five days, when the second generation of adult, the beetle, is developed. It requires from two to three weeks for the weevil to develop from egg to adult, hence a number of generations are produced in a season. The offspring of a single pair in a season may exceed 12,000,000 individuals.

Fighting the boll weevil.—Since the weevil life is spent and damage done chiefly in the square or boll, methods of poisoning and picking have not proved very satisfactory. The most important step in the destruction of the weevil is to kill as large a proportion of them by exposure during the winter months as possible. In order to do this the fields should be cleaned of all of the stalks and rubbish and the seed bed prepared in the early fall. Cotton stalks should be thoroughly uprooted and if possible plowed under just as soon as the crop is picked. Then the ground should be well dragged and packed close so as to shut all crevices through which the beetle might come to the surface. Rubbish left upon the ground during the winter months will be sure to furnish a safe hiding-place and protection for the weevil, hence should be burned.

The next most important step is the planting of an early variety in order to get the crop well out of the way of the larger broods of weevils. Through a system of seed selection it is possible to develop a plant that is very strongly resistant to the attacks of the boll weevil.

Since the weevils live mainly upon the cotton boll and the cotton plant, it is easy to understand why it is important to rotate the crop. Cotton should not be grown on the same piece of ground in boll weevil territory a second year. This plan, if followed out, is also bound to bring about the diversification of farming so greatly needed in the South. The weevils can not possibly live in the soil for more than twelve months without direct contact with a source of food supply, hence the effectiveness of a three-, four- and five-year rotation having the cotton field for each successive year sufficiently separated so as not to make it easy for the weevil to pass from one field to the other. Cotton seed should be treated with *carbon bisulphide* in order to make sure that no weevils are carried into new soil.

The cotton anthracnose or boll rot.—Next to the boll weevil, this is considered one of the destructive enemies to cotton production. It is usually referred to as *boll rot* and is a disease caused by fungous growth which attacks the seedlings, the stems, and the boll pedicels. It causes the loss of many millions of dollars every year. It develops readily in hot muggy weather and where the planting has been close. The best way to prevent this disease is by careful seed selection. Healthy seed is very important and the systematic rotation of crops necessary as the disease spores will live upon dead bolls from year to year. It is also possible to develop through selection of seed from healthy stalks a plant quite resistant to the disease.

Topics for Investigation

1. To what extent does the boll weevil work in your region? When did it first appear? Is it increasing or decreasing? Ask your father about these questions.
2. What other enemies damage the cotton crop in your vicinity? What measures are being followed to eradicate the evil?
3. Make a collection of all the insect enemies of cotton available in your vicinity, and learn to identify each.
4. Work out a crop rotation based on cotton, corn, or whatever is the staple crop of your region.
5. Make a list of all the different uses which the parts of the cotton plant serve.

6. Make a map of the cotton states and show where the boll weevil started to attack cotton in Texas, and indicate upon the map the progress of the boll weevil from year to year up to the present time. What states are not now infested with this plant enemy?

4. *Demonstrations*

1. Demonstrate the proper method of selecting cotton seed in the field.
2. Demonstrate how the lint was removed from the seed before the time of the cotton gin.
3. Demonstrate how to pick cotton properly.
4. Show the difference between the long and the short staple cotton fiber.
5. Demonstrate the proper method of treating the seed before planting.

5. *Play Contests*

1. Judging of cotton bolls, cotton stalks, and cotton seed for seed variety.
2. Cotton picking contest in the field.
3. Contest to show how to determine the types and varieties of cotton.
4. Contest in the judging of different kinds of cloth made with all or a part of cotton fiber. A large number of samples of different colors, texture, weave, etc., should be furnished from which this work can be done.
5. Cotton drawing contest.
6. Essay writing contest.

6. *Cotton Clubs*

Boys' and girls' cotton clubs should be organized throughout the entire cotton belt. Consult the state leader in charge of club work and obtain his help, follow-up instruction, and direction. The following will prove a good basis of award for such a club project:

1.	Yield	20
2.	Net profit on investment	20
3.	Exhibit of products, including both market and seed samples	20
4.	Crop records and story of year's work	20
5.	Cultural methods practised as evidenced by soil building, seed selection and work to defeat the boll weevil and other insects and plant diseases of the plant	20
	Total score	100

CHAPTER VIII

THE POTATO

THE common white, or Irish, potato is a native of South America. It was brought to North America by the early Spanish settlers. Potatoes are now so important an article of food in almost every country that little more than one-twentieth of the world's supply is grown in the United States.

1. *The Potato Plant*

Secure, if possible, a complete potato plant, including the roots and tubers. What is the shape of the stem? The nature of branching? The type of leaves? The flowers? Do potatoes bear seed? Are potatoes raised from seed? Why not plant potato seed instead of the tubers? Are the tubers a part of the root system, or do the roots only bear the tubers as the stems of tomatoes bear the fruit? Compare a potato plant and a tomato plant.

The plant.—The potato plant varies from one and one-half to five feet in height, though it does not show this great a height owing to its spreading habits of growth. The terminal clusters of flowers bear seeds, from which new varieties are often developed. For practical purposes the plant is reproduced from the tubers.

Though both plant and roots die upon the ripening of the seed and tubers, the potato is a perennial by means of the tuber from which the plant is reproduced. Since the tubers are destroyed by freezing, they should be harvested before frost. Potatoes are annuals in all regions where the soil freezes during the winter.

Tubers.—Examine a tuber. Note the distribution of the "eyes." These contain the buds from which the new plants are produced. The end at which they are thickest is called the "seed" end, and the other the "stem" end. At which end is the tuber attached to the roots of the plant? Are some potatoes more deeply indented at the eyes, and more irregular in shape than others? Which are more desirable for cooking? Why? Which have the better market demand?

Though there are hundreds of wild plants belonging to the same genus as potatoes, comparatively few of these are known as cultivated plants. Among the most closely related cultivated plants are the tomato and tobacco, which belong to the same family; the dasheen is grown in the South as a substitute for potatoes.

2. *Potatoes as a Farm Crop*

After corn, cotton, hay, wheat and oats, potatoes are one of our most valuable crops. They are raised in every state, though the chief potato region consists of ten or fifteen northern states reaching from the Missouri River eastward to the Atlantic. More than three million acres are planted with potatoes in the United States each year. The annual crop is nearly three hundred and fifty million bushels, or about four bushels to every inhabitant.

The potato region.—The following are the fifteen states which, according to federal statistics, produced the largest amount of potatoes for the period 1902-1911, together with the percentage of the entire crop of the United States grown by each:

New York	12.02%
Michigan	9.72%
Wisconsin	9.72%
Maine	7.60%
Pennsylvania	6.47%
Minnesota	5.71%
Ohio	4.66%
Iowa	3.93%
Illinois	3.39%
California	2.71%
Colorado	2.33%
New Jersey	2.30%
Washington	2.18%
Indiana	2.15%
Nebraska	1.15%
All others	24.35%

3. *Raising the Crop*

The soil.—Potatoes thrive best in a rich sandy loam containing a good supply of *humus*. Hard stiff soils or heavy clay are not well adapted to potato raising. The best soil on the farm should be devoted to the potato field, both because potatoes demand a better soil than most other crops, and because the value of potatoes per acre is greater than almost any other field crop.

Ground that has recently raised clover, alfalfa or some other legume is especially suited to potatoes. While barnyard manure will greatly increase the yield, it will also favor the ravages of scab and other potato diseases, and so lower the quality of the crop. It is usually a mistake to plant potatoes on a freshly manured field. If manure is used, it is better to follow a heavy manuring with a crop of corn, and then plant potatoes for the second year crop.

Green manuring, that is, the plowing under of green crops such as clover or alfalfa, will add greatly to the yield. If the sod is old, it is usually better to grow one crop of corn before potatoes are planted on the field. Commercial fertilizers can be used to advantage for potatoes on most soils.

The seed bed.—Potatoes should have an especially well prepared seed bed. The plowing should be deeper than for most crops, since the seed is planted deeper and loose soil must be had for the roots and tubers. In average soils the plow should be set to a depth of not less than eight inches.

The seed bed must be well pulverized and thoroughly packed. Usually not less than four harrowings and diskings are required for the best results. Experiments have shown that the difference in yield caused by harrowing part of a field four times and the remainder of it but twice may be as much as twenty per cent. of the crop in favor of the better preparation.

The planting.—Potatoes should be planted not less than four inches deep. If less than this depth it will not give room for the tubers to grow without protruding from the ground. This is sure to result in injury from sunburn. Most potato growers drill the seed, dropping single pieces of seed from twelve to fifteen inches apart in the row. In some regions potatoes are planted in cross rows like corn, with three cuts of seed to the hill.

The date for planting differs in various regions, but the greater part of the crop in the northern states is planted during the last half of May. From twelve to twenty bushels of seed are required for an acre, depending on how the tubers are cut for planting. Where crops of any considerable size are raised, the dropping is usually done with a machine or planter, some makes of which are arranged to distribute commercial fertilizer at the same time.

Cultivating the crop.—Potatoes demand good cultivation. Harrowing should be done before the potatoes are up. From one to two harrowings may be given after the plants appear. Throughout the growing season a fine soil mulch should at all times be maintained by means of frequent cultivation. Especially after a rain should the soil crust be broken. The cultivation should be rather shallow, and potatoes should not be hilled up as is so often done.

Harvesting the crop.—When the vines have died the potatoes have stopped growing and the crop is ready to harvest. In the case of small fields, potatoes are often harvested by being plowed out with an ordinary plow, the tubers being picked up by hand, and the field afterward harrowed to uncover any that have been missed.

In regions where potatoes are grown in large quantities the digging is done with machines, several kinds of which are now on the market. The average machine will turn out about three acres in a day, and will require from five to ten pickers to keep up with it.

Storing the crop.—In order to keep well, potatoes must be stored in a cool place. The house cellar is usually too warm for them, and they also give out an unpleasant odor that permeates the house. A common type of vegetable cellar to be found on many farms is built with concrete or stone walls, the excavation being made on a side hill. It is covered with a shingle roof, and has a board floor on a level with the ground at the upper side, thus making an excellent tool and machinery house over the space used for vegetables.

Topics for Investigation

1. What is the acreage of potatoes raised on your home farm this season? If you are not certain, go out and measure the field carefully. Compare the acreage of each of the farms represented in the school.

2. What is the yield of your potatoes per acre? How

does this compare with the other farms of your vicinity? With the state? With the United States?

3. Select two medium-sized potatoes, one regular, smooth and with shallow eyes, and the other irregular and with deep-set eyes. Weigh each. Pare both potatoes, as nearly the same as possible. Now weigh the skins, also the pared tubers. Which lost the larger percentage in paring? Which is easier to pare? Which looks more pleasing for the table? Which would be the better to select for seed? Which one is better for the market?

4. Bring a sample of as many different varieties of tubers as can be found in your neighborhood. Learn to recognize the chief breed characteristics so as to identify the different varieties, such as Early Rose, Bliss Triumph, Early Ohio, Gold Coin, Burbank, Rural New Yorker, Walter Raleigh. What are the principal early varieties? Late varieties? Do you find mixtures in which it is impossible to determine the varieties?

4. *Improvement Through Selection of Seed*

One of the first factors in successful potato growing is the securing of good seed. Without this, fertility of soil and careful cultivation are largely wasted.

Good seed will possess the following qualities: It must (1) be *pure,* that is, free from mixtures of varieties; (2) be taken from *productive* plants, or "hill selected"; (3) be *uniform* in size and shape; (4) be *firm and sound,* not shrunken or decayed; (5) be entirely *free from disease;* (6) *not wholly mature* when harvested; (7) have *sprouts just showing* at time of planting.

It has been estimated by experts that attention to these points would add at least ten per cent. to the potato crop each year. This would mean an increase of nearly thirty-five million bushels, and worth about $21,000,000 annually.

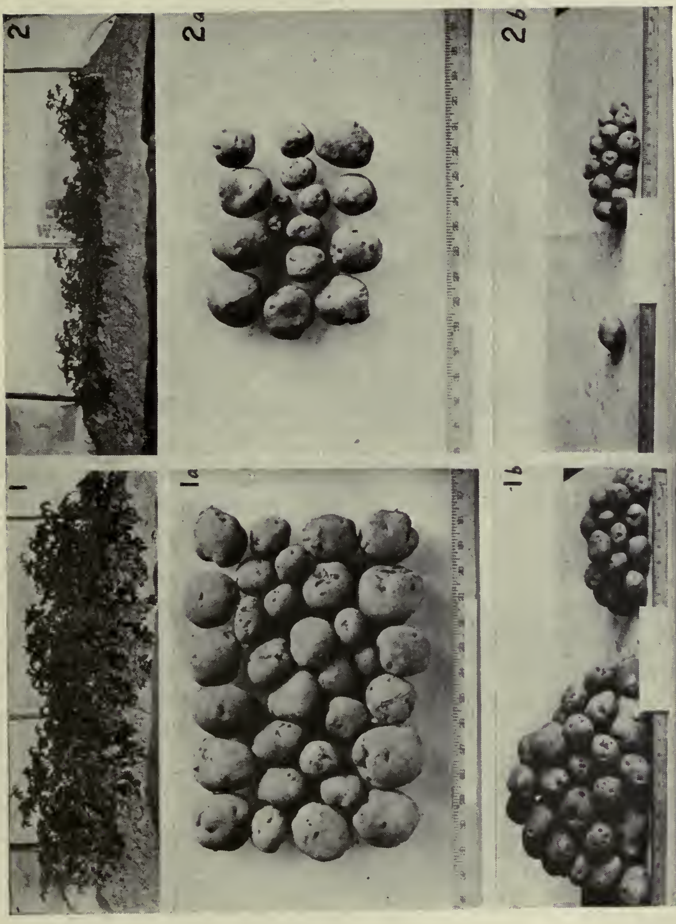
Pure seed.—Mixed varieties present several disadvantages in potato growing. The crop will not mature evenly. Thus, when the earlier variety has ripened and is ready for the market or table, the later one will have the potatoes just setting, and unfit for use. Mixed varieties do not cook evenly, and when baked or broiled together some will be overdone before others have softened. General mixture of varieties in potatoes as in other crops tends to degeneration and running out of the strain or breed.

Seed from productive plants.—Seed should be taken only from the strongest and most productive plants, no matter what the variety. This can not be accomplished by selecting seed from the potato bin, any more than the best seed corn can be selected from the crib or wagon. For a certain tuber may itself be of good size and look promising, but have come from a plant that produced but one or two potatoes, or that grew only one tuber of fair size, with several culls.

One of the most successful methods of developing high-grade seed potatoes is what is called the *tuber-unit* method. This consists of selecting from the seed bin a quantity of the most perfect tubers, each to weigh from six to eight ounces. These are cut for planting by splitting the tuber into four quarters, from seed end to stem end.

The tuber-unit method.—The four pieces of each potato are planted in succession twelve inches apart in the row. A longer space is left between the sets of fours, thus making it possible to watch the outcome of each tuber by itself. Before the plants begin to die, careful inspection is made, and any mixtures, and imperfect or weak plants are marked for rejection. Only the most promising and uniform are reserved for the selection of seed.

When the crop is harvested, each set of four is dug by itself. A further selection is made by rejecting the total



Strong and weak tuber units. Nos. 1a and 2a, the yield from Nos. 1 and 2 respectively, Nos. 1b and 2b are the yield from five tubers planted from 1a and 2a respectively.

product if any one of the four plants has failed to produce uniform, desirable tubers. The potatoes produced by each set of four selected for seed are put into separate sacks and kept for further examination.

Second season of tuber-unit planting.—Finally, the contents of each sack are inspected for the weight of marketable and unmarketable tubers, and other desirable qualities of the type. From each of the four-plant units the best ten tubers are to be selected for the next year's planting. This selected seed is planted the following year in the same way as the first season, thus giving forty plants to the unit instead of four. The product from the best forty-hill rows is kept for seed for the general crop for the following year. By thus keeping a breeding plat for seed, potatoes can be greatly improved, and the yield much increased.

The tuber-unit method can be rendered even more effective by making the first selection from the field instead of the potato bin. This is done by going into the field before the vines begin to die and marking a number of the most vigorous and desirable plants. These are harvested separately before wholly mature, and seed taken from the best hills.

The practise of planting for seed the small and unmarketable potato culls can not be too strongly condemned. It lessens the yield, lowers the quality of the crop and causes the variety to deteriorate or "run out."

Cutting seed potatoes.—Whether it pays better to cut potatoes for seed or plant the whole tuber has been much discussed. It is believed by many potato growers that under average conditions the yield will be greater when quarters are planted than when pieces with single eyes are used, and that halves will produce more than quarters. It is not sure that whole tubers will produce a larger yield than halves. The weight of experience seems to favor planting halves.

Immature seed.—For vitality, high yield and good market qualities, potatoes intended for seed should be harvested before entirely ripe (by hill selection); that is, before the vines have died. Many experiments have shown that immature seed will produce a considerably higher yield than seed allowed to ripen before digging.

Home-grown seed not always best.—Contrary to the rule with most farm crops, seed brought from another region often produces a better crop of potatoes than home-grown seed. Especially is this true when northern grown potatoes are taken farther south. Not only is the yield increased, but the time required for maturing is shortened by securing seed from colder regions. Great care should be taken in importing seed tubers not to introduce new forms of potato diseases.

5. *Potato Enemies*

Potatoes have many enemies, and the number seems to be increasing, owing to diseases being brought in from other countries.

Scab.—Scab is one of the most wide-spread and destructive of potato diseases. It causes a rough, pitted, scabby condition which may attack the tuber in patches, or extend over the entire surface. Whether scab is caused by a fungous growth or a species of soil bacteria is not certain. It is fortunate, however, that a very simple and effective remedy is known. This consists in treating seed potatoes before planting.

There are several mixtures used for this purpose; the cheapest and most easily applied is a formalin solution.

This is prepared by mixing one pint of formalin with thirty gallons of water. The seed potatoes are soaked in the solution for two hours, and then planted without allowing them to come into contact with bags or utensils in which scabby potatoes have been kept.

Leaf, or early blight.—Leaf blight is another common potato disease. It attacks the leaves and stems, first showing about the time that the tubers begin to form. Its presence may be detected by the presence of grayish brown spots on the leaves, the part of the leaf attacked soon becoming hard and brittle. Within three or four weeks the leaves are all killed, and the stem is also affected. The tubers grow but little after the leaves are first attacked; hence the crop is ruined unless the blight can be checked.

The ravages of leaf blight can be almost if not wholly prevented by spraying the plants with the Bordeaux mixture (see page 249). This solution is applied with a spraying machine at the rate of about fifty gallons to the acre. From three to five sprayings during the season are required when leaf blight threatens. One pound of Paris green to the acre at the first spraying, and the same amount later in the season will also destroy the potato beetles, which often prove such a pest.

Late blight, or rot.—The blotches and blackish streaks often seen running through tubers are caused by late blight, or potato rot. This disease first attacks the leaves and stems, causing them to soften and decay, producing a bad smell. Late blight often appears suddenly, and spreads through a field with great rapidity. A green, healthy-looking field may turn almost black in a day or two.

The treatment for late blight is the same as for leaf blight, and should never be neglected in regions where blight is common. It is far better to begin the spraying before either form of blight begins to appear, for this is the easiest time to prevent it.

1. Select tubers of the same size from different varieties, such as Early Rose and Rural New Yorkers. At your homes try boiling them together. Do they cook in the same time? Try baking, frying, etc.

2. How deep does your father plow the ground for potatoes? How deep does he plant? Does he use commercial fertilizers? Does he manure the field for potatoes? If so, is the crop scabby?

3. What plan is used in selecting seed for your potato crop? Are culls ever used for seed? Is there any more reason in using small potatoes for seed than in taking your seed corn from nubbins?

4. Suppose that seed potatoes are seventy-five cents a bushel, and that when quartered twelve bushels are required to plant an acre; also suppose that by planting halves instead of quarters the yield is increased twenty bushels per acre, and that the new crop sells at sixty cents a bushel. Which way of cutting seed is best, and by how much an acre?

5. Bring samples of potatoes affected by scab; by rot. Study the effects of each on the tuber. Secure if possible samples of plants affected by blight, and learn to identify the disease. What is the most troublesome potato disease in your region? What is the remedy?

6. After talking with your father about it, itemize the cost of raising an acre of potatoes. Compare this with the cost of producing an acre of corn; an acre of wheat or oats. Now, taking the average yield of each crop, compare the profit of potato raising with that of other crops. Would it not be possible to double the yield of potatoes per acre in your region? How would you go at it?

6. *Potato Demonstrations*

1. Demonstrate how to select seed potatoes from the hill.

2. How to prepare seed potatoes by cutting for seed.

An Iowa potato club boy and a part of his crop.

Club boy, and prize seed potatoes, sprouted enough for planting.

3. How to manufacture potato starch out of culls and injured tubers. (See recipe, U. S. Dept. of Agriculture.)

4. How to grade and crate potatoes.

5. How to prepare potatoes in various ways for use in the home.

7. *Potato Play Contests*

1. Potato race.

2. Potato paring contest, based on time, skill and weight of peeling, using twelve uniform tubers.

3. Potato judging contest.

4. Variety naming contest.

5. Oral recipe contest. How to use the potato for the home.

8. *Potato Club Projects*

One of the most interesting field or garden crop projects is in connection with the production and management of a plat of potatoes. This can be taken up uniformly by both boys and girls, using not less than one-eighth acre as a club plat basis per member.

The club work.—The study and practise in the work are to be based on the entire management of the club plat, including treatment for diseases and insects, grading, crating, marketing, manufacturing of potato starch, study of the life history and the relation of the potato to the various activities and studies of the schoolroom.

Club festival.—A potato club festival, covering all the interests of potato culture in the community, with the exhibits of both fresh and cooked products, lectures on potato culture, etc., can be made one of the big events of the fall term, to which all the patrons of the school can be invited.

The award.—The basis of award for both school credit and prizes may be as follows:

1.	Yield	30
2.	Net profit on investment	30
3	Exhibit of products (fresh and cooked)	20
4.	Crop report and story	20
	Total Score	100

CHAPTER IX

TOBACCO CULTURE

FOUR of the leading agricultural plants have been given to the world by the Americas. They are the white potato, the sweet potato, corn and tobacco. The Indians were probably the first users of tobacco. They used it for chewing and smoking as early as the sixteenth century.

1. *The Tobacco Region*

Soil and climate.—Tobacco may be successfully grown in all latitudes in the United States from Canada to the Gulf of Mexico. Yet the quality and flavor of the plants are so greatly affected by climate and soil that the crop is nearly all raised in a relatively small area. On fertile clay soil the tobacco plant grows large and heavy with leaves rich in oil or gum and cures dark red or black. In light sandy soil the same strain will produce thin leaves, fine texture, and will cure yellow or mahogany color, hence the necessity of selecting the soil carefully. Kentucky and the states bordering upon it produce more than half of our native crop.

The tobacco states.—Named in the order of their importance, the twelve leading states in tobacco production are: Kentucky, Virginia, North Carolina, Tennessee, Ohio, Pennsylvania, New York, Wisconsin, South Carolina, Connecticut, Maryland and Missouri. This territory grows more than ninety-five per cent. of the native commercial crop.

2. *Uses and Classes of Tobacco*

In accordance with the use to which it is put tobacco may roughly be divided into two great classes: (1) cigar tobaccos, and (2) tobaccos for other lines of manufacture. Each of these classes has several types or varieties.

Cigar tobaccos.—A cigar consists of three different parts, *wrapper,* or the outer layer of tobacco leaves; *binder,* or the second layer; and *filler,* or the central portion. Each of these parts requires a different type of tobacco. The tobacco in a single cigar may therefore come from three widely separated regions.

For example, the Connecticut valley and parts of Florida and Georgia are the principal wrapper-leaf sections of the United States. Wisconsin and Pennsylvania produce chiefly a binder-leaf type. Certain districts in Pennsylvania, Ohio and New York, and small areas in Florida, Georgia and Texas grow the filler-leaf types.

Three important varieties comprise most of the cigar tobaccos grown in this country. These are: (1) the *Broadleaf,* or Seedleaf, group, grown chiefly for wrapper and binder purposes; (2) the *Havana Seed* group, a wrapper and binder variety, though grown also for filler; and (3) the *Cuban* group, grown principally in southern regions for use as filler.

Manufacturing tobacco.—Kentucky and parts of adjoining states are the great manufacturing tobacco region of the United States. Many different varieties are grown, chief among which are *White Burley, Maryland, Oronoca* and *Pryor.*

These and other similar strains are also produced in most states of the South.

3. *Raising the Crop*

Tobacco requires more careful cultivation than almost any other farm crop. This, in part, is because the plant is very sensitive to soil and climatic conditions, and in part

A typical Connecticut tobacco field.

because the flavor is affected by the soil conditions and the care given the plants.

Soil and seed bed.—Rapid and unhindered growth from time of planting to maturity is necessary to secure fine texture and good flavor. The seed bed should therefore be worked to the finest tilth.

Tobacco, like cotton and corn, requires a rich soil and a careful rotation of crops. A free use of fertilizer, especially nitrogen and potash, is necessary for the best results. From ten to twenty tons of stable manure to the acre should be plowed under, preferably in the fall and the ground well cultivated in the spring before planting. Commercial fertilizers containing nitrogen, phosphorus and potassium are often profitably used in addition to manure. Most tobacco soils also require the application of lime, not alone to improve the growth of the plant, but also to better its quality.

Many tobacco growers find it profitable to *burn* the seed bed before planting the crop. This is usually done either (1) by shoveling the top two or three inches of soil into a specially constructed sheet-iron box heated by a wood fire and moved over the field; or (2) by the application of steam heat directed to the surface of the field by means of apparatus devised for the purpose. The object of this heating of the soil is to kill the weeds and other tobacco enemies and thereby give the plants a better chance for free growth.

Seed selection.—The seed from the tobacco plant should be as carefully selected from the mother stalk as is the cotton or seed corn. Seed should be taken from the healthy plants with well-shaped leaves free from suckers. The proper standard of a plant for quality and high production should be considered.

Planting and cultivation.—Tobacco plants are grown from seed planted in hotbeds or cold-frames. The plants are transplanted to the field in rows about three and one-half feet apart. The transplanting may be done by hand or with a horse machine. Cultivation should begin as soon as the plants have started to grow and continue as long as the size of plants will permit. The first cultivation should be deep,

New cigar leaf, Cooley hybrid plant.

and the later ones should be shallow to avoid cutting the roots and to conserve the soil moisture.

Harvesting the crop.—Tobacco is harvested by one of two different methods. Either (1) the entire plant is cut off near the ground when the middle leaves are ripe,

Curing tobacco in barn on a large Kentucky plantation.

allowed to wilt for a time, and then hung under cover to cure; or (2) several pickings of leaves are made by beginning with those nearest the ground, which ripen first, and stripping them from the central stalk. When this plan is followed the leaves are carried to the curing barn when partly wilted and hung in rows to dry. Usually five pickings are required for harvesting the entire crop.

4. *Insect Enemies*

The tobacco plant is subject to fewer enemies than most other farm crops, yet much damage at times results from the ravages of certain insects.

The tobacco flea-beetle.—The tobacco flea-beetle or "flea bug" is widely distributed and does much harm to growing tobacco. It is a small insect, oval in shape and reddish-brown in color. The beetles usually appear in July, beginning their attack on the lower leaves and gradually proceeding to the upper. The leaves upon which the beetles have fed show small dry spots which later become holes through the leaf. As the leaf is the valuable part of the plant it is evident that great damage may be done the crop by these pests.

A few simple remedies are effective in large degree in destroying the tobacco flea-beetle. *First,* since the insect thrives on several different kinds of weeds, such as the jimson and various nightshades, the margins of the field should be kept clear of all weeds that might serve to harbor the beetles. *Second,* a few clumps of such weeds may be left at certain places about the field to attract the insects and these clumps then treated with arsenate of lead or any other of the arsenical sprays. *Third,* the tobacco plants themselves may be sprayed with similar poisons.

The tobacco horn worm or "hornblower."—This insect, which is also found in almost every part of the tobacco region, frequently causes great damage. The horn worm is the larva, or caterpillar, of either one of two species of sphinx moths. The worm is from two to three inches in length, green in color, with the horn, or tail, end of the body either red or black, depending on the species to which it belongs.

Small farm tobacco curing barn, South Carolina.

The row to row variety test of a tobacco experiment station, North Carolina.

Since the horn worm feeds on the leaves of the plant, it may be controlled in the same way as the flea-beetle, by the use of arsenical sprays. Some planters depend on hand picking of the worms when the number is not too great. The moths from which the caterpillar comes are sometimes poisoned by placing sweetened *cobalt* in the flowers of the jimson weed from which the insect sucks honey.

Tobacco bud worms.—Two different species of worms attack the buds of growing tobacco, biting holes in the young leaves. One of these, called the *true bud worm,* occurs frequently in southern tobacco regions. The moth from which the caterpillar comes is small and of a greenish color. The other species, called the *false bud worm,* is the same caterpillar that attacks cotton, corn, tomatoes and various other crops. It is familiar throughout the South as the *cotton boll worm,* and in the North as the *corn ear-worm.*

The best remedy so far devised for these pests is the arsenical sprays already recommended. Clean culture and freedom from weed fringes about the fields will also tend to reduce their number.

Topics for Investigation

1. If tobacco is grown in your region, to which class does it belong, *cigar* or *manufacturing* tobacco? What varieties are represented?

2. To what markets is the crop in your vicinity shipped? At what price does it sell?

3. Do the tobacco growers in your region use plenty of fertilizer? If so, what kinds are used? Is lime or rock phosphate used? Are the seed beds *burned* before planting?

4. What method of harvesting is used? Is the drying accomplished by natural air currents or by firing? What is meant by "drying tobacco, coming in case"?

5. Cut a cigar transversely across and note the three parts of its structure, wrapper, binder and filler. Split one of the pieces longitudinally and study the parts.

6. Show how to make a bookkeeping record of raising an acre of tobacco, including all the expense involved and the amount received for the crop.

7. In what way can tobacco be used for the treatment of insect and plant diseases?

5. *Demonstrations*

1. Demonstrate how tobacco should be planted.
2. Show the proper method of transplanting.
3. Demonstrate how to thin and hoe the plants.
4. Demonstrate by the use of plants how they should be harvested and prepared for the dryer.
5. Show how to treat the tobacco plant for wilt.
6. Show how the cigar is made from the different kinds of tobacco.
7. Demonstrate how to select seed from the stalk.
8. Demonstrate how to prevent cross pollenization of the tobacco plant.

Note: Every tobacco grower in the neighborhood should be induced to carry on a series of tobacco demonstrations each season under direction of county demonstration agents in order to convince themselves and neighbors as to what constitutes good practise and efficient management of a tobacco plantation.

CHAPTER X

SUGAR FARMING

SUGAR, a soluble form of the carbohydrates, is one of our most important foods. It has great nutritive value, is easily digested, and is palatable to nearly every one. We consume about 4,000,000 tons a year, or more than 80 pounds for each person in the United States. In less prosperous nations sugar is found too expensive a food, and a much smaller proportion is used. Only about one-fourth of the sugar required for home consumption is grown in this country, the remainder being imported.

There are five principal varieties of sugar used: *cane* sugar, *beet* sugar, *maple* sugar, *corn* sugar and *sorghum.* Cane sugar leads both in the amount used, and in the number of grades produced. Most of the finer table and manufacturing sugars are from cane. Beet sugar comes next in amount. Maple sugar is not produced in large amounts. Large quantities of corn sugar and sorghum are used in the form of sirup, or molasses. Less important varieties are *grape* sugar, from starch; *fruit* sugar, from fruits and honey; *malt* sugar, from malted grains; and *milk* sugar from the milk of cows, goats, etc. The chemist divides all sugars into two classes, *saccharose* and *glucose.*

1. *The Sugar Regions*

Nearly every state grows some amount of one of the five principal kinds of sugar.

Cane sugar region.—By far the greater part of the sugar used in this country is made from sugar cane. Only a small proportion of what we require is produced here, most of it being imported from the West Indies and other tropical or semi-tropical regions. Practically all our home-grown cane sugar is raised in the following states, which are named in the order of the amount produced: Louisiana, Georgia, Texas, Alabama, Mississippi, Florida, South Carolina, California, North Carolina. Of these states, Louisiana has produced more than twice as much as the other eight states combined.

Beet sugar region.—The beet sugar region is far more widely distributed than the cane sugar region. The following are some of the leading beet sugar states: Colorado, California, Michigan, Utah, Idaho, Wisconsin, Montana, Ohio, Kansas, Iowa and Nebraska. This wide area indicates that sugar beets will thrive in a great variety of climates and soils.

Sorghum sugar regions.—Sorghum also thrives over a wide range of territory, as will be seen from the distribution of the following leading sorghum producing states: Kentucky, Tennessee, Missouri, Texas, North Carolina, Illinois, Oklahoma, Indiana, Alabama, Mississippi, Louisiana and Ohio.

Maple sugar region.—The leading maple sugar states are New York, Ohio and Vermont. Pennsylvania, Michigan and Indiana also produce considerable quantities.

2. *Producing Cane Sugar*

The cane sugar plant, which grows much like corn, was originally a tropical plant, but most varieties under cultivation will thrive best in a semi-tropical climate. Some varieties will even succeed in temperate regions. Territories having a temperature of from 65° to 90° Fahrenheit during midsummer are considered best. Under good conditions the plants will grow from twelve to twenty feet high.

Sugar cane was first introduced into Europe by the Moors. It was known as the "honey bearing Indian reed." Plantations were later established in Spain and Sicily. Spanish sailors later carried the seed to the Azores, Canaries, West Indies and other islands. From these sources the plant was brought to America.

Varieties of sugar cane.—The most common varieties grown in the United States are *Louisiana Purple,* which is known in Georgia as *Red Cane; Louisiana Striped* or *Ribbon Cane;* a strain known as *D-74*, and another known as *D-75*.

Moisture.—Cane sugar, because of the large amount of foliage, requires abundant moisture during the growing season. The average rainfall should be from two to four and one-half inches per month during the period of greatest growth. The cane may be successfully grown by irrigation, as it is capable of drawing from the soil practically all the water supply necessary for its development.

Soil requirements.—The soil requirements of the cane sugar plant are very much the same as those of the sugar beet, corn, potato and trucking crops. The soil should be well filled with humus, light and well-drained. The plant requires a well-prepared seed bed and is thought to produce the largest quantity of sugar content where the soil is best adapted for the production of corn and heavy forage crops. The cane sugar plant resists drought better than corn and is sometimes grown successfully in the semi-arid land of Oklahoma, Texas, Kansas and Nebraska.

Cultivation and management of crop.—The cultivation and general management of the soil before planting is similar to that required for successful corn production. After the seed bed has been thoroughly prepared by deep plowing and subsoiling where possible, the soil should be pulverized thoroughly, and a fine surface mulch should be maintained throughout the growing season. This is best done by shallow cultivation, and harrowing. The crop should be kept entirely free from weeds and should be thinned so as to permit the proper development of the canes.

Harvesting and manufacturing.—When the cane is used for forage purposes, as is often done, it is usually cut early in the season, when it has attained a height of about three or four feet. It can be fed at once, or put into a silo, or even cured in the field as hay and fed during the winter months.

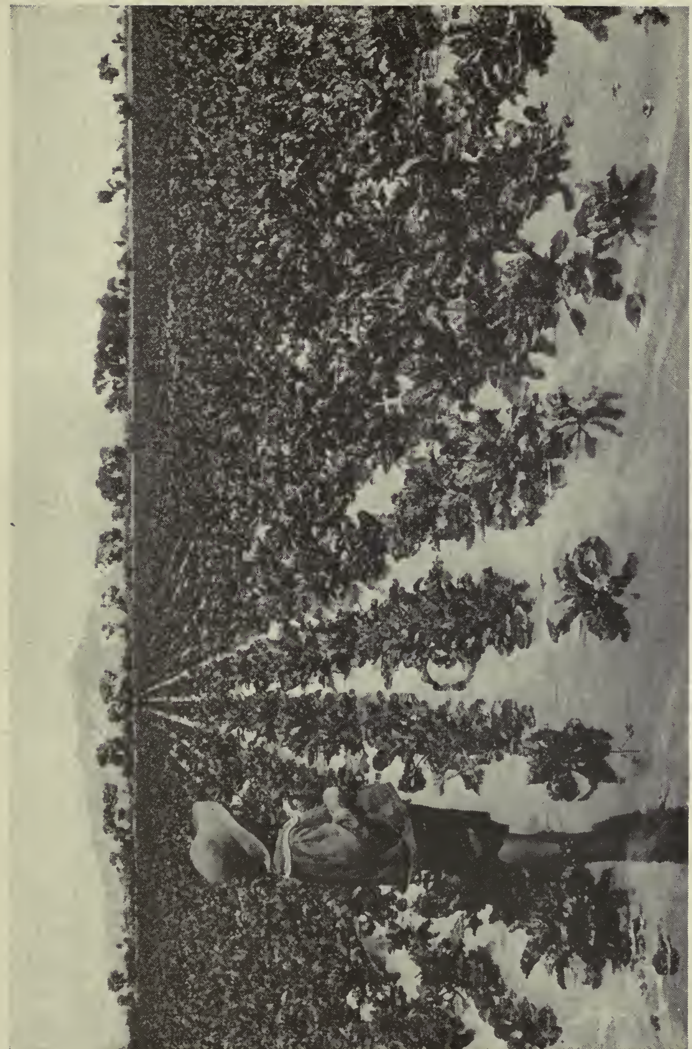
When used for sirup or sugar the cane should be cut before frost, or as soon as the heads are past the milk stage and before they harden. The heads or tops should be cut off and leaves stripped and kept for forage purposes. These are valuable for farm stock and the seed is especially prized for poultry. For seed purposes the best heads are cut when nearly ripe and hung up to dry.

After the tops and leaves have been stripped, the canes are cut and hauled to the sugar house where they are run several times through crushers. The juices extracted from the cane are strained, allowed to settle in order to remove the impurities, and then evaporated to the proper consistency. If used as sirup the juice is canned in tin, if used for sugar it is kept in form of sap and then purified, evaporated and refined, finally becoming either *white, granulated, brown,* or *open kettle* sugar, or *New Orleans molasses.*

3. *Growing Sugar Beets*

Under right conditions of climate and soil and with a sugar factory near at hand the raising of sugar beets can be made a very profitable industry.

Soil.—Sugar beets grow successfully in any soil that will produce a good crop of corn, wheat, potatoes, or other



Four hundred acres of sugar beets under irrigation, Salt River Valley, Utah.

common crops. New soil, so favorable for most crops, is not so good as cropped soil for sugar beets, especially if the soil contains much decaying vegetable matter. Beets are a good reclaimer of run-down soils, and may sometimes be used to help improve worn out or depleted land.

Climate and moisture.—As far as temperature alone is concerned, regions having an average of 70° Fahrenheit for June, July and August are most favorable for sugar beets.

Sugar beets require a fair amount of moisture. This may be provided (1) by rainfall averaging from two to four inches per month during the growing season; (2) by irrigation; or (3) by sub-surface water seeping upward to the roots through soil of such a nature as to favor this method of irrigation.

Sugar beets on irrigated land.—No more favorable conditions for raising sugar beets can be found than on the irrigated lands of the West. Nor can a more profitable crop be discovered for many semi-arid regions than beets. It has been estimated that one million acres of western irrigated land devoted to the raising of sugar beets under intensive cultivation would increase our sugar crop to such an extent that we could raise all we need instead of only twenty-five per cent. of it.

Raising the crop.—Special methods are required for the successful raising of sugar beets. The ground should be plowed not less than nine inches deep. The plow should be followed furrow by furrow with a subsoiler, loosening the soil to a depth of six or eight inches and more if possible. The weeds must be kept down, as beets are not good fighters of such enemies. Frequent cultivation is required to maintain a loose soil and a fine mulch for the preservation of moisture.

4. *Producing Saccharine Sorghum*

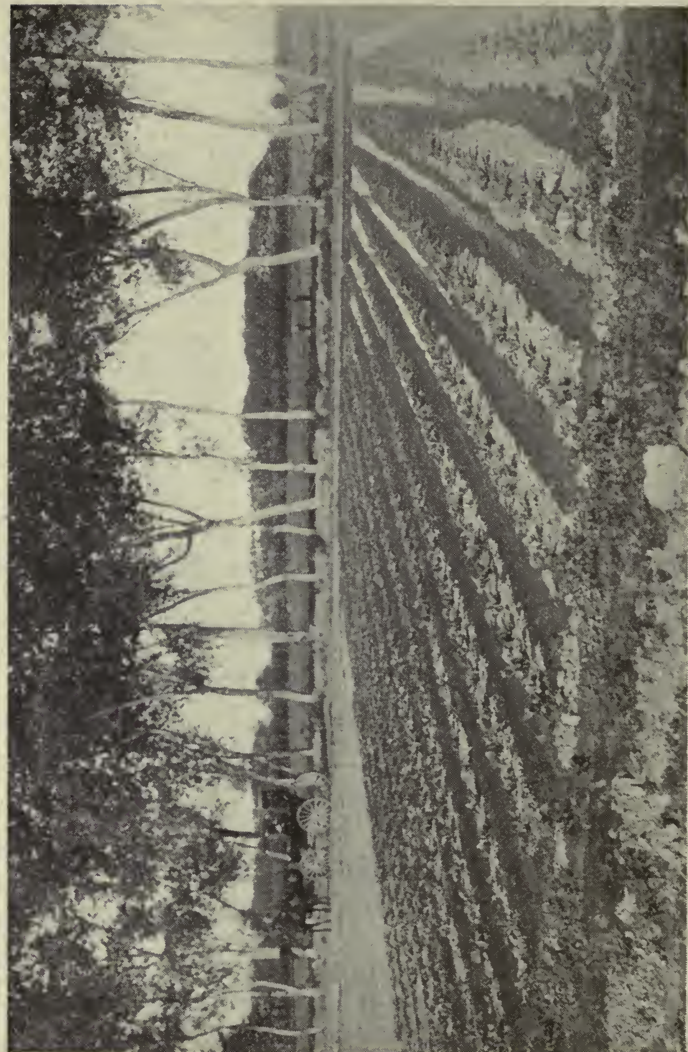
The sorghums comprise a wide range of varieties, which may be divided into two great groups, (1) grain sorghums; and (2) saccharine sorghums, used for forage, sirup and sugar.

Varieties of saccharine sorghums.—There are seven important saccharine sorghums: *Sumac, Amber, Orange, Planter, Gooseneck, Honey* and *Sapling.* Of these, the Sumac has proved the best for southern regions, and the Amber for northern regions.

The Sumac is the sweetest, has the largest supply of leaves and yields best of the saccharine varieties. It requires from one hundred and eight to one hundred and fourteen days to mature seed. The Amber is more slender of stem, has fewer leaves, and matures seed in from ninety to ninety-four days.

Climate and soil.—Sorghum will grow in any climate and soil that will successfully produce corn. It roots more deeply than corn, and often does well for one or two crops on soil too much exhausted for a good yield of corn. Sorghum is, however, hard on the soil, since it produces so large an amount of forage and grain. Sorghum resists drought better than corn. It has proved successful in southwestern regions too dry for good corn production. The methods of fertilizing and cultivating suitable for corn are practical for production.

Harvesting and manufacturing.—Sweet sorghum used as forage may be cut green from the time it is two or three feet high until it is ripe, and fed at once or cured for hay. If the sorghum is to be used for sirup or sugar, it should be cut from the time the seeds are well on in the milk stage until they are hard. The crop should be harvested without frost.



Irrigating sugar beets, New Mexico.

The stalks are cut about six inches above the ground. The seed tops are cut off and saved for forage. The canes are run through a roller crusher to extract the juice, which is treated much the same as the juice from sugar cane in the process of its manufacture.

5. *Producing Maple Sugar*

The United States and Canada are the only regions where maple sugar is made. The American Indians understood the art of making sugar from maple trees before the earliest explorers reached this continent.

The sugar maple region.—While all maple trees have sweet sap, only a few varieties produce sugar in paying quantities. The *sugar maple* stands first and the *black maple* second in importance. The red maple, silver maple and Oregon maple produce sugar sap, but hardly in paying quantities.

The sugar maple is spread over a wide area, but occurs in large enough quantities for commercial sugar production only in New England, New York, Pennsylvania, the states of the Ohio Valley and around the Great Lakes.

Tapping the trees.—Tapping should be done as early in the season as the run of sap begins. Not only does this insure a larger quantity of sap, but the first runs are the sweetest. The time of tapping varies with the season and locality, usually from late in February till the middle of March.

The hole bored in the tree should be from 3/8 to 1/2 inch in diameter, and from 1 1/2 to 2 inches deep. It should slant slightly upward into the tree so that the sap will easily drain out. As a rule only one tap to the tree should be made. Spouts, preferably of metal, are fitted into the holes, and buckets hung from the spouts to collect the sap.

Making the sugar.—Once collected, the sap is evaporated by boiling in kettles, tanks, or other specially adapted apparatus. When the right consistency has been reached, the sirup is poured into molds and allowed to cool. It is then ready for the market. Maple sugar is considered a

Tapping maple trees in Vermont. Too many taps.

delicacy, and many attempts have been made to produce substitutes as acceptable as the genuine article. Some of these have been so successful that it is often difficult to tell the imitation from the real. One authority says that were all the maple trees cut down we would continue to have "maple sirup" on the market.

Topics for Investigation

1. Have your mother help estimate the amount of sugar consumed in your home in a year. How many pounds to the person?

2. What proportion of this sugar is cane? Beet? Sorghum? Corn? Maple? Where is each produced?

3. Make a study of the process by which each kind of sugar is manufactured and write an account of it. Join with your teacher in making a collection of samples of sugars in different stages of manufacture.

4. Draw a map of the United States and locate the sugar regions.

5. What sugars are produced in your region? Could others be successfully grown? If not, is the trouble in the climate, soil, or both? Ask your father about this.

6. *Sugar Demonstrations*

1. Demonstrate how to test sugar beet, cane, maple and sorghum seeds, for vitality, using the cloth and blotter tester.

2. Demonstrate how to change sugar into sirup and sirup into sugar. Explain processes.

3. Demonstrate by the use of lump and powdered sugar the soil capillarity and the use of a surface mulch for the preservation of moisture.

4. Demonstrate how to find the starch and sugar content of a sugar cane or sugar beet.

5. Demonstrate how to tap a maple tree, including preparation of material, tapping tree, hanging container in place, and closing up the wound after tapping.

7. *Sugar Play Contests*

1. Sugar variety naming contest.
2. Contest in sugar making.
3. Contest in tapping maple trees.

4. Contest in the making of wooden taps or spouts for trees.

5. Contest in candy making, products to be judged on exhibit as are other products.

6. Essay writing contest on sugar production and manufacture.

8. *Sugar Farming Club Projects*

Where any one of the types of sugar farming discussed is a practical industry the school may well be organized into a club for the purpose of translating the theory of the chapter into definite practise at home. If the club be organized in the sugar beet, sugar cane, or sorghum cane, the area should be one acre; if in maple sugar production it may involve the setting out and management of a certain number of trees, or the care and management of from ten to one hundred trees, and should include tapping; also the manufacture and sale of sugar products. The maple sugar club project and tree or wood-lot planting work will make a fine combination. The basis of award for the contest in the club project may be as follows:

1. Yield per acre	30
2. Profit on investment	30
3. Exhibit and quality of products	20
4. Story and record of club work	20
Total score	100

CHAPTER XI

FORAGE CROPS

OUR study so far has dealt mostly with the cereals—the crops raised chiefly for their grain. We now come to study the distinct types of *forage* crops, or those grown for their leaves and stems, which are fed to stock. Besides serving them as food for animals, certain forage crops are of great value in enriching the soil and causing it to produce larger yields of cereals.

When the forage plants are fed green by grazing, we call the crop *pasture;* if cut, and at once fed green without allowing time to cure, it is called a *soiling* crop. If the crop is cut and allowed to cure before feeding it, it is called *hay, straw, fodder,* or *stover* as the case may be. We have already noted that a forage crop, cut and stored so that it will keep green, is called *silage* or *ensilage.*

1. *Important Forage Crops*

The most important forage crops may be divided into two broad classes, *grasses* and *legumes.*

Grasses.—The grasses are among the most widespread and important of our plants. They include an almost endless variety, many of which grow without cultivation, or even special seeding, the seed being carried by the wind, birds and in many other ways.

Among the most important grasses grown in the northern states are *timothy, blue-grass,* the *millets* and *red-top.* Common to the southern states are *Bermuda grass, carpet grass, Lespedeza, Johnson grass, orchard grass* and *brome-grass.*

It must not be forgotten that our great cereals, corn, wheat, oats, barley, rice, rye, etc., also belong to the grass family.

While there are so many varieties of grasses, they possess certain characteristics in common. For example, practically all grasses bear their seeds either (1) in a *spike,* like wheat, barley or timothy; or else (2) in a *panicle,* like oats or blue-grass. Most of the grasses have hollow stems, with nodes, or joints, dividing the stem into sections.

Some of the grasses are *annuals;* that is, they make their growth, raise seed and die all in one season, as oats, corn, or wheat. Other grasses are *perennials;* they live on from season to season without replanting, as timothy, clover, alfalfa, blue-grass, or Bermuda grass.

Legumes.—The legumes differ from grasses in that they bear their seeds in *pods,* like beans and peas. These pods vary in form from the close, nearly straight pod of the pea to the curled pod of alfalfa. When the seed is ripe, the pod splits open, and the seeds scatter. Most legumes branch more freely than grasses and also send their roots more deeply into the soil.

Some of the most important legumes are the *clovers, alfalfa, soy-beans, cow-peas,* the *vetches* and the ordinary garden peas and beans.

The legumes differ widely in their manner of growth, ranging all the way from small herbs like clover, to various vines, shrubs and even trees. Some of the legumes are annuals, some are biennials, and others perennials.

2. *Importance of the Forage Crops*

Forage crops in the United States rank next in value after corn and cotton. The total acreage of improved pastures and harvested forage crops is considerably more than all the grain crops combined. The most important forage producing region of the United States is found in the north central states, reaching from Michigan and Ohio on the east to Kansas and Nebraska on the west.

Uses of grasses and legumes.—Grasses and legumes have two principal uses: (1) they supply the most important part of the food of farm animals, and (2) they aid in building up the soil, making it productive for other crops. They are also serviceable in saving the soil from washing and blowing.

A great proportion of our cattle, horses, sheep and hogs are raised with forage as their chief food. Where good pasturage is available, little or no grain is fed to growing stock, and often none even to milk cows. And when grain is used to fatten stock, or to give strength, as in the case of work horses, forage is required to supply the volatile oils as well as bulk and coarseness necessary to digestion.

Both grasses and legumes tend to improve the soil. Their decaying roots, stems and leaves form an important part of the soil, called *humus*. This vegetable matter not only enriches the soil, but makes it lighter and more porous, so that air can better get to the roots of growing plants. It also favors proper drainage in damp soils.

Legumes and the nitrogen of the soil.—Legumes, however, enrich the soil in a special way, and are widely cultivated for this purpose. In order to understand how legumes do their work of improving the soil, it must be known that plants demand certain foods from the soil. One of the most necessary plant foods is *nitrogen*. If this is lacking in the soil, the crop does not grow well, and the yield is reduced. For example, wheat takes much nitrogen from the soil; this is the main reason why wheat can not be grown on the same land year after year. The nitrogen becomes exhausted. The soil is "worn out." It is estimated that a twenty-bushel crop of wheat removes about thirty-five pounds of nitrogen from each acre.

Nitrogen may be returned to the soil in several ways. One of the most common ways is by means of barnyard manure, which is rich in nitrogen. Another way is through commercial fertilizers, such as sodium nitrate, ammonium sulphate, or dried blood saved from slaughter-houses. But the amount of manure is limited, and the commercial fertilizers are expensive. And this is where the legumes come in to help. Legumes *are able to gather nitrogen from the air and deposit it in the soil.*

There are millions of pounds of nitrogen in the atmosphere resting on every acre of ground. But the plants can not make use of this nitrogen in the form in which it exists in the air. It has to be made over for them. *This is accomplished by bacteria* which have their homes in the tubercles or nodules found on the roots of leguminous plants.

In the small tubercles to be seen on the roots of clover, alfalfa, soy-beans or cow-peas are millions of bacteria, each able in the process of its own growth to take nitrogen from the air, change it into the form needed by growing plants, and leave it in the soil for the next crop. In this way the legume is able not only to secure its own growth, but to leave the soil richer through the action of its bacteria friends. The raising of legumes is therefore one of the best and most economical ways of enriching the soil. So important is the group of legumes that a separate chapter will be given to the most important ones.

Topics for Investigation

1. What are the chief grasses used for pasturage in your neighborhood? For hay? For lawns?

2. What are the principal legumes cultivated in your vicinity? Which are annuals? Which are perennials?

3. Make a collection of the principal grasses found on your father's farm. Study their method of growth. Compare stems, leaves, roots, and method of seed bearing.

4. Make a similar collection and study of the common legumes.

5. Secure the roots of clover, of alfalfa, of peas, beans and any other available legumes. Make a study of the tubercles, comparing size and number. The bacteria are too small to be seen except with a powerful microscope. The tubercles are most plentiful in the early part of the growing season.

6. Illustrate how a bookkeeping record can be kept of the various types of forage crops, such as alfalfa, cowpeas, red and crimson clover, blue-grass, etc.

7. Make a study of the map, locate the principal forage territories, and indicate the various types of grasses and forage crops that are being produced in the different sections. Indicate in each state the acreage allotted to each type of forage.

8. Indicate what kind of stock thrives best on certain forage crops, and tell why.

3. *Forage Demonstrations*

1. Demonstrate how to prepare and make exhibits of the various types of grasses, legumes, plants, etc.

2. How to make a grass seed test.

3. The difference between a good and a poor grass seed, stems and heads.

4. Show how grass seed should be sown and what constitutes a good stand.

5. Demonstrate how to make different things in connection with the forage crops, such as haycocks, stacks, and how to cut hay with the scythe.

4. *Forage Crop Club Projects*

In many schools it will be practicable for boys and girls to organize into clubs for the purpose of growing and demonstrating the possibilities of profitable farming in alfalfa, red clover, crimson clover, cow-peas, beans, etc. The age requirements should be the same as in other clubs. The area of the plot should not be less than one acre and may be more, depending on the size of the field available for the work.

The award.—The basis of award should be:

1.	Average yield per acre	30
2.	Net profit on investment	30
3.	Exhibit of products (hay and seed)	20
4.	Crop report and story	20
	Total score	100

For most localities the four most important forage crops in which to organize clubs would be alfalfa, clovers, cow-peas, and blue-grass sod for the lawn.

CHAPTER XII

THE CLOVERS

CLOVERS are the most widely grown family of legumes among the farm crops. There are many different types of clover, such as red clover, white clover, alsike clover and crimson clover. By far the most important of these is the red clover, especially throughout the northeastern quarter of the United States. The great red clover section reaches from Maine to Virginia, and as far west as the Missouri River. Either alone, or mixed with grasses for hay and pastures, red clover claims from one-eighth to one-third of all the cultivated land throughout the northeastern and north central states. It is now also being successfully grown in Montana, Washington, Oregon and in the far Southwest.

1. *The Red Clover Plant*

Red clover is so common a plant that it can usually be studied near at hand in the field. Every pupil should therefore examine the growing plant, and bring a complete specimen, including the root, to school for further reference. Also secure a plant of timothy, and other grass or plants commonly grown with red clover.

Topics for Investigation

Study of the red clover plant.—Compare the clover and timothy plants (1) as to root systems, (2) stem and mode of branching, (3) mode of flowering and seed bearing.

A young red-clover plant, showing the characteristic nodules on the roots.

1. Which has the longer roots? Which will make the denser sod? Why? Do you find any tubercles on the roots? Is the stem of either hollow? Jointed? Which stands more erect? Why? What is the difference in their leaves? Which bears the larger number of seeds to the head? The larger seeds?

2. After red clover has been cut, from what part of the plant does the new growth start? How many cuttings a season can usually be made of red clover? Which cutting is used for the production of seed?

3. What is the shape of the individual flower of the red clover? How many flowers to the average head? How many seeds does each flower bear? What is the shape of the seed? Learn to identify it when mixed with the weed seeds most commonly found in red clover, such as trefoil, curled dock, wild mustard, dodder, or others.

4. Write an accurate description of the red clover plant, so that one who has never seen the plant could identify it from your description.

2. *Value of Red Clover on the Farm*

Red clover as forage for stock.—Red clover makes an ideal forage crop for all classes of farm stock. Besides being highly palatable, it contains a large proportion of *protein,* one of the most necessary elements of food for animals. So essential is protein for the growth of animals and the production of milk and butter, that bran, oil meal, and cottonseed-meal are commonly fed to supply this element. Where red clover can be successfully raised it largely takes the place of the more costly foods, and at the same time supplies the roughage needed by all animals. When grain is fed, as to chickens, hogs or cattle, red clover, either green or cured, forms a most valuable item of food.

The worth of clover as an animal food has not been fully understood. It has been computed by experts that a ton of red-clover hay has almost two-thirds as much feeding value for farm stock as a ton of wheat bran, and more than two-thirds the feeding value of a ton of shelled corn.

Red clover as a soil renewer.—As a soil stimulant and fertilizer red clover is almost without a peer except alfalfa. By its use in the rotation of crops, it is possible to keep the supply of nitrogen and humus almost undiminished in the soil, throughout years of cropping. The bacteria living in the root tubercles transform atmospheric nitrogen into soil nitrogen and leave it for other crops. The roots and stems, decaying, add to the humus.

At the average price for commercial fertilizers often used to enrich land, a ton of clover is worth nearly ten dollars to plow under as a fertilizer. Fields which have been in red clover frequently produce ten bushels more of grain to the acre than before the clover was grown.

In the use of clover as a fertilizer it must be remembered, however, that clover adds to the soil chiefly nitrogen and humus; and that if the crop is all removed each year, *none being plowed under and no manure returned,* the amounts of nitrogen and humus in the soil are increased but very little. Potash and phosphorus, two other plant foods often failing in worn soils, must be supplied either by the use of commercial fertilizers or barnyard manure.

3. *The Raising of Red Clover*

Red clover will grow successfully on any soil that will raise corn. Soil that is wet and heavy or lacking in humus will not produce a satisfactory stand of clover. Red clover has a remarkable root system, sending its main roots down as deep as six or eight feet in light friable soil. This enables plants which have received a good start to withstand considerable drought.

The seed bed.—The seed bed for clover should be

Sweet clover on an Iowa farm.

finely pulverized, but well packed. If sown on freshly plowed land, it is necessary to harrow until the ground becomes firm, otherwise a poor stand is sure to follow. The ground should be clean, as clover is not a good fighter of weeds.

Red clover may be sown in the early spring on fields of winter wheat. In this case no preparation of the seed bed is required. The covering of the seed may be accomplished by weathering. A more certain way is to harrow the wheat after the clover has been sown, or even both before and after the seeding of the clover. If properly done this does not injure the wheat. Red clover is also often sown in the spring with oats as a nurse crop.

Another common method of seeding red clover is in a field of standing corn just following the last cultivation. This plan has worked successfully, especially in some of the eastern and southern states. If the crop of corn is heavy enough to shade the ground, or if the fall happens to be dry, a successful stand is uncertain.

Time of sowing.—In the larger part of the red-clover region, it does not seem to matter greatly whether the clover is sown in the spring or the fall. Which time is better depends on the season. Young clover plants do not easily withstand drought. If a dry season follows the seeding, the stand will not succeed no matter when the planting is done.

In spring seeding with a nurse crop of winter wheat, the clover should be sown at the earliest possible moment. If the ground is not to be harrowed to cover the seed, it may be sown on a late fall of snow. This gives the clover plants the advantage of a start before the moisture is out of the soil, and also before the nurse crop gets large enough to shade the young plants.

If the seeding is done in the fall, the crop should be sown early enough so that the clover plants will attain a growth of from four to six inches before the freezing weather. Otherwise they may not be able to live through

Seeds of red clover and common impurities.

the winter, especially in the northern states. Seeding after August fifteenth is unsafe in the northern states.

Clover seed.—A great deal of the trouble found in securing a good stand of red clover comes from poor seed. Good red-clover seed should (1) be plump, and not shriveled; (2) look bright instead of dull; (3) vary in color from violet to light yellow, but not be a dull brown; (4) show individual seeds medium to large size; (5) be free from all weed seed and rubbish; (6) be free from what is called "hard" seed. By hard seed is meant grains whose seed coat is such that the seed absorbs moisture but slowly hence may not germinate for several weeks or even months. The seed of very new varieties may contain as much as fifty to sixty per cent. of hard seed.

As is the case with most other farm crops, it is safer to secure clover seed from near home than from a distance. In this way one may be sure that the variety is adapted to the season, climate and soil conditions of the vicinity, and be sure that the seed does not contain noxious weeds and other impurities.

Cleaning red clover seed.—Ordinary red clover seed contains many different kinds of weed seeds. Some of these look enough like clover grains that they may pass unnoticed. Sowing clover mixed with weeds not only reduces the stand of clover, but compels the clover to divide its moisture and food with its worst enemies, besides rendering the ground foul for other crops.

Screening red clover seed through a sieve with twenty meshes to the inch will remove all the smaller weed seeds, while retaining the medium-sized and larger clover grains. Seeds of wild carrot, ragweed, thistles, buckthorn, wild chickory, and several other weeds bearing large seeds are not removed in this way. Clover seed should first of all be selected from a field that is as free as possible from weeds. Even then, screening will pay for the removal of the smaller clover and weed seeds.

4. *Harvesting the Red Clover Crop*

Red clover should be cut for hay just as it is past full bloom. If cut much earlier than this the entire food value of the plant is not obtained; if it is allowed to stand too long the leaves begin to fall, and the stems become dry and stiff. If the second crop is to be cut for seed, it may be necessary to cut the first somewhat early.

The care of clover hay.—In stacking or mowing the hay in a barn, the important thing is to avoid exposure to the weather, or becoming dry enough so that the leaves crumble and are lost. For the leaves of red clover, while they are only about forty per cent. of the weight of the plant, contain almost two-thirds of the protein of the whole plant. Clover hay that has become too dry is also very dusty, and not so good for feed.

Red clover hay does not shed rain so well as the grass hays, and should therefore be stored in a barn where possible. If it must be put into stacks, these should be built with the greatest care, keeping the middle of the stack full and well tramped. The top should be covered with canvas, or with a coating of grass or straw.

Care must be taken not to put red clover into the barn or stack when it is damp from dew or rain, as it has a tendency to heat. This heating not only damages the hay, but not infrequently sets fire to the stack or barn and burns it down.

Harvesting red clover for seed.—Red clover seed is usually secured from the second crop of the season, the first being harvested for hay. The clover is cut either with a mower or a special header, and run through a clover huller. By special adjustment an ordinary thrashing machine may be used for hulling the seed. Clover straw still possesses good feeding value after the seed is removed.

5. *The Enemies of Red Clover*

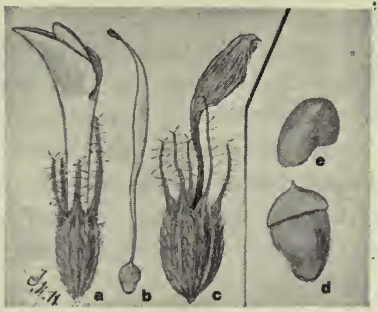
In the starting of the clover crop, the two principal enemies to be encountered are drought and hard winters. A stand not infrequently fails from one or the other of these natural causes, which can not be guarded against, except to sow the crop at proper times, and according to proper methods of seeding. Red clover is so valuable, however, that an occasional failure to secure a stand should only spur the farmer to try for better success.

Insect enemies.—Various insects seem to find red clover highly palatable, and hence feed upon it. Yet only a few of these do the crop any great damage.

One of the worst of these pests is a small species of beetle known as the *clover root-borer*. This beetle is of a brownish color, and grows about one-sixth of an inch in length. The larvæ of this insect attack the roots of the clover, usually during the second year of the crop. They have done the most damage in regions east of the Mississippi River, especially in Michigan, Indiana and Ohio. The only remedy so far found is to plow the damaged field as soon as the hay is removed. The larvæ are then without food and soon die, leaving the field free of their kind for a future crop.

The seed-bearing qualities of red clover are often seriously damaged by the *clover-seed chalcis fly*. This is an insect shaped like a wasp, and about the size of a seed of red clover. Just before the clover seed begins to harden this fly lays its eggs in the growing seed. As the larvæ develop they use the seed for food, entirely destroying it by the time they secure their growth. The chalcis fly is responsible for much of the poor yield of clover seed. It is one of the worst clover crop pests in the United States. It is thought that light pasturing in the early spring, or even

Effect on clover seed of the chalcis fly.



Stages in development of red-clover seed: (a) flower; (b) immature seed vessel; (c) flower ripe; (d) mature seed vessel; (e) seed.

Second crop of red clover nearly ready to cut for seed. The first crop yielded 2½ tons to the acre.

mowing the clover soon after it starts will do much to reduce the danger.

Clover has at least one enemy that works after the crop is stacked or mowed; this is the *clover-hay worm.* It usually works in the bottom of the stack or mow, eating the softer portions of the plant, but also damaging the feeding qualities of the hay by its excrement and a web that it leaves. Salting the hay near the bottom of the stack or mow will do much toward stopping the work of this pest.

While the botanists tell us that red clover is a perennial, it is seldom able to maintain a stand for more than three or four years, when it must be reseeded. Red clover is usually followed by a grain crop before clover is again grown.

6. *Other Types of Clover*

Crimson clover.—This clover and its cultural methods are similar to those of red clover, but it differs from the other clovers in being an annual. It is a relatively new crop, having recently been brought to this country from Europe. It is grown chiefly in the southeastern part of the United States, where it assumes the same importance that red clover has farther north. Crimson clover does not demand so rich a soil as red clover or alfalfa. It is of great importance in the east, southeast and southwest of the United States.

White clover.—White clover is well known over most of the red clover region. It differs in its manner of growth from red clover, being of a creeping habit, and therefore not well adapted to use as a hay crop. White clover is very hardy, and will often work its way into a pasture without seeding, the seeds being carried by winds and the birds.

It makes an excellent pasture grass, and is also often used in lawn mixtures.

Alsike clover.—Alsike clover is named from a town in Sweden, where it is said to have originated. It resembles red clover but is of a finer, more delicate type, and therefore does not yield so well. While red clover will produce two crops each season, alsike clover will grow but one. This clover is especially suited to wet heavy soil which will not grow red clover, and in such regions proves a valuable crop.

Topics for Investigation

1. How many acres or clover are now growing on your father's farm? Make a comparison for all the farms represented in the school. What other legumes are raised at your home? Is the clover grown alone, or with other hay crops? What are they?

2. How long have your father's clover fields been down? Ask your father whether clover that has been down two or three years begins to die out? What is the oldest field of clover in the vicinity?

3. Secure several samples of red or crimson clover seed. These may be taken from the supply intended for sowing, or from the barn floor where clover is fed. Study these samples with reference to the qualities named in the text for clover seed. What proportion of the seed turns out to be weed seed instead of clover? Can you identify the different weeds represented?

4. Make a seed tester out of two plates and pieces of Canton flannel. Place one hundred seeds of clover between the plates, dampen the cloth and keep warm for four or five days. How many of the seeds have sprouted? What percentage failed to grow? Is it probable that some of the seeds were "hard"?

5. If clover seed such as you tested is selling at eight dollars a bushel, what would the good seed in your sample really cost the purchaser? Would a farmer better

pay nine dollars a bushel for pure seed, ninety-five per cent. of which is strong and pure, or seven dollars a bushel for dirty and impure seed, seventy-five per cent. of which will grow? Have in mind also the fact that the farmer can not afford to sow weed seed with his clover. Will it pay to test the clover seed before planting?

6. Secure specimen plants and samples of seeds of all the different clovers to be found in your region. Learn to identify both plant and seed.

CHAPTER XIII

ALFALFA

1. *The Alfalfa Plant*

FIRST of all secure, if possible, samples of growing alfalfa plants. Go into the field and dig up several plants of different sizes, one year old, two years old, and three years old. Try to obtain the entire root system of at least one good-sized plant. This may be hard to do, as the roots usually extend from eight to ten feet down in the soil, and under favorable conditions often twice this depth.

Study of the alfalfa plant.—Study the plant, noting the mode of branching, the system of leaves, the method of flowering, and the arrangement of seeds and pods. Look for the tubercles on the roots. These are most plentiful in the spring. Later in the season they fall off and decay in the soil. If the roots are pulled up roughly, the nodules will be stripped off and remain in the ground. The individual bacteria can not be seen except with a powerful microscope.

Topics for Investigation

1. How many cuttings to the season are made of alfalfa? How many of clover? Of timothy?
2. What is the average cutting of alfalfa to the acre? Of clover? Of timothy? Of cow-peas? Compare, then, the total crop for the season of the three kinds of forage?
3. What is the market value of alfalfa per ton? Of clover? Of timothy? Of cow-peas? Compare the value per acre for feeding purposes of each of the three hay crops.

4. What does it cost to produce an acre of alfalfa and harvest it? Of clover? Of timothy? Of cow-peas? Find which is the most profitable crop based on market value for feed.

2. *The Growing of Alfalfa*

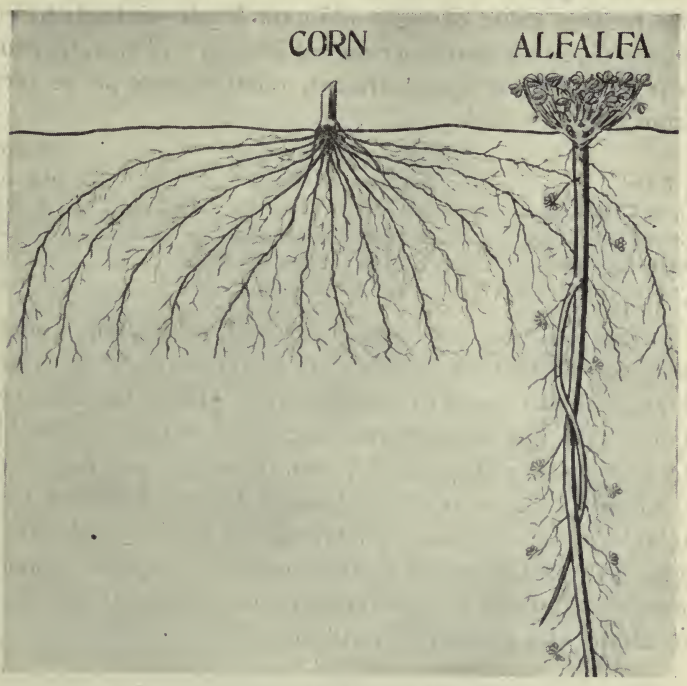
Alfalfa is one of the oldest plants known. It was known in Greece five hundred years B. C., and raised in England before Columbus discovered America. It has been known in this country for more than a century, but only recently has it become of any great importance as a farm crop. And even yet, its value is but little understood, and the methods of its growth management are far from mastered.

Acreage of alfalfa.—At present barely one-tenth as many acres are devoted to alfalfa as to clover and timothy, and one-ninth as many as to wheat. We have twenty acres in corn to every acre in alfalfa. Yet the amount of land devoted to alfalfa is increasing every year, and it will soon become one of our principal forage crops.

The alfalfa region.—The alfalfa region of the United States at present lies principally west of the Mississippi River. Out of about five million acres of alfalfa raised in the entire country, Kansas grows one million acres, or one-fifth of the crop.

Alfalfa is especially adapted to dry soils and climates, and is therefore of the greatest value in the semi-arid regions of the West. Utah, Arizona, Colorado, Idaho and other western states are using alfalfa to make fertile many acres of soil almost barren for other crops.

The great corn belt states are admirably adapted to the raising of alfalfa, but have as yet done little with it. For example, the following are the ranks of these states in the production of alfalfa in the United States: Ohio, nineteenth; Iowa, twentieth; Kentucky, twenty-first; Illinois, twenty-second; Wisconsin, twenty-third; Indiana, twenty-fourth, and Michigan, twenty-ninth.



Comparison of corn and alfalfa roots, showing why alfalfa is a drought resister.

3. *Alfalfa as Forage for Stock*

Alfalfa is one of the most valuable forage crops known for the feeding of farm animals. Like clover, it contains a high degree of that most important element of food, *protein,* which goes to make both bone and muscle. With such forage as timothy, corn, stover, or straw fed to stock, protein must be supplied in the form of bran, or some other such feed. Alfalfa serves the same purpose, and is much cheaper to produce.

Feeding value of alfalfa.—The following table shows the feeding value of eight different kinds of feed, based on the digestible nutrient material in each: (*Farmers' Bulletin,* 339. These figures are only relative, since prices vary from year to year.)

Feed	Value per ton	Feed	Value per ton
Green alfalfa	$ 7.00	Timothy hay	$ 9.00
Green clover	5.96	Cow-pea hay	19.76
Alfalfa hay	20.16	Wheat bran	22.80
Clover hay	14.12	Shelled corn	20.16

It is seen that the feeding value of alfalfa hay is more than double that of timothy. It is almost equal to wheat bran, and just equal to shelled corn. Alfalfa has an additional value for feeding stock because it is highly palatable to almost every farm animal, even to poultry and hogs.

Bran costs an average of about twenty dollars a ton; to raise alfalfa hay costs an average of about five dollars a ton. Why not *grow* the protein needed by the farm animals instead of buying it? As farmers learn more of the value of alfalfa this is what they will do.

4. *Alfalfa as a Renewer of the Soil*

Alfalfa is probably the best of the legumes as a soil renewer. The bacteria which grow in the root tubercles are able to take the nitrogen directly from the air and add it to the soil in such form that it can be used by other crops. The deep rooting system of the alfalfa plant also enables it to bring other minerals from the lower layers of the soil, depositing them near the surface where other plants can use them. The generous roots add much *humus* to the soil.

In Colorado, Nebraska and Wyoming, farmers have found that almost double the yield of grain is produced from the same fields after they have been in alfalfa for several years. Even greater results have been experienced in

Examining the tubercles on alfalfa roots in a southern field.

the South in the yield of cotton crops that have followed alfalfa.

Alfalfa can be used in the same way throughout the corn region to improve the soil for other crops. Besides being one of the cheapest and most effective means known of restoring certain elements to worn soil, it is also a crop which is in itself more profitable than almost any other crop that can be raised.

5. *Raising the Crop*

Soil requirements for alfalfa.—It is especially important in raising alfalfa that soil naturally wet shall be

School children in Cook County, Illinois, studying the relation of alfalfa to corn growing.

well drained. While alfalfa requires much moisture in growing, it will not stand the dampness of undrained soils. If submerged with water it will quickly die.

In heavy damp soil there is also likely to be more *acid* than is good for the alfalfa plant. Before sowing alfalfa it is, therefore, best to test the soil for acid. This can easily be done by taking a little of the soil when damp and placing it upon blue *litmus paper* (or by some of the other methods recommended by state experiment stations). If the paper turns to a pink color it indicates the presence of acid, and the soil should then have an application of *lime* to counteract the acid.

Starting alfalfa.—If proper methods are used it should be no harder to start alfalfa than clover. First of all, the seed must be most carefully selected, and should be tested before sowing. This can easily be done by means of a home-made tester, as in the case of clover.

Particularly should the seed be free from all noxious weeds or other impurities. For weeds are among the worst enemies of alfalfa. In some parts of the country the alfalfa crop is completely killed out of certain fields in a few years by the increase of weeds.

The seed bed should be more carefully prepared than for almost any other farm crop. After plowing it must be harrowed so thoroughly as to pack it well and leave a fine mulch on top. If the seed bed can be prepared some time ahead of the sowing so as to give an opportunty for several harrowings so much the better. The seeding may be done either broadcast or with a drill. It has been found best in most parts of the country not to sow alfalfa with a nurse crop, since the nurse crop deprives the young alfalfa plants of moisture, nourishment and light. It is of great advantage to manure the field before seeding to alfalfa.

Inoculating the soil.—It is usually best to *inoculate* the soil before sowing alfalfa. This means to put into the soil some of the bacteria which inhabit the root nodules. Almost any soil suitable for alfalfa has some of these bacteria to begin with, so that alfalfa may often be started without inoculation. But where the supply of bacteria is very small, and where the soil is poor it will pay to inoculate. This may easily be accomplished by gathering the surface soil from a field on which alfalfa has been raised, and scattering it at the rate of one hundred to five hundred pounds to the acre over the field to be sown.

An alfalfa plant several years old. Note the generous root system and the size of the plant.

Similar results can be had by gathering soil in which sweet clover so commonly found along the roadsides has been growing. Care must be taken in gathering and scattering the soil not to allow it to be exposed to sunlight, as this will kill the bacteria. It is better therefore to secure the soil and spread it over the new field on cloudy days or in the late evening. The alfalfa seed should be sown immediately and harrowed in so that the bacteria may be covered, and be thus secure from the sunlight.

Time for seeding.—Late summer has been found the best time for seeding alfalfa in the East and the South, while in the West spring seeding is the rule. Spring seeding has also been found to work better in Minnesota, Wisconsin and the Dakotas. No general rule as to the time of seeding can, however, be given. Much will depend on the climate, length of season and amount of rainfall or irrigation water available. The chief thing necessary is to seed as long as possible before the time of year that will be hardest on the plants. In the North this requires spring or early summer seeding in order that the plants may get sufficient growth before freezing to withstand the winter. Alfalfa plants less than six inches high do not ordinarily live well through the hard northern winters.

In some regions there is trouble in getting the plants started before drought comes on to check their growth. Throughout the corn belt late summer seeding should usually be practised. Alfalfa sown during August and the first week of September will have the best chance throughout this region.

6. *Harvesting the Crop*

Time for cutting.—Alfalfa makes the best hay if cut while in early bloom. A better means of determining the time for cutting is, however, to watch the start of the new shoots from the base of the plant. These shoots make the growth for the succeeding crop. When they are from one to two inches in length is the best time to harvest. In this way the new growth goes on without interruption.

If the cutting takes place much earlier than this, there is a loss of growing time in waiting for the new shoots to develop. If, on the other hand, the cutting is delayed until these shoots are too long, the mower will clip them off and they must begin all over again, thus delaying the next crop. Usually it is possible to secure three cuttings of alfalfa in

Side delivery raker in an alfalfa field, yielding two tons to the acre on second cutting.

the corn region and as many as eight and even more in some of the irrigated regions of the West. It is evident that if the greatest number of cuttings is to be secured each crop must be cut as soon as it is ready in order to let the next crop get properly started.

Handling the hay.—Alfalfa, like clover, should be harvested so that the hay may reach the barn or stack with the least possible amount of handling or exposure to the weather. The alfalfa leaves contain a large proportion of the food value of the plant, and are easily crumbled and lost if the hay gets too dry.

Probably the best plan is to cock the hay when the stems are about half dry, stacking it when moisture no longer shows as a wisp of the plant is twisted by the fingers. In regions where frequent rains are the rule during the haying season, it pays to have haycock covers consisting of squares of muslin to the corners of which weights are attached, or pins to thrust into the hay or the ground.

7. *Enemies of Alfalfa*

Weed enemies.—Undoubtedly weeds are the worst enemies of alfalfa in most parts of the country. This is particularly true throughout the West and Southwest. Among the weed enemies are *witch-grass, crab-grass* and *dodder* in the West, *blue-grass* and *foxtail* throughout the Middle West, crab-grass, wild clovers, dandelions, etc., in the South and East, wild clovers, crab-grass, ordinary weeds and the *barleys* in the far West. Cultivation with the spring-tooth harrow or disk is the best means of killing most of the weeds.

An especially troublesome weed among alfalfa is *dodder.* Dodder is a plant which twines itself about the alfalfa seedlings, soon attaching its threadlike stems firmly to the alfalfa plant. The dodder stem then withers away near the ground and the dodder continues to live as a parasite on the alfalfa. It is almost impossible to exterminate dodder when it has once secured a foothold in an alfalfa field. Turning sheep into the field to graze is one remedy for this pest. Another is to cut the alfalfa very low or even remove it entirely on any spots in the field where dodder starts.

Insect enemies.—Alfalfa does not have so wide a range of insect enemies as some of the other farm plants.

A six-weeks-old field of alfalfa in North Dakota.

Alfalfa curing under cover.

The alfalfa weevil and grasshoppers are probably the worst enemies of this kind, particularly in the regions of the West. It has been found that disking an alfalfa field late in the fall in the northern states and mid-winter in east central states exposes the weevil and grasshopper young to freezing and the attacks of birds, and thus reduces their number.

Topics for Investigation

1. How many acres of alfalfa are grown on each farm represented in the school? How long has alfalfa been raised in the vicinity? Why is not more grown, since it is one of the most profitable crops known?

2. Out of one hundred successful alfalfa growers in the corn belt, eighty-five testified that they had planted according to the following program: Manured the ground, fall plowed, summer fallowed the next season (surface cultivated without crop), limed, inoculated, seeded about August first. Make an inquiry among the alfalfa growers in your vicinity. How many did all these things? Which did they omit, if any? How did they succeed?

3. Collect samples of field soil taken several inches below the surface from each of the farms represented in the school. Moisten the soil, roll it into a ball, cut the ball into halves, and place between the halves a piece of litmus paper, leaving it a few moments. Does it turn pink? If so, this is an indication of acid or sour condition of the soil. What treatment should an acid soil receive before being sown to alfalfa?

4. If there is no alfalfa grown on your father's farm, talk with him about the crop, and join with him in starting a small field. Would your field need liming? Would you know where to secure soil for inoculating? If there is no alfalfa near, is there not sweet clover along the roadside?

CHAPTER XIV

OTHER LEGUMES

WHILE red clover and alfalfa are the most important leguminous plants for large portions of the United States, there are several other legumes that deserve attention. Chief among these are the *cow-pea,* grown chiefly in the South; the *vetches,* the *soy-bean,* the *peanut, field beans* and *peas,* and several others of lesser importance. These are produced (1) for forage, or hay feed, (2) for soil renovation, and (3) for their seeds.

1. *The Cow-pea*

The cow-pea is to the South what red clover and alfalfa are to the West and North. It grows successfully on almost any kind of soil found in the cotton belt, and its cultivation is being rapidly extended throughout this region.

The plant.—The cow-pea was but recently introduced into this country, coming from China. The plant resembles the ordinary garden bean in appearance and manner of growth. It reaches a height of from one to nearly five feet. The smaller varieties stand nearly erect, the taller varieties spreading out vine-like on the ground.

The leaves are broad, and grow in clusters of three. The flowers resemble those of the garden pea, and are greenish-yellow in color. The pods, which are cylindrical in shape, grow from two to some seven inches in length. The roots, which penetrate deeply into the soil, bear tubercles, which are the home of nitrogen-gathering bacteria.

The cow-pea.

Cow-peas as forage.—Cow-peas, when harvested for hay, yield from two to three tons to the acre. The feeding value of cow-pea hay is fully equal to that of red clover, and nearly equal to alfalfa or wheat bran. It has been found a better forage feed for working animals in the South than grass hay. It is rich in protein, and therefore an acceptable substitute for corn or cottonseed-meal in the fattening of stock.

Since the cow-pea is an annual, it does not lend itself to the making of permanent meadows or pastures as does alfalfa. Cow-peas sowed in corn are profitably used as pasturage for hogs, the gain in weight being in some cases more than twice as fast with a mixed feed of cow-peas and corn as when corn alone is fed. Cattle also do well on a pasturage of cow-peas. Bloating is likely to occur, however, if grazing is allowed when the cow-peas are wet.

The cow-pea as a soil renovator.—The cow-pea improves the soil in two ways: (1) like other legumes, it is able through its root bacteria to gather nitrogen from the air and transfer it to the soil; and (2) its many roots, coarse stubble and stems, especially when the latter are plowed under as green manure, add much humus to the soil, making it more porous.

In many parts of the South cow-peas are coming to be largely used in crop rotation, with cotton the principal crop. The field is planted with cotton either two or three years in succession, then a crop of corn and cow-peas grown, and then a return to cotton. In Missouri, Arkansas, Tennessee, Alabama and other states of this region, cow-peas are being successfully used in rotation with wheat and oats. An increase of from fifty to more than one hundred per cent. in other crops following cow-peas is not uncommon.

2. *The Vetches*

The vetches are another group of legumes, grown most extensively on the Pacific Coast, less commonly in the South, and hardly at all in the North. Michigan, however, has made some excellent *hairy* vetch crop records. Although more than one hundred different varieties of vetch are known, but two are commonly grown in the United States, *common* vetch and *hairy* vetch.

Common vetch.—Common vetch is an annual, closely resembling the garden pea. Its stems are very slender, and grow from three to five feet or more in length. There are many different varieties of common vetch, of which the gray-seeded is most commonly grown in this country.

Low temperatures are fatal to common vetch; it can not be successfully raised in regions where the thermometer goes lower than about fifteen degrees Fahrenheit.

Hairy vetch.—Hairy vetch is much more hardy than common vetch, and may be raised in almost any portion of the United States. It finds its greatest use in supplying a legume for forage and improving the soil where red clover or alfalfa does not succeed, or where a short rotation crop is desired.

Hairy vetch has great power to resist drought, and does well on a sandy soil. It will also thrive on a soil so alkaline that most legumes refuse to grow on it.

3. *Soy-Beans*

Soy-beans are native to Asia, where they have been grown from time immemorial. In China, India and Japan, some two hundred varieties are cultivated for human food, furnishing a staple article of diet in many regions. They have not proved palatable to Americans, however, and are raised in this country chiefly as one of our forage crops.

Hairy vetch.

Where red clover or alfalfa can be successfully grown, soy-beans will have little place, since they are less profitable. They are especially adapted to the cotton belt, however, and to the southern portion of the corn belt. Since soy-beans are drought resistant, they also grow well in the semi-arid regions of the West. They have as yet made little headway as a crop in this region because of the ravages of the rabbits, which find their foliage a savory delicacy.

Feeding value.—The soy-bean has as great feeding value for stock as alfalfa, and is worth more than cotton-seed-meal as a food for hogs, sheep and cattle. The straw, after all the grain has been removed, is as valuable as timothy hay, and even more palatable to most farm animals.

4. *The Peanut*

Peanuts are grown in this country chiefly in the south Atlantic region. The plant produces stems from one to two and one-half feet in length. It has rather small leaves, growing three in a cluster. After flowering, the stems penetrate into the soil, where the pods or nuts are produced beneath the surface.

Uses of peanuts.—Peanuts are produced largely for their use as human food. Besides the roasted nuts sold on nearly every street corner, large quantities are made into peanut butter, oil, etc. The vines make an excellent forage for stock. Certain varieties are grown in the South exclusively as forage for hogs.

Topics for Investigation

1. Secure if possible a complete specimen of each of the legumes described in the chapter. If they are not grown in your vicinity, write your agricultural college and inquire as to how they may be obtained. Study each different plant, and learn to identify it.

Root of a soy-bean, showing bacteria-inhabited tubercles.

2. Secure seed of each of the legumes discussed. Learn to identify the seed. Plant in the school garden or at home, and watch the development of the plant.

3. Which of these legumes could be grown in your region? Would they be profitable? Talk with your father about this. If they would not pay, is it because of unfavorable climate, unsuitable soil, or because more profitable legumes can be grown? If you are not sure on any of these points, write your agricultural college.

CHAPTER XV

MEADOWS AND PASTURES

ALTHOUGH meadows and pastures claim more than half of all the farm land of the United States, they receive far less attention than any other part of the farm. About one-fourth of the acreage from which hay is harvested is native wild meadow; this is chiefly located in the newer portions of the West. Pastures are often used from year to year with no care taken to improve them. Yet in many cases meadows and pastures well repay the time and expense necessary to make them more productive.

1. *Meadows*

Requirements of a meadow.—Meadows are commonly used for a double purpose—the production of hay, and providing the rotation of crops required to maintain the fertility of the soil. It is necessary therefore to select such plants for the meadow as will serve both of these ends. This is possible with our wide range of grasses and legumes from which to choose.

Meadow plants should (1) yield well; (2) be palatable; (3) tend to improve the soil; (4) grow strong and thick enough to keep down the weeds; (5) produce an even firm sod, free from high tufts or bunches.

The surface of the meadow should be smooth and free from obstructions of all kinds that will interfere with the harvesting of the hay crop.

Meadow grasses and legumes.—Most of our meadows are mixtures of grasses, or of grasses with legumes. Alfalfa seems to thrive best alone, but most meadow plants grow well in company with some other variety. Red or crimson clover and timothy, for example, are commonly found growing together.

Several advantages come from planting mixed meadows: the different plants draw their nourishment from various

Two profitable western industries—dairying and fruit-raising (State of Washington).

depths of the soil, thus using its full strength more completely and increasing the yield of hay; mixtures accommodate themselves to peculiarities of seasons, sometimes one grass and sometimes another thriving better; mixed forage provides variety for stock, making the feed more palatable and affording a wider range of food elements.

When hay is raised for market instead of being fed on the farm, however, it is often best to devote the meadow to one plant alone, thus producing what is called a "pure" hay. Timothy is the favorite meadow grass for pure hay, and leads the market in all the great hay-buying centers. For working horses, timothy is thought by many to be superior to clover or to mixed forage. Pure red clover or alfalfa is often desired for fattening stock.

Meadow mixtures.—The mixture to be used in seeding a meadow will depend on the climate, soil and use to which the forage is to be put. Red clover and timothy are the most common mixture found throughout the northern states, the proportion of seed used being about three-fifths timothy and two-fifths clover. For damp undrained soil, alsike clover is substituted for red clover, or mixed with it. A very common mixture for average soils is the following amounts per acre:

Timothy	15 pounds
Red clover	6 "
Alsike clover	4 "

This combination will produce about a half-and-half mixture of hay the first year, with timothy predominating the second year, and pure timothy thereafter. On very wet soils, red-top may be substituted for the red clover. If the soil is also strong in acid, it is best to omit both clovers, and use the red-top with the timothy.

Care of meadows.—Under our system of rotation of crops meadows are usually not left down more than from two to four years, with sometimes a year or two of pasturing before the sod is broken up for other crops. Most of our meadows are therefore new and, like a strawberry bed, must be constantly remade.

One of the chief enemies of the meadow is weeds. They not only hinder the newly seeded meadow from getting a good start, but injure the value of hay, reducing the market price. If allowed to grow in the meadow from year to year, the weeds will also leave the soil foul for the crops that follow when the meadow is again tilled.

Spring seeded meadows should not be pastured the following fall even if the plants look thriving. This is sure to reduce the yield of hay the following season, and may cause the plants to winter kill by exposing the roots. The

Stacking by means of modern machinery saves much labor.

aftermath, or second growth, on older meadows may be pastured, though it does not pay to feed them close. Especially should new meadows not be trampled by stock while wet.

Permanent meadows.—Many meadows are located on wet ground, or on soil that for some reason is not cropped. In other cases there is neglect to rotate the meadow land with the remainder of the fields in the crop series. It is often found that meadows that are thus left for a number of years have a tendency to "run out."

The yield of hay on almost any meadow left without attention for several years *decreases from one-third to one-half.* Weeds begin to appear, and patches here and there become thin or die out. The less desirable grasses crowd out the better ones. Such a meadow is highly unprofitable. If tillable, it should be plowed up and put into other crops. If not, it should be improved and its quality kept up.

It is not hard to keep permanent meadows in a state of high production, but it requires some labor and expense. The following treatment will do much to keep permanent meadows in good condition: (1) No weeds are to be allowed to go to seed; (2) if the soil is run down, the field should be manured or other fertilizer used on it; (3) the soil should be loosened and the sod-bound condition relieved by disking; (4) fresh pure grass seed should be scattered, especially over thin or weedy places.

Topics for Investigation

1. What proportion of your father's farm is in meadow? In pasture? Compare with all the farms represented in the school.
2. How many different meadows on your home farm? How long has each been down? Which are the more successful, the older or the newer ones? Why?
3. Make a collection of the different meadow plants produced on your home meadows. How many different kinds of grasses? How many legumes? Do you find any grasses that were not sown, but which have come in of their own accord? Learn to identify each different grass and its seed in your meadows.
4. Make a collection of the most troublesome weeds found in your meadows. Learn to identify both plants and seeds. How many farmers in your region cut down the weeds on their meadows to keep them from going to seed?
5. Go out into some meadow near by and examine it

for the five qualities specified for meadows. What was the yield per acre? Is red-top as palatable for stock as timothy? As clover? As cow-peas? Does timothy improve the soil?

2. *Pastures*

More improved farm land is devoted to pastures than to any cultivated crop. Pasturage supplies the greater proportion of the feed for the production of milk, butter, beef, mutton and wool and is an important factor in the production of poultry and pork. The annual value of our pasturage is more than that of any other crop raised.

Requirements of a pasture.—Pastures should possess in general the same qualities as meadows. They should (1) yield well; (2) have such grasses as will start early and continue to grow late; (3) be palatable and nutritious to stock; (4) form a firm tough sod that will stand trampling; (5) have fine rather than coarse grasses; and (6) be free from weeds.

Pasture grasses and legumes.—The best meadow grasses are not always the best pasture grasses. For example, *timothy,* the queen of hay grasses, is too coarse when used alone for the best pasture grass, and does not stand trampling so well as some others.

Pastures should usually be made of a mixture of plants. This will provide some varieties that start earlier than others, root at different depths, adjust themselves to various kinds of seasons, supply variety for stock, and endure longer without running out. Pasture mixtures should contain a much greater variety than meadow mixtures.

Pasture mixtures.—Over the greater portion of the United States north of the cotton belt and the region west of the Missouri River, Kentucky blue-grass and white clover are the most common and valuable pasture grasses. No matter what mixture is sown, one or both of these grasses is sure to make its appearance, and gradually force most other grasses out. When blue-grass and white clover have taken possesion of a pasture they grow reasonably well together, though in some seasons one of them will predominate, and again the other.

Throughout the South, Bermuda grass is the chief pasture plant, though it is commonly mixed with Rhodes grass for dry soils and with orchard grass for wet regions. Red-top is successful on wet heavy soil.

For starting a pasture on good land in northern regions, a mixture may be made of something like the following proportions:

Timothy	10	pounds
Red clover	3	"
Alsike clover	2	"
White clover	2	"
Kentucky blue-grass	3	"
Brome-grass	2	"
Meadow fescue	2	"
Orchard grass	2	"

This will make sufficient seed for one acre. If the pasture is on very wet undrained land, the red clover may be omitted and red-top substituted in its stead. Even though timothy will soon be driven out by blue-grass and white clover, it should head the mixture as it roots more quickly than the others, and acts as a cover crop while the slower grasses are getting started.

Care of pastures.—If permanent pastures are to be kept up to a high state of efficiency they demand even more care than meadows.

On fairly good soils, pastures do not usually require manuring, though a light coat of manure will increase the yield of any pasture. Nearly every pasture needs the assistance of a mower to keep down the weeds. This is because stock do not find most weeds palatable, and so eat the grass, leaving the weeds to flourish. Many pastures are thickly sprinkled with weeds which not only rob the soil but prevent cattle from eating the grass growing close to their roots, thus adding to the waste. Weeds should be cut from the pasture each year before they bear seed.

Grazing stock not only reject the weeds for the more

Baling hay in the West directly from the meadow.

palatable grass, but also have their preference among grasses. All have noted that the uplands in a pasture are grazed close, while low wet areas are hardly touched. In many cases the low parts of a pasture are almost wasted, because the red-top and other wet-soil grasses are less palatable than the blue-grass and clovers which thrive only on well drained soil. Such marshy places should be drained; the better pasture grasses will then soon take possession.

Pastures, like meadows, may become sod-bound. Almost every pasture can be improved by disking or cultivating with a knife-toothed harrow. When this is done, fresh grass seed should be scattered on thin places or a desirable new variety added to the plants already established.

After being grazed, pastures grow better if they have a rest during the wet season from trampling and cropping. It is therefore best to have two pastures, using them alternately, instead of feeding the one continuously throughout the season. Such an arrangement usually requires only the expense of a partition fence, which the increased yield and comfort to animals from the pasture will well repay.

Topics for Investigation

1. What is the age of the different pastures on your father's farm? What is the predominating grass? What other grasses are in the mixture?

2. Is there a pasture near by consisting of both upland and marsh land? If so, which is the more closely cropped? Secure samples of the grass from each part; what grass predominates in each case? Would it not pay to drain the wet portion?

3. Make a study of the pastures represented at the school for the weeds growing in them. What proportion of the pastures may be called weedy? What weeds predominate? Are they ever mowed?

4. How many of the farmers in your vicinity follow the plan of dividing their pasture, so that the one part may rest while the other is being used? If this is not done at your home, figure the cost of running a division fence so that it would be possible. Talk with your father about the cost of the fence.

5. Are any of the pastures in your region ever disked to loosen the sod? Is new seed ever sown on them? Do you think any of them are sod-bound? How can you tell?

6. What is the cost per rod of laying field tile in your vicinity? Investigate any wet areas on your home pasture where the grass is rejected by the stock, and determine how many rods of drainage would be required to make the soil tillable. Suppose draining would double the feeding value of such an area, would the drain pay good interest on its cost? Figure this all out and talk with your father about it.

PART II. HORTICULTURE

CHAPTER XVI

THE VEGETABLE GARDEN

THE South is somewhat behind the North and West in the raising of garden vegetables for the home table. Yet vegetables are one of the cheapest and most necessary articles of food. Not only are they palatable, but they add variety to our tables and supply certain food elements not obtained from other foods. The vegetable garden can be made the most profitable part of the farm. It is safe to say that a garden may be made to yield at least from eight to ten times as great returns as the same amount of land planted to cotton or other farm crops. Most regions of the South are especially well adapted to gardening, since the long growing season will allow a succession of crops almost throughout the year. More attention to this important phase of agriculture would therefore be profitable, would add to our supply of fresh and palatable food, and would save both drug and doctors' bills by supplying a better balanced and more healthful diet.

Topics for Investigation

1. Measure your home garden and find the amount of space devoted to vegetables this season. Make a comparison with other members of the class. Compute the average size of vegetable gardens for the neighborhood.

2. Make a list of all the different vegetables raised in your home garden this year. How many different kinds? What proportion of the space was devoted to each? (Compare the number of different kinds and the proportion of each with the garden plan shown on page 209.)

1. *Plan of the Vegetable Garden*

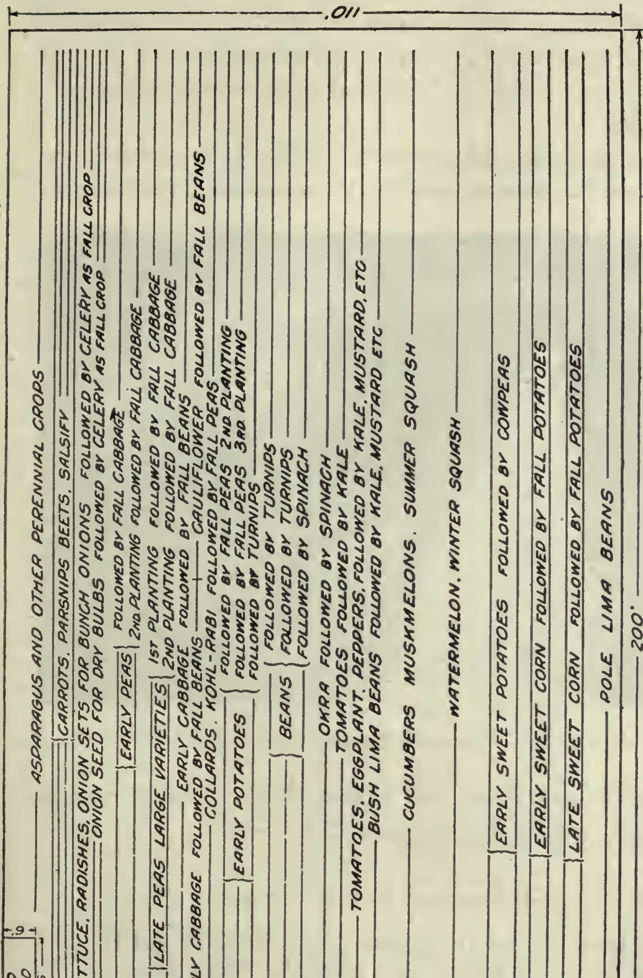
The vegetable garden should be carefully planned before time to begin planting, and a diagram made allotting to each crop its location and proper amount of space. This will save time in putting in the crop and insure a better arrangement.

The plan.—A well-planned garden provides (1) for a succession of crops supplying the table with fresh vegetables practically all the year, and by means of cold storage and home canning, *throughout the winter* in the South, as well as during the spring and summer. This can be accomplished by selecting a reasonably wide range of crops and by successive plantings of certain kinds.

(2) The right proportion of space should be allowed for each vegetable, depending on the tastes of the family and allowing for the canning of a supply for home use. As a result of careless planning an over-supply of one vegetable often results in loss and waste.

(3) The crops should be arranged in the order of their time of planting, so that the planting can begin at one side of the garden in the early spring, and proceed across until all are in. This arrangement saves much labor in cultivation without interfering with crops already planted.

(4) If the cultivation is to be done with horse implements, as it should be in all larger gardens, the rows should run the long way, and a turf turning ground be left at each end. It also pays to place in each row plants that require the same kind of cultivation and that mature in about



The above plan (see *Farmers' Bulletin* 647) suggests how to carry out the principles stated in the text. These varieties will, of course, need to be modified to adapt them to the preferences of the family and to the soil and climate.

the same time so that together they will get out of the way of later plantings. Spade and refertilize and plant all vacant space. Allow no idle land even to the extent of a square foot.

Planting time and maturity.—The time required for growth and the date of planting the common garden vegeta-

The boy with a hoe. Back-yard gardening in Washington, D. C.

bles recommended by the United States Department of Agriculture are shown on page 211.

Topics for Investigation

1. Make a careful diagram of your home garden plot, showing its exact length and breadth. Now make a plan for this plot similar to the one shown on page 209, being careful to preserve the planting order from one side to the other. What plants would you add which are not shown in the sample garden? Would you leave any out? What substitutions would you make better to suit your locality?

Kind of Vegetable	Time of planting South	North	Ready for use after planting
Asparagus	Fall or early spring	Early spring	1 to 3 years
Beans, bush	Feb. to Apr. (Aug. to Sept.)	Apr. to July	40 to 65 days
Beans, pole	Late spring	May and June	50 to 80 days
Beets	Feb. to Apr. (Aug. to Sept.)	Apr. to Aug.	60 to 80 days
Brussels sprouts	Jan. to July	May and June	90 to 120 days
Cabbage, early	Oct. to Dec.	Mar. and Apr.	90 to 130 days
Cabbage, late	June and July	May and June	90 to 130 days
Carrots	Mar. Apr. Sept.	Apr. to June	75 to 110 days
Cauliflower	Jan. Feb. June	Apr. to June	100 to 130 days
Celery	Aug. to Oct.	May and June	120 to 150 days
Corn, sweet	Feb. to Apr.	May to July	60 to 100 days
Cucumbers	Feb. Mch. Sept.	Apr. to July	60 to 80 days
Dasheen	Mar. to Apr.	Apr. to July	140 to 180 days
Eggplant	Feb. to Apr.	Apr. and May	100 to 140 days
French endive	May to Oct.	May to June	100 to 130 days
Horseradish	Early spring	Early spring	1 to 2 years
Lettuce	Sept. to Mar.	March to Sept.	60 to 90 days
Melon, muskmelon	Feb. to Apr.	Apr. to June	120 to 150 days
Melon, watermelon	Mar. to May	May and June	100 to 120 days
Onions, seed	Oct. to Mar.	Apr. and May	130 to 150 days
Onion,sets	Early spring	Fall, Feb. to May	90 to 120 days
Peas	Sept. to Apr.	March to June	40 to 80 days
Peppers (all)	Early spring	May and June	100 to 140 days
Potatoes, Irish	Jan. to Apr.	March to June	80 to 140 days
Pumpkins	April and May	May to July	100 to 140 days
Radishes	Sept. to Apr.	March to Sept.	20 to 40 days
Rhubarb, plants	Sept. to Apr.	Fall or spring	1 to 3 years
Salsify	Sept. to Apr.	Early spring	120 to 180 days
Squash, bush	Spring	April to June	60 to 80 days
Squash, late	Spring	April to June	120 to 160 days
Swiss chard	Feb. to Apr.	Apr. to Aug.	60 to 80 days
Tomatoes	Dec. to Mar.	May and June	60 to 80 days
Turnips	Aug. to Oct.	April (July)	100 to 140 days
Chinese cabbage	May to July	March to Aug.	60 to 100 days
Fennel	May to July	March to Aug.	60 to 100 days

2. How many plantings of radishes were made in your garden? Of lettuce? Of peas? Of beans? Of sweet corn? Of greens?

3. Is your garden manured every year? Is the soil in good condition and free from weeds? Is rubbish allowed to remain on the garden over winter, thereby making a harbor for insects?

Members of Market Garden and Home Canning Club packing vegetables for parcel-post shipment.

2. *Culture of the Garden Crops*

Most of the vegetables named in the preceding section can be raised without technical training in their cultivation. A few, however, must have special treatment if they are to succeed, and if there is not time to give them this extra attention they would better be left out of the garden plan.

Typical dasheen hill, a new vegetable substitute for the potato for the South and Southwest.

Hill of dasheen, showing reproduction of one corm in a season.

In raising the hotbed crop care must be taken to lift the sash during the warm part of bright days, and also to water sufficiently. Watering should be done in the morning on sunny days, otherwise the cooling may chill the plants. If the temperature grows too high the sash must be lifted, or the plants will be destroyed.

Transplanting.—When the time comes for transplanting to the open soil care must be used or the change may kill the tender plants or greatly check their growth. To avoid this hotbed plants are often transplanted to another bed, called a cold-frame, covered with glass but not heated. This is known as the "hardening off" process. Transplanting almost any plant is of great advantage since it causes the multiplication of many small roots which add to its growth.

Vegetables that require special treatment.—The larger and later varieties of peas grow so high that they require support, so they will not spread out on the ground and the pods rot. Where an abundance of brush is available, rods may be stuck in the ground for them to run on. Woven chicken wire is an excellent substitute and takes much less time. Lima beans also need poles. Because of this, bush varieties are sometimes grown in their stead.

Celery and French endive, as well as most head lettuce varieties require bleaching to produce the best results. To accomplish this, the plants are usually set at the bottom of a trench which is gradually filled in as the plants grow; or the outer leaves may be folded up and tied around the heart of the plant to shade it from the sun. At the end of the season the rows may be hilled up so that the plants are covered to the top.

Club Festival and Home Garden exhibit, Public Library, Tacoma Park, Washington, D. C.

3. *Insect Enemies of the Vegetable Garden*

Fortunately, most of the garden vegetables are not subject to great injury from insects. Certain plants are, however, special targets for these pests, and must be protected or they will almost certainly be destroyed.

The most common enemy of cabbage and cauliflower is the cabbage-worm, which is the larvæ of the common white butterfly seen about the cabbage patches. The most effective remedy is spraying with the *arsenate of lead preparation,* made by mixing three pounds of the paste with fifty gallons of water. To this should be added a mixture of resin and lime, or soap, to cause the insecticide to stick to the leaves.

The cucumber beetle.—The worst enemy of cucumbers is a small striped beetle which eats the leaves of the young plants. When only a few hills are raised they may be kept off the plants by making a small wooden frame over which is stretched wire mosquito netting, and placing these boxes over the hills. These pests can also be controlled by spraying with the arsenate of lead compound. The roots of the plants are sometimes attacked by the larvæ of the beetle. Tobacco dust sprinkled on the roots is an effective remedy.

The cucumber beetle is also the most troublesome enemy of squash, muskmelons and watermelons. These plants may be protected in the same way as the cucumber.

The aphis.—The aphis, a small green fly, is a sucking insect that attacks lettuce, peas and other green leaf crops. It is also frequently found on flowering shrubs. It may be controlled by spraying with a mixture of soap and water, or with a nicofume preparation mixed according to directions on the package.

The cutworm.—The cutworm attacks a number of

The white grub: (A) pupa; (B) beetle; (C) larva.

different vegetables, cutting them off just at or near the surface of the ground. The remedy is fall plowing, and poisoning. An effective method of attracting to the poison is to dip clover blossoms in Paris green, or add Paris green to a mixture of bran and molasses, and strew around the roots of the plants.

Topics for Investigation

1. Which of your garden crops have been most attacked by insects? Have you used any of the spray compounds as a remedy? If so, what ones, and for what insects? Was it successful? Do you know how to mix and apply the more common insecticides?
2. Talk with your father and mother and plan your home vegetable garden for next season. Bring your plans to school, and compare the different plans presented to determine the best.
3. Prepare a plan and specifications for a small hothouse which can be heated with an old stove or from the house heating plant.
4. Show how to keep a garden account for a season; at least six different kinds of products should be included in the items.
5. Make a map of the United States and show the most important vegetables grown in each section. Compare the vegetable garden products of the Pacific Coast with those of the Atlantic Coast; the northern tier of states with the cotton belt states.

4. *Garden Demonstrations*

1. Demonstrate how to prepare, pack and ship vegetables by parcel post.
2. Show how to make different types of boxes for marketing products.
3. Demonstrate how to make a home-made canning outfit, by using wash boiler, garbage bucket, pail and tub.
4. Show how to can vegetables by the cold-pack method. (See Chapter XX, on Home Canning.)
5. Demonstrate how to mix garden sprays and how to use them.

A Pasadena, California, school vegetable garden.

School gardens, Portland, Oregon. Home gardens their destiny.

6. Demonstrate how to make a few vegetable dishes and how to serve them.

5. *Garden Play Contests*

All contests with garden products should be a combination of play with helpful practise and instruction.

1. Vegetable judging contests.
2. Story contest. Tell origin and life history of different vegetables such as tomato, swiss chard, sweet corn.
3. Vegetable spelling contest.
4. Vegetable drawing contest. Place on stand before contestants a number of vegetables and have them draw them.
5. Vegetable canning contest.
6. Paring, labeling and packing contests.

6. *Home Garden and Canning Club Projects*

One of the most interesting of club projects in connection with the public schools is the work of the home garden and canning club. This can be undertaken in much the same way in both city and rural territory. The club plat should be operated on a business basis, and should be large enough to make possible an attractive net profit on the investment of *time, money* and *energy* of the member.

Club members should range in age from ten to eighteen years, inclusive, and be divided into two classes denominated as senior and junior gardeners. The basis of award for school credit or prizes may be as follows:

1. Yield of garden	20
2. Net profit on investment	20
3. Variety of vegetables, appearance of garden	20
4. Exhibit of products, fresh and canned	20
5. Record and story, "How I Made My Crop"	20
Total score	100

CHAPTER XVII

CULTURE OF FRUITS AND NUTS

FRUIT and nut farming have in recent years enjoyed a remarkable growth. The home fruit garden is coming to be considered no less important than the vegetable garden, and large commercial orchards are now an important factor on many of the reclamation projects of the semi-arid regions of the West and Southwest. Millions of acres of land in all parts of the United States, especially in the South and in the dry regions are yet available for the fruit and nut industry. The use of fruits and nuts as a part of the daily food supply is also rapidly extending to include almost every family in both this country and Europe.

1. *The Home Fruit Garden*

The home fruit garden, like the vegetable garden, should be planned for cultivation by means of horses. The rows should therefore run the long way of the garden. The fruit garden may well join the vegetable garden, and be approximately the same size, about ninety by two hundred and forty feet for a farm garden. The entire plat will then contain approximately one acre of ground.

All fruit trees should be treated with a dormant spray, applied at some time during the dormant season. A second spraying should be applied just after the leaf buds burst, and a third at blossoming time. Apples should be sprayed just as the petals fall, and pears just before the blossoms open. It is fully as important to spray at the right time as to use the right mixture. The successful gardener must understand his fruit trees and the habits of their enemies.

Topics for Investigation

1. Make a list of all your home fruits by varieties.
2. Is your fruit garden well cultivated and free from weeds? Are any of the plants sod-bound? Is mulching used?
3. Learn to identify surely and quickly each of the different fruit trees, shrubs and vines, either when in foliage or dormant.
4. Go with your teacher or some expert gardener to some near-by fruit garden and learn how and why the different plants should be pruned. Is your home orchard well pruned?
5. Bring specimen branches or stems of the different garden fruits and show where and how the fruit is borne. Make a drawing in each case.
6. Is your fruit garden regularly sprayed? What kind of spray machine is used? What mixtures? What enemies are most troublesome in the case of each fruit?
7. Make a collection of all the different insects and fungi you can find that damage fruit in your region. Learn to identify each. What spray is used for each?
8. Estimate the value of the fruit produced in your home garden last year. Did it pay for the ground occupied, the expense and the time used? How can the amount of fruit and its net profit be increased? What are your plans in this direction for next year?

2. *Commercial Citrus Fruit Orchards*

The citrus fruits constitute one of our most important orchard crops. The orange, the lemon and the grapefruit are coming into even greater use than the apple or other staple fruits. The lime and the tangarine are also growing in favor, and are finding a place in the citrus orchards

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Citrus orchard territory.—Florida and California are recognized as our leading citrus fruit states. The whole

Fruit farms and orchards, Southwest.

southern tier of states is developing the industry successfully, however, and some of them bid fair to rival the two mother states. There are to be found large and profitable orchards of oranges, grapefruit, limes and lemons in the southern portions of Arizona, New Mexico, Texas, Louisiana, Alabama and Georgia.

The orange.—The orange came originally from Asia, but now it is a native of nearly every country where a tropical or subtropical climate prevails. It is highly de-

Almond orchard, southern and western territory.

Riverside orange groves of California.

veloped in Porto Rico, Hawaii, the Philippine Islands, South America, China, Japan, Spain, Portugal, Sicily and Asia Minor. The fruit is shipped from these countries in great boatloads to the markets of the world.

When Columbus and his men landed in America they

Oregon raisin vineyard.

found two kinds of citrus fruit growing in Florida, the rough lemon of the Everglades and the sour orange of the hummock lands farther north. When the Spaniards came a little later they planted the seeds of their cultivated oranges. From these seeds there developed the great seedling orange groves of the South. At the present time, however, there have been developed many budded and grafted varieties, and the orange commonly known as the navel orange. In Florida alone there are hundreds of varieties. There is still shipped out to the northern markets a great deal of the seedling stock, but more and more the navel orange is coming to claim the best markets. The Parson Brown is a very early variety, sweet and wholesome. The Pineapple is somewhat later and is considered by many the most delicious of southern varieties. The Florida Valencia is a late variety resembling the California Valencia. A considerable difference in flavor and texture exists between Florida oranges and those grown in the Southwest owing to the fact that the former are usually grown under humid conditions and the latter by irrigation.

The lemon.—The lemon tree grows very much the same as the orange except that it is smaller and has a lighter colored leaf. The flowers are tinged with red and the fruit is of a paler yellow with a more sour and acid flavor. While the oranges are used largely for breakfast fruit dishes, desserts and general eating purposes, the lemon is used for sirups, beverages, flavoring extracts, etc.

The grapefruit.—The grapefruit tree is also in many respects like the orange. The fruit is larger and of a very pale yellow color. The flesh is of a lighter texture than the orange, is sour and sometimes bitter. It is used extensively throughout the United States, and in fact much of the rest of the world as a very palatable breakfast fruit. It will grow in practically all sections where the orange can be produced. The grapefruit is a native of the Malayan and Polynesian islands. It is a more hardy plant than the orange, and will adapt itself more readily to the local conditions. The grapefruit industry is at present developing very rapidly in Florida, California and several of the gulf states.

The lime.—The lime resembles the lemon tree in appearance, excepting that it is smaller. It is cultivated extensively in the West Indies, Florida, southern Mississippi, part of Alabama and to some extent in other gulf states. The tree is more thorny than other citrus trees. It bears white flowers, and the fruit resembles the lemon, but is smaller in size. It has a large amount of acid in its makeup, and is used extensively for beverages and sirups.

Soil and climate requirements.—Citrus fruits require a deep, fertile and well-drained loam soil. The soil needs lime, and should be kept rich in humus and nitrogen. All citrus fruits demand a warm, subtropical climate, a great deal of sunshine and freedom from cold winds, frost and cold nights. One of the greatest dangers to the citrus fruit industry of the United States is from frosts and the uncertainty of orchard localities in the matter of early and late freezing. The killing of fruit buds by late spring frosts must be met by some of the special methods, such as whitewashing, smudging and heating by means of oil pots. The last named method is probably the most efficient.

Cultivation and management.—No type of farming requires greater care in the matter of management and cultural methods. The orchard bed should be prepared by deep plowing and a thorough pulverization of the top soil. The soil should be kept free from weeds and a constant dust mulch maintained throughout the season for the conservation of the moisture. From the fact that an orchard will remain bearing for years there is great danger of depleting the soil of its fertility and making the orchard unproductive, hence the necessity of cover crops, the plowing under of legumes, the adding of barnyard manure, lime, potash, and other fertilizing material from time to time as they are needed. In matters of tillage and cultivation the citrus orchard should be as carefully managed as a corn

Clean cultivation and intercropping. Three-year-old apples trees—2,500 acres, Idaho.

field or a vegetable garden. The irrigated orchards of the Southwest require a little different type of management owing to the peculiar conditions under which the land is handled. Most of the irrigation of citrus orchards is done by surface irrigation, bringing the water from its source to the head of the orchard by means of lateral ditches and then distributing by sublaterals, furrows or corrugations. The water is conveyed from this head ditch down through the orchard and is absorbed by the root system by means of radiation.

Annual pruning, thinning and spraying of the orchards is of greatest importance in the management of citrus fruits. The neglect of these usually means not only a defeat for the following year, but an enormous loss for a number of succeeding years.

Picking and packing.—Great care and skill are required in the picking and packing of all citrus fruit. In the best commercial orchards we find great packing plants erected at considerable expense where the fruit is not only sorted and carefully crated, but washed and polished and then wrapped and placed in neat packages or in boxes ready for the market. Those who would make a success of citrus fruit production need to give a great deal of time and attention to this particular phase of the work.

Marketing.—Most of the citrus fruit at the present time is marketed through various associations. The individual grower is at a disadvantage when it comes to marketing his products, *first,* because he does not have enough in quantity to command the attention of leading buyers; *second,* because he can not secure the same transportation rates given to larger concerns; *third,* because he does not have time to study the markets and so exercise the best business judgment in a matter so essential to a profitable return from his fruit. The importance of the marketing end of this business is shown by the fact that some of the largest growers are investing thousands of dollars in packing and marketing facilities where in former years the packing was done in the orchards and marketing attended to only in a sort of haphazard way. Some of the packing plants in California and Florida cost upward of $10,000.

Topics for Investigation

1. What per cent. of the land in your state is devoted to citrus fruit? Give the approximate acreage of oranges, lemons, limes, grapefruit. In your judgment, what per cent. of the other available unused land could be profitably used for citrus fruit purposes?

2. What varieties of oranges are produced in your section? What varieties are considered the most profitable and the most desirable for table use?

3. Where do your local stores secure their stock of citrus fruit? Make inquiry and find out, if possible, the distance between the orchards where these are produced and your local market. Find out how much it costs to transport this fruit per box to your market.

4. What is the food value of the oranges and grapefruit? Why do doctors often advise that small children, invalids, and sick people take a great deal of orange juice?

5. What are the reasons for changing from the native sour and sweet oranges of Florida to the production of the navel orange? If you wished to order budded and grafted stock, of whom would you buy? Where would you go?

6. What is the difference between budding and grafting of trees?

7. Secure at the local market a navel orange, the sweet Florida orange and several other distinct varieties. Try to discover the difference in flavor, color, texture. What particular qualities does the citrus fruit market demand in its fruit? How may we secure these qualities from our orchards?

8. By the use of a score card judge ten oranges, ten lemons, and ten grapefruit.

A typical Arizona orange tree.

3. *Other Important Fruits of the South and West*

The pineapple.—This is one of the desirable and promising fruits of southern Florida, southern California and southern Texas. The range of its territory will undoubtedly be considerably expanded within the next few years. Much of the region in the southern sections of the gulf states, as well as southern New Mexico and Arizona, especially when the land in the latter states has been reclaimed and water made available, will permit the growing of this fruit. The pineapple is widely used for sauces, salads and other desserts, as well as for flavoring extracts, marmalades, etc.

The olive.—The olive is one of the oldest fruits known to the world. It is fast becoming a profitable fruit industry in our southern states, especially in southern California. The olive tree is of a low branching, evergreen variety from 15 to 35 feet high. It has small dark green leaves, and a dark green fruit which turns a brownish black when ripe. It is native to Africa, Asia and Greece. The commercial orchardists are growing the olive in Italy, France, Spain, Greece, Asia Minor, Mexico, Peru, Algeria, Tunis, and in the United States some very large commercial orchards are found in southern California. The trees will begin to bear when from six to eight years old. A good tree of this age will produce from five to eight gallons of oil, and the yield increases gradually up to as high as fifty gallons. An olive tree will bear profitably from forty to fifty years, but the tree itself will continue to live and appear hardy and strong for upward of a hundred years.

Figs.—The fig is a very valuable and profitable fruit. It grows well in Florida, southern Alabama, Mississippi, Louisiana, Texas, Arizona, southern Utah and southern California. The tree is propagated from cuttings taken from roots in the fall of the year or in early spring. The fig tree produces every year, and at the age of two or three years will bear a considerable crop.

Peaches and pears.—Peaches and pears are grown extensively in practically the entire southern half of the

Four-year-old pear tree, Idaho. Orchard club members gathering fruit.

United States. The fruit is very desirable not only for dessert purposes, but for canning. The peach and pear industry has greatly developed in recent years under more scientific management, the adaptation of varieties to climate and other local conditions, increased facilities for transportation, cold storage, etc., have given great encouragement to this fruit industry. Peaches especially will not stand much handling, and are too perishable a product to ship a great distance from grower to consumer. Success in the handling of these orchards depends very largely upon the amount of business management and intelligence exercised.

4. *Nut Farming of the South and West*

The largest commercial nut orchards of the United States are found in the southern and southwestern states. This industry has greatly developed during the last fifteen years, and as the cultural methods become better understood the area will be greatly increased. Nuts constitute a very important part of our daily diet. They furnish a very excellent substitute for meats, which are increasing so rapidly in cost to the consumer. Most of the nut trees grown in this country are considered very excellent trees for the farmer's wood lot, and for ornamental or shade purposes in our village and city lots. Some of the leading commercial varieties are the *almond, English walnut, pecan* and *filbert.*

The almond.—The almond tree very much resembles the peach tree in size, foliage and flower. The almond is a very valuable nut because of the high percentage of food to shell. When the fruit ripens the pecan breaks open, the pulp dries, and the nut falls to the ground. It is then gathered and prepared for the market. The largest almond groves are found in the southern half of the states of Florida, Texas and California. Almonds were brought to this country from Spain and countries adjoining the Mediterranean sea. They are used very extensively for confections, cooking purposes, medicine, flavoring extracts, and sometimes for perfumery.

The English walnut.—The English walnut is one of the largest and finest nut trees of the South and Southwest. It will bear profitably at the age of six years and will continue to bear for thirty years. The walnut industry has not developed in this country nearly so far as is possible. It is conceded by the authorities that this nut will grow profitably in eight or ten states, yet at the present time it is confined largely to the southern half of California and southern Texas. It is found growing fairly well in states as far north as Illinois, Indiana, Delaware, Virginia, Maryland, Pennsylvania and New Jersey.

The pecan.—One of the most profitable nut industries of America is that of the pecan. The tree grows wild in a number of our states and is cultivated in practically all of the southern region, and particularly by some of the largest commercial orchardists in southern California, Texas, Louisiana, southern Mississippi and Georgia. The pecan industry has only fairly begun, and it is probable that the area and output will be greatly increased. The trees are produced in practically the same way as the citrus fruit trees, by budding and grafting. They are set about forty feet apart and will begin to bear at from five to eight years of age, and continue to bear from twenty-five to forty years. There are a large number of varieties of pecans. The best commercial variety is the one known as the Louisiana and Texas paper shell. The tree is valued not only for its food qualities, but as an ornamental and shade tree.

Other varieties of nuts.—The United States was at one time well covered with nut trees in the forests from the east to the west and as far north as the Canadian line. The deforestation which is constantly going on has, however, greatly reduced the number of wild nut trees. The black walnut, butternut, hickory nut, chinquapin, chestnut, and hazelnut are all fast becoming extinct as wild nuts, and sooner or later, in order to conserve these varieties, it will be necessary to produce them as domestic trees. Every farmer should be especially interested in including the nut trees in his work of reforestation or the development of his wood lot. In setting out shade trees in the cities on vacant lots, dooryards and back yards a careful selection of nut trees will be well worth while.

Topics for Investigation

1. Make a census (1) of all the different kinds of nut trees on your home farm, (2) of all to be found in your locality.
2. Join with the class in making a collection of all the different kinds of nuts available from the forests and in the markets near at hand. Learn to identify each. Find out where each kind was produced.
3. Consider what nut trees not grown in your locality could be profitably introduced. Consider also the question of shade and ornamentation.
4. Make a study of a table of food values of nuts. Look up the food value of other articles of food and make a comparison.
5. On a map of the United States locate the areas where the principal nuts are grown.

5. *Demonstrations*

1. Demonstrate how to grade and pack a box of oranges or apples.
2. Show how to polish and dry different kinds of fruit before packing.
3. Demonstrate how to can windfall apples in two different ways. Girls may show how to prepare dishes from canned products for table use.
4. Demonstrate the wrong, then the right way to core and pare apples.

5. Demonstrate how to mix and use the different orchard sprays. See Chapter XIX for directions.

6. Demonstrate how to make a fruit tree graft. How to bud an orange tree.

7. Demonstrate how to prepare oranges, lemons, figs and apples for the county or state fair exhibit.

8. Show how properly to prepare grapefruit for table use as a breakfast dish.

9. Demonstrate how to irrigate a bearing orchard.

10. Demonstrate how properly to hull and crack the various nuts mentioned in this chapter.

6. *Play Contests with Fruit and Nuts*

1. Fruit paring contest, based upon time, skill and weight of peelings and finished products.

2. Variety naming contest in both fruit and nut classes.

3. Nut cracking contest.

4. Contest in judging of apples, oranges and pecans.

5. Guessing games with both fruit and nuts in matters of naming varieties after descriptions are given. Second, by guessing the number of any given variety or kind of fruit or nuts a certain vessel will hold.

6. Apple canning contest; use windfall apples.

7. Canning contests. To see who can prepare and can the largest quantity of any kind of fruit in a given time.

8. Manual training contests in making canning outfits, fruit presses, smudging vessels, crates, etc.

9. Tree pruning contests.

10. Geography, language and arithmetic contests, based upon fruit and nut interests.

7. *Club Projects*

In connection with the fruit and nut industry it is highly desirable to organize orchard management clubs.

This will encourage the application of the information of this book in real practise. Club members in addition to meeting once a month should agree to do the work in *pruning, spraying, trimming, cultivation, managing, intercropping, picking, grading, crating, marketing,* and then, by means of canning, save all windfall fruits and packing house culls. The basis of award may be as follows:

1.	Management of orchard	20
2.	Condition of the orchard at close of season	20
3.	Net profit on investment	20
4.	Exhibit and quality of both fresh and canned products	20
5.	Crop report and story of season's work	20
	Total score	100

The above score can be modified to suit club projects with strawberries, peaches, pears and citrus fruits.

The fall fruit and vegetable festival held in connection with the school for the entire community should be one of the most interesting events of the year. At this time the demonstrations, exhibits and play contests can be successfully carried out with definite educational and recreative value to all.

CHAPTER XVIII

THE TOMATO

TOMATOES are becoming so important a garden and truck crop as to deserve a special chapter. They came originally from tropical regions, where the vines bear fruit all the year.

1. *Importance of the Tomato*

For a long time tomatoes were not known to have value as a food, but were thought to be poison. The plants were then cultivated for ornamental purposes and were known as "love apples."

Uses now as food.—The chief value of tomatoes as a food lies in the sugars and protein, and in a stimulating effect on digestion. More than three hundred recipes have been worked out in preparing tomatoes for our tables. Many more people will use tomatoes as a part of their diet when they come to know more of their value.

Tomato growing states.—Tomatoes will grow successfully in almost every part of the United States. Maryland is one of the largest tomato producing states, and has the largest number of tomato canning factories. New Jersey, Indiana, California and Delaware rank next.

Hundreds of thousands of cases of tomatoes are now being grown and canned annually by the boys and girls of the canning clubs. It is estimated that, after paying the expenses of raising his crop, a club member from ten to eighteen years of age can make from ten to twenty-five dollars a day for the time he puts in canning the crop for market.

2. *Varieties*

In selecting the varieties for the home garden the length of season, quality, yield and appearance of the crop should be considered.

Early varieties.—There are a great many varieties from which to select. Among the favorites are: *Earliana,* Chalk's *Early Jewell, Bonnie Best, Globe* and *Prince's June Pink.*

Late varieties.—The chief late varieties are: *Stone, Matchless, Beauty, Ponderosa, Dwarf Stone, Acme* and *Trophy.*

3. *Raising the Crop*

Where the seasons are short it is necessary to start the plants in a hotbed and transplant them when all danger of frost in past. In the northern states it is well to use the cold-frame for hardening off the plants before setting in the garden. This process strengthens the plants and enables the crop to mature before freezing in the fall.

Transplanting.—Have the seed bed well prepared by deep spading or plowing, thoroughly manured with a well-rotted barnyard manure, and well pulverized. The plat should be marked off in rows three or four feet apart, according to the variety of tomatoes grown. The large hardy varieties will require a distance of four feet each way, while the dwarf varieties will do well three feet apart. In transplanting, have the holes opened up, remove the plants from cold-frames or hotbed without injuring the roots. Allow enough soil to accompany the roots so that the plant may go on growing without pause.

Pruning.—Much of the success of the tomato crop depends on proper pruning and staking. Tomatoes are especially liable to fungous and bacterial diseases, and therefore need to be kept from the ground and given an abun-

A plot of tomatoes in Geauga County, Ohio, showing the result of careful pruning and staking.

dance of sunlight. The vines should be pruned at the time of transplanting or soon afterwards by pinching off the suckers, or secondary leaf buds, found in the axils of the leaves. This will cause the plant to grow tall instead of spreading out. After each vine has developed four or five clusters of fruit the top bud should be pinched off to prevent the plant from growing too high.

Staking.—The method of pruning described requires staking to support the vines. For this purpose a single stake may be driven beside each hill, or a continuous meshed wire or other form of fence may be used. Soft twine or cloth should be used for tying the vines. No loop should be drawn tightly around the plant.

Spraying.—The tomato vines should be thoroughly sprayed with Bordeaux mixture several times during the season. The first spray should be given about the time the first fruit begins to form, or even earlier if the season is warm and moist. This will prevent the plants from being attacked by mildew. Remove at once any tomatoes that show a brownish discolored area about the blossom end. This will prevent the spread of disease.

4. *Harvesting and Marketing*

Gathering the crop.—Tomatoes should be gathered when ripe and firm and should be handled with great care to prevent crushing or bruising. For marketing they should be graded in three classes, *prime, medium* and *culls.* The more nearly uniform in size, shape and color, the more will the market offer for the product.

Canning.—Tomatoes for canning purposes should be thoroughly ripened and be of a deep red color, smooth and firm. They should be canned whole so as to permit the use of the tomato in as many different ways as is possible with the fresh tomato. Water should not be added to jars or cans when canning tomatoes, as this will dilute their flavor, destroy their color, and injure their purity. The culls may be put up for such purposes as *puree*, for tomato soup and breaded tomatoes.

Topics for Investigation

1. Write a brief history of the tomato. Name the different uses to which the tomato is put in your own home. Can you suggest still other uses? Why should tomatoes be canned whole?

2. How many quarts of tomatoes did you raise and can last year? What kind of soil is best adapted to the culture of tomatoes?

3. Make a drawing of a hotbed, giving all dimensions. Write out full directions for preparing, filling and caring for the bed.

4. Show how to keep a bookkeeping account of one-tenth acre of tomatoes, covering items of cost and cash received from the time of preparing the hotbed to and including the canning and marketing of the crop.

5. Show on the map of the United States the greatest tomato states, and the approximate location of the territory in which the early varieties should be grown and the territory in which the late varieties should be grown.

5. *Demonstrations with the Tomato*

1. Demonstrate how to scald, pare and core the tomato.

2. How to can tomatoes.

3. How to grade and crate for parcel-post shipment, prime grade tomatoes.

4. Demonstrate how to use the tomato in the home by preparing certain dishes.

5. Demonstrate the proper method of pruning and staking tomato vines.

6. Other demonstrations of cultivation, hoeing, spray-

Waterloo, Iowa, club girl demonstrating how to prune the tomato plant by pinching off the axillary bud.

ing, thinning, etc., can be undertaken in connection with tomato culture.

6. *Tomato Play Contests*

1. Tomato race, conducted on very much the same plan as the potato race.
2. Tomato judging contest.
3. Tomato canning contest.
4. Can labeling contest.
5. Essay writing contest on the origin and history of the tomato.
6. Tomato problems contest.
7. Tomato recipe giving contest.

7. *Tomato Club Project*

Another of the interesting club projects is the growing of a club plat of tomatoes and studying all of the interesting lessons from the selection of the variety of seed, through the hotbed, cold-frame, transplanting, pruning, staking, cultivating, gathering, grading, crating, marketing and home canning of the surplus products. To this can be added sewing of apron and cap, and finally the preparing of the product into various dishes for the table. For the rural communities one-tenth of an acre should be the acreage basis, and for city and village work, not less than a square rod.

The basis of award should be:

1.	Yield, total pounds of tomatoes	20
2.	Net profit on investment	20
3.	Quality, both fresh and canned products	20
4.	Variety of canned and prepared tomato products on exhibit	20
5.	Cost record and story "How I Made, Canned and Marketed My Crop"	20
	Total score	100

CHAPTER XIX

GARDEN AND ORCHARD SPRAYS

POISONOUS sprays for the destruction of insect and fungi of garden and orchards have come into general use. Upon their successful application often depends the value of the crop, both as to quantity and quality. Not infrequently an entire failure of yield results from the attack of these pests when they are not destroyed in time. Wormy and scabby apples, rotting peaches and plums, blighted berries and diseased vegetables prove the necessity for some means of stopping their ravages.

The purpose of the two classes of mixtures, *fungicides* and *insecticides,* is indicated by the name applied; the *cide* in each word means to kill. Only the more important and common fungicides and insecticides will be described here.

1. *Bordeaux Mixture*

Bordeaux mixture is one of the most successful and widely used fungicides. Used at proper strength it is harmless to most plants, though it has been found injurious to some, especially plums and, in less degree, peaches. It will also stain foliage and fruit upon which it falls.

Composition.—Bordeaux mixture is made when needed, of *copper sulphate* (blue vitriol) and *lime.* The strength may be varied, depending on the required use. The proportions most generally accepted are:

4 pounds of copper sulphate.
6 pounds of fresh lime.
50 gallons of water.

The copper sulphate is the active agent in killing the fungi, while the lime prevents injury to the plant. Besides this "4-6-50" mixture, other formulas frequently used are of the proportions 4-4-50, and 5-5-50.

Making the mixture.—When but a small amount of spraying is to be done the only equipment required for making Bordeaux mixture is a fifty-gallon barrel, two twenty-five gallon tubs, buckets and a fine-mesh sieve.

Fill one of the smaller tubs with water, and suspend just below the surface four pounds of copper sulphate in a loose bag, giving it time to dissolve. This will require about an hour, though the process can be hastened by using hot water. Slake six pounds of lime in the other tub, using hot water and reducing the lime to a paste. When the lime has cooled, dilute to twenty-five gallons.

Now stir the contents of the tubs, and pour bucketfuls of each mixture simultaneously through a sieve into the larger barrel, making sure that the streams mix. Stir well, and the compound is ready for the spraying machine.

Use.—The amount needed for a garden can be judged from the fact that a tree in full leaf and having a spread of twenty-five feet will require about four gallons of the mixture. Most beginners use too little, hence fail to get the best results.

Bordeaux mixture is not effective against insects. If, however, *arsenate of lead* in the proportion of two pounds to each barrel of the mixture be combined with it, the compound will serve as a check on both insects and fungous diseases. Scab, apple blotch, bitter rot, wilt, mildew and brown rot are controlled by Bordeaux mixture.

2. *Lime-Sulphur Mixture*

The lime-sulphur mixture, besides being an insecticide for certain plant insects, is also a fungicide serving the same

Duchess apples, showing results of punctures of the plum curculio. This injury could have been saved by proper spraying.

Spraying apple trees.

general purpose as Bordeaux mixture. It has the advantage of not injuring certain plants, such as peaches and plums, to which Bordeaux mixture is not adapted. Some fruit growers are coming to employ it as their principal fungicide.

Composition.—The strength of the mixture may vary, the proportion of the ingredients commonly being:

8 pounds of flour of sulphur.
8 pounds of fresh lime.
50 gallons of water.

Making the mixture.—The lime-sulphur compound may be made by several different processes, one of the simplest of which is the *self-boiling* process. To make the self-boiled mixture, put eight pounds of lime to slake, and while the slaking process is going on, sift over the lime eight pounds of finely powdered sulphur. Stir constantly, adding water until a thin paste is secured. Dilute to fifty gallons, and strain before using.

Lime-sulphur may be also bought ready for use. Although it costs slightly more than the home-made product, the time saved makes the commercial form cheaper if but a small amount is required.

Use.—Lime-sulphur controls scale insects and curculio, as well as such fungous diseases as scab, leaf curl, brown rot, etc. Arsenate of lead may be used with this mixture also.

3. *Arsenate of Lead*

Arsenate of lead is one of the most important stomach insecticides known, and has largely taken the place of Paris green with most fruit growers. It seems to be palatable to all garden insects. It adheres well to foliage, hence does not easily wash off in showers as does Paris green. It will not injure plants no matter how strong the solution.

And it also acts as a fungicide, especially when mixed with lime-sulphur.

Composition.—Arsenate of lead is easily compounded, the usual formula being:

22 ounces arsenate of lead dissolved in 2 gallons of warm water.
8 ounces arsenate of soda dissolved in 1 gallon of water. (Use wooden pail in each case.)

The two solutions are now poured together and diluted with water to make a mixture of fifty gallons, then it is ready to spray.

Arsenate of lead may also be procured in the form of a paste ready to dilute for the spraying machine. Three pounds of the commercial paste will make fifty gallons of spray. It will hardly pay to go to the trouble of mixing the compound at home, since the ready-made product usually costs no more than the ingredients for making the mixture.

Use.—The arsenate of lead mixture may be used either alone or with fungicides for destroying nearly the whole range of biting insects attacking garden fruits. It has proved of the greatest service, especially in the spraying of apples.

4. *Paris Green*

Paris green is one of the oldest and best known of the insect poisons. Several thousand tons are used each year for this purpose.

Composition.—Paris green is often prepared for spraying by simply dissolving from four to eight ounces in fifty gallons of water. The standard formula, however, is:

4 ounces of Paris green.
½ pound of lime.
50 gallons of water.

Crop from four sprayed peach trees; one basket of scabby fruit at the left; the remainder sound.

Crop from four unsprayed peach trees. Sound fruit in three baskets at left; the remainder scabby. Why spray?

The lime is to be slaked and mixed with the water. The Paris green is mixed to the form of paste in a small quantity of water, and then added to the water.

Use.—Paris green may be used in combination with the Bordeaux mixture, but not with lime-sulphur. When mixing it with Bordeaux, the Paris green should be combined with the diluted lime before it is brought in contact with the copper sulphate.

5. *Kerosene Emulsion*

Kerosene is one of the best of contact insecticides. A small particle of it on any part of the body means certain death to any insect. Pure kerosene, however, will injure most plants, hence must be used in a mixture. The best of these is what is known as kerosene emulsion.

Composition.—The formula for the mixture commonly used is:

½ pound hard laundry soap shaved fine.
1 gallon of soft water.
2 gallons of kerosene.

Making the emulsion.—One of the advantages in the use of this spray is the ease with which it can be made. Dissolve the soap in one gallon of boiling water; remove from the stove and at once add two gallons of kerosene. Stir while cooling until a soft, butter-like mass is obtained. Dilute one part of this stock solution with ten or twelve parts of water as needed for spraying.

Use.—Kerosene emulsion may be used on all kinds of tender foliage without injury. It will control the various kinds of plant lice, slugs, etc.

6. *The Resin-Lime Mixture*

One of the difficulties in using many of the insecticides and fungicides is that they do not adhere well to the smooth foliage of the plants. The resin-lime mixture is often used in combination with other compounds to insure their sticking to the plants until they have done their work.

Composition.—The formula employed is:

5 pounds of pulverized resin.
1 pound of concentrated lye.
1 pint of fish or some other animal oil.
5 gallons of water.

This mixture is the stock solution, which is still further diluted as used.

Making the mixture.—The oil, resin and one gallon of cold water are to be put into an iron kettle and heated until the resin softens. Add the lime and stir well. Then add four gallons of hot water and boil until a little mixed with cold water gives a clear amber-colored liquid. Add water to make up for what has boiled away, making five gallons of the compound.

Use.—This spray, besides causing other mixtures to adhere to the foliage of plants, is itself an excellent contact insecticide. Its principal effect is through making a smothering coating over the body of the insect. It is used in some regions as a dormant wash for the control of scale insects. When used with Paris green or Bordeaux, two gallons of resin-lime compound are mixed with eight gallons of water, and this added to forty gallons of the spray.

Topics for Investigation

1. Copper sulphate costs from seven to ten cents a pound, and lime, when bought in small quantities, about fifteen cents a pound. What, then, should be the outlay in making fifty gallons of Bordeaux mixture? What would it cost for material to spray ten apple trees averaging a twenty-five-foot spread?

2. Under the direction of the teacher and with great care in handling both before and after mixing, let the class

join in making up a Bordeaux mixture, substituting one ounce for each pound of the ingredients in the formula, and a corresponding amount of water. What is the color of the compound? Will it keep indefinitely if covered to save evaporation? Spray a few trees on school ground.

3. Make a lime-sulphur mixture, reducing the amounts as before to one ounce for each pound of ingredients.

4. Make up a kerosene emulsion, using one pint of kerosene and a corresponding amount of other ingredients.

5. Secure catalogues describing spraying machines, examine the different makes, and decide which is best for the use you would require in your home garden and orchard. If uncertain write your state agricultural college about it.

CHAPTER XX

HOME CANNING OF FRUITS, VEGETABLES AND SOUPS

IT is both practicable and economical to can the surplus vegetables, fruit, sweet corn, greens and other products that commonly go to waste in the orchard, field and garden.

1. *Home Canned Products and the Table*

When the average home has learned to can its surplus fresh food products, then the family may have a balanced ration every day in the year, and the cost of living will be greatly reduced, and it will turn the garden and orchard by-products into net profits.

Home canned foods.—The average family should plan to have for table use from the home-canned supply *one quart of vegetables, one quart of fruit* and *one quart of greens* for every day in the year when these foods are not available in the garden. The ration based on these foods and supplemented by meats is better balanced and less expensive than one based on meats with a scarcity of fruits and vegetables. Such a system will have a tendency to cut down both the doctor's bills and the grocery bills, and will furnish a more palatable diet.

The surplus food products.—The importance of home canning is still more fully realized when we stop to consider that in most states probably from one-fifth to one-half of all the fruits and vegetables raised are allowed to go to waste. They are not needed for immediate consumption, and methods of grading, crating and marketing are not understood. Home canning may save all of this surplus.

Successful canning not difficult.—By following simple recipes and time-tables for sterilization, even school children can successfully can anything that grows in the garden, field or orchard. Once canned the product has a money value, and is as standard in the market as sugar or nails.

The list of recipes and time-tables given in this chapter are written for use in connection with the usual home canning utensils, and with the five distinct types of home-made or commercial canning outfits. Such outfits are not expensive. They can be bought all the way from eighty-nine cents up to twenty dollars, depending on type and size. All kinds of glass jars, bottles and tin cans commonly used in the old methods of canning can be used with these devices. (Write to U. S. Dept. of Agriculture, States' Relations Service, Washington, D. C., for *Farmers' Bulletins* and circulars of instructions on home and club canning.)

The following recipes and canning instructions are taken from the "N. R." Series of Home Canning Club Instructions prepared by one of the authors and his assistants for the U. S. Department of Agriculture, Office of Extension Work, Northern and Western States. These instructions are equally valuable for home canning in the southern as well as the northern states.

Methods of Canning.—There are five common methods of canning in use:

1. *Open Kettle Method.*—The oldest method is what is known as the "hot-pack" or "open-kettle" method, which requires the cooking of the food products before packing, and sealing the pack after the sterilization has been completed. This is the most laborious and the most unsatisfactory method, especially when canning vegetables and meats.

Uncle Sam's canning kitchen in which field workers are trained in the art of home canning.

Very few people succeed by this method in the conservation of their surplus vegetables, meats, fish, etc., though they succeed very well in canning of the general fruits.

2. *Intermittent Method.*—The "intermittent" process, or fractional sterilization method of canning of fruits, vegetables, and meat is a very successful method, as far as the effect on bacteria and spores and the keeping of the food products are concerned, but is very unsatisfactory with many products, in that it requires too much time and consumes too much fuel as well as the energy of the already overworked housewife. There are few people who would be encouraged to go into the extensive canning of the by-products and surplus fruits and vegetables, such as vegetable greens, peas, snap beans, lima beans, tomatoes and sweet corn, if the only way open to them would be the intermittent process. The object of these instructions is to encourage the canning of large quantities of the cheaper food products, available on practically every farm, and having these fresh vegetables and fruits available for three hundred and sixty-five days in the year, rather than for an occasional holiday or Sabbath, or for use when friends have been invited into the home. By adopting the single period or cold-pack method and following the recipes given in this book it will be possible to reduce the cost of fuel for canning purposes greatly from that required by the intermittent process, and it will reduce the amount of labor and time on the same basis. Also, we trust, by the adoption of these methods, that it will not only be possible to have a larger supply of common vegetables and fruits for daily use, thus making a better-balanced ration for the family, but that it will result in a greater net profit to the average farmer, and a lower cost of living as well for our city dwellers.

3. *Cold-pack Method.*—The method used by the best

commercial canneries in the United States is known as the "cold-pack" and *single period method of canning.* This simply means that the fruits are packed in their fresh and natural state into the glass jar or container. Sirup is applied, and the sterilization is done in the jar or container after it is partially sealed, thus making it impossible for bacteria, spores and molds to enter or come in contact with the food product after the sterilization has taken place. By this method vegetables are blanched in boiling hot water, plunged quickly in cold water, skins removed or otherwise cut in sections and prepared, then packed in container and sterilized in partially sealed glass jars or the perfectly sealed tin cans. By this method, all food products, including general fruits, vegetables, and meats can be successfully sterilized in a single period, with but one handling of the product.

4. *Cold Water Method.*—There is considerable misunderstanding as to the meaning of the term "cold-pack method of canning." It is often interpreted as meaning the *cold-water method* of canning, which is not true. It simply means that the food products are packed in the containers, jars or tin cans, in their fresh state, and all sterilization or cooking performed after the pack has been completely or partially sealed. The cap is never removed after the cooking has been completed until the product is to be used during the year.

The *cold-water method* of canning referred to by housewives is a method often used for the canning of rhubarb, green gooseberries, and a comparatively few other sour and highly acid vegetables and fruits. We do not recommend this method for the reason that most of these products will need to be cooked anyway before they can be used, either for pie-filling or sauces, and it is a saving of labor to do the cooking at the beginning, when the product is canned. For the benefit of those who wish to know the cold-water method, we simply suggest that the product is thoroughly washed, placed in a strainer, and scalding hot water poured over the product very rapidly; then the product is packed in its fresh state, and cold pure water applied until the jar is full. If these steps are taken quickly, in rapid succession, the method may be successful, especially with rhubarb and gooseberries.

5. *Vacuum Seal Method.*—The vacuum seal method of canning is a comparatively new method in the art of home canning. If using this method you can follow the cold-pack, one period recipes given in this book excepting that you will have to secure the special vacuum seal jars and small air pump. By leaving a half-inch space at the top of the jar and pumping a vacuum into the jar after it has been blanched, sterilized and cooled a little, the pressure caused by the vacuum will make it unnecessary to sterilize or cook the food as long as otherwise.

CANNING EQUIPMENT

The canning outfits available for the sterilization of food products during the canning season may be divided into five general classes and four types; steamers, fireless cookers and bake ovens may also be successfully used.

1. **Home-made** outfits, such as wash boilers, tin pails, milk cans, wash tubs and lard pails. These are especially made convenient and more efficient when false bottoms, with lifting handles, are added, and tight fitting covers are made possible.

2. **Hot-water bath commercial outfits.** These outfits are constructed usually for out-of-door work and have sterilizing vat, lifting trays, fire box, and smokepipe all combined into one piece. They are light and convenient, and are planned as portable outfits. The only advantage of these outfits over the home-made devices is that they are

Backyard club demonstration in home canning.

Rural life director training Cook County (Illinois) teachers in methods of home canning, in office of county superintendent of schools, Chicago.

made for convenience and have all of the necessary equipment with which to can and operate the outfit. Both the home-made and hot-water commercial are classed as hot-water bath outfits. They contemplate that the sterilization of all food products will be done in boiling hot water with water over top of highest jar or can.

3. **Water-seal outfits.** This is a type of canning outfit made with an inner seal and jacket and a cover that

Two types of canning outfits: (a) the water seal; (b) the aluminum steam pressure type, used by a canning club girl.

passes into seal and between the outer jacket and inner jacket, thus making three tin or galvanized jackets and two water columns between the sterilizing vat and the outer surface of the canner. The chief value of this type of canner is in the fact that one can maintain a higher temperature, and keep it more uniform than with the hot-water bath outfits. This is especially valuable in the canning of vegetables and meats, where the higher temperature means so much in the saving of time, fuel and energy in effecting a complete sterlization of the food products.

4. **Steam-pressure outfits.** This type of canner is manufactured so as to carry from five to thirty pounds of steam pressure and is equipped with vat, crate, cover, thermometer or pressure gauge, safety valve and steam pet-cock. The safety valve can be easily regulated so as to carry different pressure values and thus accommodate the needs of various vegetables and food products.

5. **Aluminum pressure-cookers.** This is a combination outfit, which is used for both general cooking purposes and the canning of fruits, vegetables and meats. Because of its general utility in the home, for the cooking of all kinds of meats, vegetables, soups, gravies and stews, it can be made to be of great labor-saving value to the housewife. It is considered the fastest canning outfit on the market. This is due to the fact that it is made entirely of aluminum and transmits heat very quickly and will carry as high as thirty pounds of steam pressure. Its makeup and necessary parts are practically the same as in the all steam-pressure outfits.

Note.—The time scheduled for sterilization given in all of our recipes is made to accommodate the four distinct types of home canners. The home-made outfits and hot-water commercial outfits are classed in the first place and under the head of "Hot-water bath outfits." The other three are classed in the order given above and under the same names, thus making the four classes with different time requirements. In using the vacuum seal jars an air pump is used for sealing; aside from this you can follow same steps in packing, blanching, adding sirup, water and salt but substitute the vacuum pressure for part of time for the final cooking period. With fruits it will be necessary to sterilize fruit enough for table use before sealing.

TEMPERATURE FOR BOILING WATER AT DIFFERENT ALTITUDES

Water boils at sea level at 212° Fahrenheit. As the altitude increases, the degree at which water will boil gradually decreases. The following table is intended as a guide to determine the increase of time required for the sterilization of food stuffs in the canning process:

500 feet above sea level, 211 degrees Fahrenheit.
1,000 feet above sea level, 210 degrees Fahrenheit.
2,000 feet above sea level, 208 degrees Fahrenheit.
3,000 feet above sea level, 206 degrees Fahrenheit.
4,000 feet above sea level, 204 plus degrees Fahrenheit.
5,000 feet above sea level, 202 plus degrees Fahrenheit.
6,000 feet above sea level, 201 plus degrees Fahrenheit.
7,000 feet above sea level, 199 plus degrees Fahrenheit.

The time table given in these instructions will be based upon the first altitude given, five hundred feet above sea level. For every four thousand feet increase in altitude it will be well to add twenty-five per cent. to the time requirements given in the recipes or time schedule for the canning of all kinds of fruits, vegetables, greens, meats and soups.

CONTAINERS

Glass Jars.—For home use it is conceded by most women that glass jars are the most desirable and economical for home canning, as they can be used from year to year, or indefinitely, by simply adding new rubbers and caps each year. Practically all of the various types of glass jars available on the market can be used successfully in the canning of all kinds of fruits, vegetables, meats and soups by the "cold-pack method" outlined in these instructions.

In the handling of all glass top jars, with the top and clamp springs, it is important to remember that the rubbers, caps and top spring are put in place, while the clamp spring is left up or raised during the entire period of sterilization.

In handling "screw top jars," it is important to remember that rubbers and caps are put in place and turned until they touch the rubber, sealed partially, not too tight. They should be loose enough to allow the escape of excessive or expanded air. All suction or self-seal tops such as Economy, Airseal, etc., are closed completely before sterilizing the products.

MAKING OF BRINES AND SIRUPS

Brines.—Brines are made by boiling salt water together to a certain degree of density. This is what is meant by the expression "making a five per cent. brine."

Table for Making Brine

Salt	*Water*	*Per Cent.*
1 lb.	12½ gal.	1
1½ lb.	12½ gal.	1½
2 lb.	12½ gal.	2
4 lb.	12½ gal.	4
5 lb.	12½ gal.	5
10 lb.	12½ gal.	10

Sugar Sirups.—Fruit sirups are made by boiling sugar and water together to a certain density. This density is usually denominated by per cent. density and is measured by a density gage or by what is sometimes termed a "mental-finger gage," which should be explained as an approximate estimate of the concentration or density of sirups.

Table of Sirup Density

Sugar	*Water*	*Per Cent.*
1 pt.	2 pts.	14
1 pt.	1 pt.	24
1 pt.	½ pt.	32
1 pt.	1 gill.	40
2½ lb.	1 gal.	10
3½ lb.	1 gal.	15
4½ lb.	1 gal.	20
6½ lb.	1 gal.	30
8 lb.	1 gal.	40

A practical formula for sour fruits is a sirup made of three quarts of sugar to two quarts of water boiled to a thin, medium thin, medium thick or thick sirup.

The formula for sweet common fruits is made of three quarts of water to two quarts of sugar, boiled to a thin, medium thin, medium thick or thick sirup.

Density Terms Defined

1. *Thin sirup* is sugar and water boiled sufficiently to dissolve all sugar, not sticky.

2. *Medium thin* is when sirup has begun to thicken and becomes sticky when cooled on finger tip or spoon.

3. *Medium thick* is when sirup has thickened enough to roll or bank up over edge of spoon when you try to pour it out.

4. *Thick sirup* is when it has become so thick that it is difficult to pour out of spoon or container (not sugared).

Thin sirups are used for all sweet fruits that are not too delicate in texture and color, such as cherries, peaches, apples, etc.

Medium thin sirups are used in the canning of the medium sweet fruits, such as blackberries, currants, dewberries, huckleberries, raspberries, peaches and pears.

Medium thick sirups are used in the canning of all sour fruits, such as gooseberries, apricots, sour apples, etc., and delicately colored fruits, such as strawberries and red raspberries.

Thick sirup is used in preserving and in making of all kinds of sun preserves.

USEFUL TABLES

1,000 No. 2 empty tin cans will weigh 212 pounds.
1,000 No. 3 empty tin cans will weigh 310 pounds.
1 case for 24 empty No. 2 tin cans will weigh 13 pounds.
1 case for 24 empty No. 3 tin cans will weigh 17 pounds.

The following table will show about how many No. 2 and No. 3 cans may be filled from a bushel of various fruits and vegetables; a No. 3 can is equal to one quart, No. 2 is equal to a pint.

Product	*No. 2 cans or pint filled*	*No. 3 cans or quart filled*
1 bushel windfall apples	30	20
1 bushel standard peaches	25	18
1 bushel pears	45	30
1 bushel plums	45	30
1 bushel blackberries	50	30
1 bushel windfall oranges (sliced)	22	15
1 bushel windfall oranges (whole)	35	22
1 bushel tomatoes	22	15
1 bushel shelled lima beans	50	30
1 bushel string beans	30	20
1 bushel sweet corn	45	25
1 bushel shelled peas	16	10
1 bushel sweet potatoes	30	20

Home garden and canning club members, Geauga County, Ohio; canning surplus vegetables.

A girl garden and canning champion of Iowa.

2. *Classification of Fruits and Directions for Canning*

For convenience we suggest that fruits be classified into four distinct groups or classes, such as *soft* fruits, *sour berry* fruits, *hard* fruits and *citrus* fruits.

1. **Soft fruits,** such as strawberries, blackberries, dewberries, sweet cherries, blue berries, peaches, apricots, etc.

Recipe for Canning Soft Fruits: Can the same day fruit is picked. Grade and rinse the fruit by pouring water over the fruit through a strainer. Cull, seed and stem. Pack immediately in glass jar or tin can. Add boiling hot sirup to top. Place rubber and top in place. Partially tighten. (Cap and tip tins.) Sterilize in hot-water bath outfit 16 minutes; in water-seal outfit 10 minutes; steam-pressure outfit, under 5 pounds of steam 8 minutes; in aluminum pressure-cooker, from 15 to 20 pounds of steam 5 minutes. Remove. Tighten covers. Invert to cool and test joints. Wrap glass jars in paper to prevent bleaching and store.

2. **Sour berry fruits,** such as currants, gooseberries, cranberries and sour cherries.

Recipe for Canning Sour Berry Fruits: Can same day picked. Stem, hull and clean. Blanch in hot water 1 minute. Remove and dip quickly in cold water. Pack berries closely in container. Add hot sirup until full. Place rubber and cap in place. Seal partially, not tight. (Cap and tip cans completely.) Sterilize in hot-water bath outfit 16 minutes; in water-seal outfit, 12 minutes; in 5-pound steam-pressure outfit, 10 minutes; in aluminum pressure-cooker outfit, under 10 pounds of steam, 5 minutes. Remove jars. Tighten covers and invert to cool and test joints. Wrap in paper and store.

3. **Hard fruits,** such as apples, pears, quince, etc.

Recipe for Canning Hard Fruits: Grade. Blanch 1½ minutes, and plunge quickly into cold water. Remove skins if necessary. Core, pit or skin. Pack whole, quartered, or sliced, as desired. Add boiling hot sirup. Place rubbers and tops in position. Partially tighten. (Cap and tip tin cans.) Sterilize 20 minutes in hot-water bath outfit; 12 minutes in water-seal outfit; 8 minutes under 5 pounds of steam in steam-pressure outfit; 6 minutes in aluminum pressure-cooker, under 10 pounds of pressure. Remove jars. Tighten covers and invert to cool and test joints. Wrap glass jars in paper to prevent bleaching, and store.

4. **Citrus fruits.**—Oranges, canned whole for breakfast dishes or sliced for fruit salads. The object of canning citrus fruits is: first, to save the surplus and the by-products; second, to furnish wholesome fruits at reasonable cost to more people; third, to help producer to transform his by-products into net profits.

Recipe for Canning Whole Oranges: Select windfall or packing plant culls. Use no unsound or decayed fruit. Remove skins and surface pulp. Blanch fruit in boiling hot water 1½ minutes or in live steam. Dip in cold water quickly. Pack containers full. Add boiling hot thin sirup about 18 or 20 per cent. density. Place rubber and cap in position. Partially seal, not tight. (Cap and tip tin cans.) Sterilize 12 minutes in hot-water bath outfit; 8 minutes in water-seal outfit; 6 minutes in steam-pressure outfit, under 5 pounds of steam; 4 minutes in aluminum pressure-cooker outfit, under 10 pounds of steam. Remove jars. Tighten covers. Invert to cool and test joints. Wrap glass jars with paper to prevent bleaching and store.

Recipe for Canning Sliced Oranges for Salad Purposes: The oranges may be divided into their natural sections or sliced with a knife. Pack jar or container full. Pour over product hot sirup of 18 per cent. density. Place rubber and cap in position. Partially seal, not tight. (Cap and tip cans.) Sterilize 10 minutes in hot-water bath outfit; 6 minutes in water-seal outfit; 5 minutes in steam-pressure outfit, with 5 pounds of steam; 4 minutes in aluminum pressure-cooker outfit, under 10 pounds of steam. Remove jars. Tighten covers. Invert to cool and test the joints. Wrap glass jars with paper to prevent bleaching and store.

3. *Reasons and Explanations for use of terms, "Scalding," "Blanching" and "Cold-Dipping."*

Scalding.—The three reasons for scalding fruits and vegetables are as follows:

1. To loosen the skins.
2. To eliminate objectionable acids and acrid flavors.
3. To make it unnecessary to exhaust the product before final cooking or sterilization later arrested or coagulated by the cold dip.

The term "scalding" is used in connection with the handling of fruits and vegetables from which skins are to be removed, and simply means to place in boiling hot water long enough to loosen the skin.

Blanching.—The three reasons for blanching are as follows:

1. To eliminate objectionable acids and acrid flavors.
2. To reduce the bulk of vegetable greens.
3. To make it unnecessary to use the exhaust period and intermittent process.

The term "blanching" means to place product in hot water for a sufficient time not only to loosen skin, but remove excessive and objectionable acids and reduce bulk.

Cold-dipping.—The three reasons for using the cold-dip in canning are:

1. To harden the pulp under the skin and thus permit the removal of skin without injury to the pulp.
2. To coagulate the coloring matter and make it harder to break down during the sterilization period.
3. To make it easier to handle the products in packing and to shorten the time of processing by quickly removing them from hot and exposing them to cold water.

4. *Classification of Vegetables and Directions for Canning*

For convenience in the discussion of canning recipes and methods of procedure, we divide vegetables into five classes.

Automatic can sealing machine, seals without heat or solder. Sold, or rented by the year, to clubs and individual growers.

1. Vegetable greens, both wild and domestic (30 varieties).

Recipe for canning vegetable greens: Prepare and can the day picked. Sort and clean. Blanch in vessel with a little water under false bottom or in a regular steamer 10 to 15 minutes. Remove. Plunge quickly into cold water. Cut in convenient lengths. Pack in jar or container tight and season by adding strip of bacon or a little chipped beef, olive oil, etc., to taste. Add hot water to fill crevices and level teaspoonful of salt to each quart. If using glass jars place rubber and top in position, partially seal; if using tin cans, cap and tip completely. Sterilize 90 minutes in hot-water bath outfit; 60 minutes in water-seal; 50 minutes in steam-pressure outfit, under 5 pounds of steam; 25 minutes in aluminum pressure-cooker outfit, at 15 pounds of steam. Remove from canner. Tighten covers. Invert to cool and test joints. Wrap in paper to prevent bleaching and store.

Edible Cultivated Greens: Swiss chard, kale, Chinese cabbage leaves, upland cress, French endive, cabbage sprouts, turnip tops, New Zealand spinach, asparagus, spinach, beet tops, cultivated dandelion, dasheen sprouts, native mustard, Russian mustard, collards, rape, fennel.

Edible Wild Greens: Pepper greens, lambs' quarter, sour dock, smartweed sprouts, purslane or "pusley," chicory, poke weed, dandelion, marshmarigold, wild mustard, milk weed, tender sprouts of red-root.

Cabbage, Brussel sprouts and cauliflower

The recipe for canning these vegetables is practically the same as for the above named vegetable greens and the same instructions may be followed, except that these products should be soaked in cold slightly salty water for 20 or 30 minutes before blanching.

Experience alone will teach the slight variations necessary in amount of time required for blanching, amount of seasoning necessary for the various vegetable greens, etc.

2. **Root and tuber vegetables,** such as carrots, parsnips, beets, turnips, sweet potatoes, etc.

Recipe for Canning Root and Tuber Vegetables: Grade for size, color and degree of ripeness. Wash thoroughly. Use vegetable brush. Scald in boiling hot water, sufficiently to loosen skin. Plunge quickly in cold water. Scrape or pare to remove skin. Pack whole or cut in sections or cubes (sweet potatoes may be mashed if desired), as required by the home or market standard. Add boiling hot water and one teaspoonful of salt to the quart. Place rubbers and tops in position. Partially seal, but not too tight. (Cap and tip tin cans.) Sterilize 90 minutes in hot-water bath outfit; 75 minutes in water-seal outfit; 60 minutes in steam-pressure outfit, under 5 pounds of steam; 35 minutes in aluminum pressure-cooker, under 15 pounds of steam.

3. **Special vegetables,** tomatoes and corn.

Recipe for Canning Tomatoes: Grade for size, ripeness and color. Scald in hot water enough to loosen skins. Plunge quickly in cold water (do not leave tomatoes in water while you skin and core them). Remove. Core and skin. Pack whole, crowd them into space. Fill container with whole tomatoes only. Add 1 level teaspoonful of salt to each quart. Place rubber and cap in position. Partially seal, but not tight. (Cap and tip tin cans.) Sterilize 32 minutes in hot-water bath outfit; 22 minutes in water-seal outfit; 15 minutes in steam-pressure outfit, under 5 pounds of steam; 10 minutes in aluminum pressure-cooker, under 10 pounds of steam. Remove jars. Tighten covers. Invert to cool and test joints. Wrap jars in paper and store.

Recipe for Canning Sweet Corn on the Cob: Can corn same day picked. Remove husks, silks, and grade for size. Blanch on the cob in a steam chest or steamer 10 to 15 minutes. Plunge quickly in cold water. Pack ears, alternating butts and tips in half-gallon glass jars, or gallon tin cans. Pour over boiling hot water and add 2 level teaspoonfuls of salt to each gallon. Place rubbers and tops in position. Seal partially, but not tight. Cap and tip tin cans. Sterilize in hot-water bath outfit 180 minutes, one period; 90 minutes in water-seal outfit; 60 minutes in steam-pressure outfit under 5 pounds of steam; 40 minutes in aluminum pressure-cooker under 20 pounds of steam. Remove jars. Tighten covers. Invert to cool and test joints. Wrap glass jars with paper and store.

Note.—When sweet corn is taken from jar or tin can for table use, remove ears as soon as jar or can is opened. Heat corn, slightly buttered, in steamer. Do not allow ears to stand in water or to be boiled in water the second time.

Recipe for Canning Sweet Corn Off·the Cob: Can the same day as picked. Remove husks, silks. Blanch on the cob in steamer or boiling hot water 10 to 15 minutes. Plunge quickly in cold water. Cut the corn from the cob with a thin sharp-bladed knife. Pack corn in jar tightly until full. Add 1 level teaspoonful of salt and a little sugar to each quart, and sufficient hot water to fill. Place rubber and top in position, seal partially, but not tight. (Cap and tip tin cans.) Sterilize 180 minutes in hot-water bath outfits; 90 minutes in water-seal; 60 minutes in steam-pressure under 5 pounds of steam; 40 minutes in aluminum pressure-cooker under 20 pounds of steam. Remove jars. Tighten covers. Invert to cool and test joints. Wrap with paper and store.

4. **Other vegetables,** such as lima beans, string beans, peas, okra, etc.

Recipe for Canning: Can same day vegetables are picked. Cull, string and grade. Blanch in boiling hot water or in steamer for 5 minutes. Remove and plunge quickly in cold water. Pack in container until full. Add boiling hot water to fill crevices. Add 1 level teaspoonful of salt to each quart. Place rubbers and tops in position. Partially seal but not tight. (Cap and tip tins.) Sterilize in hot-water bath outfit one period of 120 minutes; 90 minutes in water-seal outfit; 60 minutes in steam-pressure outfit, under 5 pounds of steam; 40 minutes in aluminum pressure-cooker, under 20 pounds of steam. Remove jars. Tighten covers and invert to cool. Wrap jars in paper and store.

5. **Pumpkin and squash.**

Recipe for Canning (pie filling): Cut up into convenient sections, core and remove skins. Cook for 30 minutes to reduce to pulp. Pack in glass jar or tin can. Add one cup of sugar, one teaspoonful of salt to each quart of pulp. Place rubber and top in position. Partially seal, but not too tight. Sterilize 60 minutes in hot-water bath outfit; 50 minutes in water-seal outfit; 40 minutes in steam-pressure outfit, under 5 pounds of steam; 30 minutes in aluminum pressure-cooker, under 15 pounds of steam. Remove. Tighten covers. Invert to cool and test joints. Wrap in paper and store.

Recipe for Canning, Special Dishes (fried, creamed, baked): Cut pumpkin or squash into small, uniform sized cubes. Blanch in boiling hot water for 10 minutes. Plunge quickly in cold water. Pack in jar until full. Add boiling hot water and 1 level teaspoonful of salt and one-half cup sugar to the quart. Place rubbers and caps in position, not tight. Sterilize 60 minutes in hot-water bath outfit; 45 minutes in water-seal outfit; 35 minutes in steam-pressure outfit, under 5 pounds of steam; 25 minutes in aluminum pressure-cooker, under 20 pounds of steam.

SPECIAL RECIPES

FRUITS

Strawberries. Can fresh, sound berries same day picked. Hull (twist berries off hull), and place in strainer. Pour water over to cleanse. Pack in jar or tin without crushing. Pour hot sirup over berries to top. Put rubber and cap in position, not tight. (Cap and tip, if using enameled tin cans). If using hot-water bath outfit sterilize 12 minutes, if using water-seal outfit or a 5-pound steam-pressure outfit sterilize 6 minutes, or if using an aluminum pressure-cooker outfit, sterilize 4 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with a paper to prevent bleaching and store. (Sirup: $1\frac{1}{2}$ quarts sugar to 1 quart water, boiled to medium thick.)

Strawberries. (Berries canned by this recipe will not rise to top in sirup.) Use only fresh, ripe, firm and sound berries. Prepare berries. Add 8 oz. of sugar and 2 tablespoonfuls of water to each quart of berries. Boil slowly for 10 minutes in enameled or acid-proof kettle, covered with a well-fitted cover while boiling. Allow berries to cool and remain over night in a covered kettle. Pack cold berries in glass jars. Put rubber and cap in position, not tight. (Cap and tip if using enameled tin cans.) If using hot-water bath outfit sterilize 10 minutes, if using water-seal outfit or a 5-pound steam-pressure outfit sterilize 6 minutes, or if using an aluminum pressure-cooker outfit sterilize 4 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Strawberry Preserve.—Make a sirup of one quart of water and 11 pounds of sugar and cook in an open kettle until a candy thermometer registers 265° when placed in the sirup. Add 8 pounds of berries to the sirup. Cook very slowly, just at the boiling point. Stop the cooking when the thermometer registers 219° and pour into shallow pans to cool. Hasten cooling by pouring sirup over berries. Skim while cooling. Fill into jars when cold and allow to stand unsealed for 4 days. Put rubber and cap in position, not tight. (Cap and tip, if using enameled tin cans.) If using hot-water bath outfit sterilize 20 minutes, if using water-seal outfit, or a five-pound steam-pressure outfit, or a pressure-cooker outfit, sterilize 15 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Cherry Preserve. Place one gallon of water in a kettle and add 10 pounds of pitted cherries. Boil slowly for 18 minutes. Add 12 pounds of granulated sugar and cook until product is boiling at temperature of 219°. Cool quickly in shallow pans. Pack into glass jars. Put rubber and cap in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 20 minutes, if using water-seal outfit, or 5-pound steam-pressure outfit, or a pressure-cooker outfit sterilize 15 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Note.—When using pressure-cooker outfits on preserves, keep the valve open during period of sterilization; in all other recipes it must be closed.

Grapes. Use fresh fruit evenly ripened. Pick carefully from the stem, wash and pack in glass jars. Cover with a thin sirup, boiling. Put rubbers and caps in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 20 minutes, if using water-seal outfit sterilize 15 minutes, if using 5-pound steam-pressure outfit sterilize 10 minutes, or if using pressure-cooker outfit sterilize 5 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Wild Grapes. Use fresh fruit evenly ripened. Pick from stem and wash. Pack in glass jars. Cover with thick, boiling sirup. Put rubbers and caps in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 20 minutes, if using water-seal outfit sterilize 15 minutes, if using 5-pound steam-pressure outfit sterilize 12 minutes, or if using pressure cooker outfit sterilize 8 minutes. Remove jars. Tighten covers. Invert to cool and test joint. Wrap jars with paper to prevent bleaching and store.

Pears.—Use sound, ripe fruit. Prepare, peel, and core. Remove all eyes. Pack whole or in halves, and blanch 10 minutes. Cold dip. Pack in glass jars or tin cans. Pour on boiling sirup, medium or thin. Put rubbers and cap in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 30 minutes, if using water-seal outfit or a 5-pound steam-pressure outfit sterilize 25 minutes, or if using a pressure-cooker outfit sterilize 18 minutes. Remove jars. Tighten covers. Invert to cool and test joint. Wrap jars with paper to prevent bleaching and store.

Wild or Damson Plum. Grade fruit for size and ripeness. Wash and pack in glass jars. Fill with thin or medium sirup, boiling. Put rubbers and caps in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 16 minutes, if using water-seal outfit or 5-pound steam-pressure outfit sterilize 12 minutes, or if using pressure-cooker outfit sterilize 8 minutes. Remove jars. Tighten covers. Invert to cool and test joint. Wrap jars with paper to prevent bleaching and store.

Huckleberries. Stem and clean huckleberries. Pack in glass jar or tin can. Fill with thin hot sirup. Put rubber and cap in position, not tight. (Cap and tip if using tin cans.) If using hot water bath outfit sterilize 20 minutes, if using water-seal outfit or a 5-pound steam-pressure outfit sterilize 15 minutes, or if using pressure-cooker outfit, sterilize 10 minutes. Remove jars. Tighten covers. Invert to cool and test joint. Wrap jars with paper to prevent bleaching and store.

Figs. Select and grade fruit. Blanch 6 minutes in boiling water and cold dip. Pack in glass jar or tin cans. Fill with medium sirup. Put rubber and cap in position, not tight. (Cap and tip if using tin cans.) If using hot-water bath outfit sterilize 40 minutes, if using water-seal outfit sterilize 30 minutes, if using a 5-pound steam-pressure outfit sterilize 25 minutes, or if using a pressure-cooker outfit sterilize 20 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Rhubarb. Wash stalks. Cut the pieces ¾ inches in length. (Do not remove skin). Blanch 2 minutes. Cold dip. Pack in glass jars. (Do not use tin cans.) Pour on thick sirup, boiling. Put rubber and cap in position, not tight. (Not safe to use tin containers unless you use a medium thick sirup of about 38 per cent. density.) If using hot water bath outfit sterilize 20 minutes; if using water-seal outfit or a 5-pound steam-pressure outfit sterilize 15 minutes, or if using an aluminum pressure cooker outfit sterilize 10 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

VEGETABLES

Egg Plant. Remove the skin of the egg plant and slice across the fruit. Make slices about ½ or ¾ inches thick. Blanch three times in boiling water to which has been added a tablespoonful of salt per quart. Plunge into cold water and pack in glass jars. Fill with boiling hot water and add a level teaspoonful of salt per quart. Put rubber and cap in position, not tight. (Cap and tip if using enameled tin cans). If using hot water bath outfit sterilize 60 minutes. If using water-seal outfit or a 5-pound steam pressure outfit sterilize 45 minutes, or if using an aluminum pressure cooker outfit sterilize 30 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Corn and Tomato (Combination). Blanch fresh corn on the cob 6 minutes. Cold dip. Cut corn from cob. Blanch tomatoes 1½ minutes and cold dip. Remove skin and core.

Chop tomatoes into medium pieces. Mix 2 parts of tomatoes with one part of corn and mix thoroughly. Pack in glass jars or tin cans. Add a level teaspoonful of sale per quart. Put rubber and cap in position, not tight. (Cap and tip if using enameled tin cans). If using hot water bath outfit sterilize 90 minutes. If using water-seal outfit sterilize 75 minutes. If using a 5-pound steam pressure outfit, sterilize 60 minutes, or if using an aluminum pressure-cooker outfit sterilize 45 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Corn, Tomatoes and String Beans. (Combination). Use one part of corn, one part of green string beans, and three parts of tomatoes. Blanch fresh corn on the cob for 6 minutes and cold dip. Cut corn from the cob, cutting from tip to butt. Prepare string beans and cut into convenient lengths. Blanch 4 minutes and cold dip. Blanch tomatoes 1 to 3 minutes and cold dip. Remove skin and core. Cut into medium pieces. Mix three products thoroughly. Pack in glass jars or enameled tin cans. Put rubbers and caps in position, not tight. (Cap and tip if using enameled tin cans.) If using hot water bath outfit sterilize 120 minutes, if using water-seal outfit sterilize 90 minutes, if using a 5-pound steam pressure outfit sterilize 60 minutes, or if using an aluminum pressure cooker outfit sterilize 45 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Chili Peppers. Use either red or green peppers. Place the peppers in the oven and bake until the skins separate from the pulp. Remove the skins. Take out seed and core if product is to be used for salads. Pack solid in glass jars or tin cans. Pour on boiling water and add one level teaspoonful of salt per pint. Put rubber and cap in position, not tight. (Cap and tip if using enameled tin cans). If using hot water bath outfit sterilize 90 minutes, if using water-seal outfit sterilize 75 minutes, if using a 5-pound steam pressure outfit sterilize 60 minutes, or if using an aluminum pressure-cooker outfit sterilize 40 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Cabbage or Brussel Sprouts. Use small, solid heads. If cabbage, cut into convenient sections and remove core. Allow product to soak in cold salty water for 20 or 30 minutes. Blanch 10 minutes. Cold dip. (See cauliflower.) Pack in glass jars or enameled tin cans. Pour on boiling water and add a level teaspoonful of salt per pint. Put rubber and cap in position, not tight. (Cap and tip if using enameled tin cans.) If using hot water bath outfit sterilize 90 minutes, if using water-seal outfit sterilize 75 minutes, if using a 5-pound steam-pressure outfit sterilize 60 minutes, or if using an aluminum pressure-cooker outfit sterilize 45 minutes with 10 pounds of steam pressure. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

Cauliflower.—Use the flowered portion.

After soaking in cold salty water for 20 minutes blanch three minutes. Plunge into cold water. Pack in glass jars or enameled tin cans. Fill with boiling water and level teaspoonful of salt per quart. Put rubber and cap in position, not tight. (Cap and tip if using enameled tin cans.) If using hot water bath outfit sterilize 45 minutes, if using water-seal outfit sterilize 35 minutes, if using a 5-pound steam-pressure outfit sterilize 30 minutes, or if using an aluminum pressure cooker outfit sterilize 20 minutes. Remove jars. Tighten covers. Invert to cool and test the joint. Wrap jars with paper to prevent bleaching and store.

MUSHROOMS

Cautions. Unless you are absolutely sure that you know a mushroom when you see it, do not run the risk of gathering and using for food what you may think are mushrooms. A very large number of people are poisoned every year because of carelessness along this line. There are many other plants of the mushroom-toadstool varieties that are very poisonous, and they resemble the edible mushrooms very much. (See *Farmers' Bulletin* 204, "Cultivation of Mushrooms.")

Canning of Mushrooms. Wash and trim the mushrooms. If small, can them whole; if large, they may be cut up into sections. Soak in cold salty water for 20 minutes. Blanch mushrooms in boiling water for five minutes. Remove and plunge quickly into very cold water. Pack in glass jars, and add boiling hot water to cover; one level teaspoonful of salt to the quart. Place rubber and cap in position, not tight. If using hot-water bath outfit sterilize 90 minutes, if using water-seal outfit sterilize 60 minutes, if using a 5-pound steam-pressure outfit sterilize 50 minutes, or if using an aluminum pressure-cooker outfit sterilize under 10 pounds of steam for 20 minutes. Remove jars. Tighten covers. Invert to cool and test joints. Wrap the glass jars in paper to prevent bleaching and store.

If canning mushrooms in tin, always use vulcanized or lacquered cans. Do not fail to blanch and cold-dip before packing, and remove the mushrooms immediately after opening the tin can.

HOME CANNING OF SOUPS

Taken from Circular N. R. 34, Series of Follow Up Instructions in Home Canning Club Project

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After you have learned to can fruits and vegetables successfully, the next logical step is to transform meat scraps, bones, ligaments and odds and ends of vegetables and cereals into an economical as well as very palatable product for the home—something that can in a few moments' time be prepared and made ready for use as a hot dish for the winter.

The canning of vegetable soups, purees, and consommés is thoroughly practical, and should be a part of the canning work of every home. It will be a delight to the housewife to be able to reach to a shelf for a home-canned pack of soup, open it, heat and serve within a few moments of time.

CANNING RECIPES

Soup Stock.—Secure 25 pounds of beef hocks, joints, and bones containing marrow. Strip off fat and meat and crack bones with hatchet or cleaver. Place broken bones in a thin cloth sack and place the same in a large kettle containing 5 gallons of cold water. Simmer (do not boil) for 6 or 7 hours. Do not salt while simmering. Skim off all fat. This should make about 5 gallons of stock. Pack hot in glass jars, bottles, or enameled or lacquered tin cans. Partially seal glass jars. Cap and tip tin cans. Sterilize 40 minutes if using hot-water bath outfit; 30 minutes if using water-seal or 5-pound steam-pressure outfit; 25 minutes if using pressure-cooker outfit.

Checking List.—Supplies needed before making soup stock. Check with this list before beginning work 25 lb. of beef bones, 10 gal. water.

Vegetable Soup.—Soak 1/4 lb. lima beans and 1 lb. rice for 12 hours. Cook 1/2 lb. pearl barley for 2 hours. Blanch 1 lb. carrots, 1 lb. onions, 1 medium-sized potato, and 1 red pepper for 3 minutes and cold dip. Prepare the vegetables and cut into small cubes. Mix thoroughly lima beans, rice, barley, carrots, onions, potatoes, red peppers. Fill glass jar or the enameled tin cans three-fourths full of the above mixture of vegetables and cereals. Make a smooth paste of 1/2 lb. of wheat flour and blend in 5 gallons soup stock. Boil 3 minutes and add 4 oz. salt. Pour this stock over vegetables and fill cans. Partially seal glass jars. Cap and tip tin cans. Sterilize 90 minutes if using the hot-water bath outfit; 75 minutes if using a water-seal or 5-pound steam-pressure outfit; 30 minutes if using the pressure-cooker outfit.

Checking List.—Supplies needed before making soup. After filling recipe, check with this list and then sterilize: 1/4 lb. lima beans, 1 lb. rice, 1/2 lb. pearl barley, 1 lb. carrots, 1 lb. onions, 1 medium-sized potato, 1 red pepper, 1/2 lb. flour, 4 oz. salt, 5 gal. soup stock.

Cream of Pea Soup.—Soak in cold water 8 lb. of dry peas overnight. Cook until soft. Mash fine. Add the mashed peas to 5 1/2 gal. of soup stock and bring to boil. Pass the boiling liquid through a fine sieve. Make a smooth paste of 1/2 lb. flour and add paste, 10 oz. of sugar, and 3 oz. of salt to the soup stock. Cook until soup begins to thicken. Pack in glass jars or tin cans. Partially seal glass jars. Cap and tip tin cans. Process 90 minutes if using hot-water bath outfit; 80 minutes if using water-seal outfit; 70 minutes if using 5-pound steam-pressure outfit; 45 minutes if using pressure-cooker outfit.

Checking List.—5½ gal. soup stock, 8 lb. dry peas, 3 oz. salt, 10 oz. granulated sugar, ½ lb. flour.

Cream of Potato Soup.—Boil 1½ lb. of potatoes, sliced thin, and 5 gal. of soup stock for 10 minutes. Add 3 oz. of salt, ¼ teaspoonful of pepper, and ½ lb. of butter, and boil slowly for 5 minutes. Make 3 tablespoonfuls of flour into smooth paste and add to the above. Cook 3 minutes and pack in glass jars or tin cans while hot. Partially seal glass jars. Cap and tip tin cans. Sterilize 90 minutes if using hot-water bath outfit; 75 minutes if using water-seal outfit; 65 minutes if using 5-pound steam-pressure outfit; 45 minutes if using a pressure-cooker outfit.

Checking List.—5 gal. soup stock, 1½ lb. thin sliced potatoes (culls will do), 3 oz. salt, ¼ teaspoonful pepper (scant), ½ lb. butter, 3 tablespoonfuls flour.

Bean Soup.—Soak 3 lb. of beans 12 hours in cold water. Cut 2 lb. of ham meat into ¼-inch cubes and place in a small sack. Place beans, ham, and 4 gals. of water in kettle and boil slowly until the beans are very soft. Remove the ham and beans from the liquor and mash the beans fine. Return ham and mashed beans to the liquor and add 5 gal. of soup stock and seasoning, and bring to boil. Fill into glass jars or tin cans while hot. Partially seal glass jars. Cap and tip tin cans. Process 2 hours if using hot-water bath outfit; 90 minutes if using water-seal outfit; 75 minutes if using 5-pound steam-pressure outfit; 60 minutes if using pressure-cooker outfit.

Checking List.—5 gal. stock, 3 lb. beans, 2 lb. lean ham, 4 gal. water. Salt and pepper to taste.

Okra Soup.—Slice 8 lb. okra into thin slices the round way. Blanch 10 minutes and cold dip. Boil 1½ lb. rice for 25 minutes. Mix okra and rice and fill cans or jars half full. To 5 gal. soup stock add 5 oz. salt, ¼ teaspoonful of coriander seed, and ¼ teaspoonful of powdered cloves, and bring to boil. Fill remaining portion of jars or cans. Partially seal glass jars. Cap and tip tin cans. Process 2 hours if using hot-water bath outfit; 90 minutes if using water-seal outfit; 75 minutes if using 5-pound steam-pressure outfit; 60 minutes if using pressure-cooker outfit.

Checking List.—5 gal. soup stock (see No. 1), 8 lb. okra, ¼ teaspoonful coriander seed, ¼ teaspoonful powdered cloves, 1½ lb. rice, 5 oz. salt.

Tomato Pulp for Cream of Tomato Soup.—Place tomatoes in a wire basket or piece of cheesecloth and plunge into boiling water from 1 to 3 minutes. Plunge into cold water. Remove the skin and core. Place tomatoes in kettle and boil 30 minutes. Pass tomato pulp through a sieve. Pack in glass jars or tin cans while hot, and add a level teaspoonful of salt per quart. Partially seal glass jars. (Cap and tip tin cans.) Sterilize 20 minutes if using hot-water bath outfit; 18 minutes if using water-seal or 5-pound steam-pressure outfit; 15 minutes if using pressure-cooker outfit.

Cream of Tomato Soup from Canned Tomato Pulp.—Place the contents of a quart glass jar or No. 3 can of tomato pulp in kettle. Add ⅛ teaspoonful of baking soda, pepper and salt to taste, 2 teaspoonfuls of granulated sugar. Boil for 7 minutes. Place 1 quart of milk and 2 tablespoonfuls of butter in a kettle and simmer for 7 minutes. Add contents of tomato kettle to contents of milk kettle and boil for 5 minutes. The product is then ready to serve.

Checking List.—1 qt. or No. 3 can tomato pulp, ⅛ teaspoonful baking soda, 2 teaspoonfuls granulated sugar, 1 qt. milk, 2 tablespoonfuls butter. Salt and pepper to taste.

Chicken Soup Stock.—Place 30 lb. chicken in 10 gal.

of cold water and simmer for 5 hours. Remove meat and bones and then strain. Add sufficient water to make 10 gal. of stock. Fill glass jars or tin cans with hot stock. Partially seal glass jars. Cap and tip tin cans. This stock is used to make soup where the term "chicken-soup stock" is used. Process 90 minutes if using hot-water bath outfit; 75 minutes if using water-seal outfit; 60 minutes if using 5-pound steam-pressure outfit; 45 minutes if using pressure-cooker outfit.

Checking List.—30 lb. chicken, 10 gal. water.

Chicken Broth with Rice.—For each gallon of soup stock use 12 oz. of rice. Boil rice 30 minutes. Fill jars or tin cans two-thirds full of rice and the remainder with soup stock. Partially seal glass jars. Cap and tip tin cans. Process 90 minutes if using hot-water bath outfit; 75 minutes if using water-seal outfit; 60 minutes if using 5-pound steam-pressure outfit; 45 minutes if using pressure-cooker outfit.

Checking List.—1 gal. chicken-soup stock, 12 oz. rice.

Chicken Gumbo.—Cut 2 lb. ham into small cubes and boil 30 minutes. Mince 3 lb. chicken and chop ½ lb. onions fine. Make a smooth paste of ½ lb. flour. Add above to 5 gal. of chicken-soup stock. Then add ½ lb. butter and ¼ lb. salt and boil 10 minutes. Then add 3 oz. powdered okra mixed with 1 pint water. Fill into glass jars or tin cans while hot. Partially seal glass jars. Cap and tip tin cans. Process 90 minutes if using hot-water bath outfit; 75 minutes if using water-seal outfit; 60 minutes if using 5-pound steam-pressure outfit; 45 minutes if using pressure-cooker outfit.

Checking List.—5 gal. chicken-soup stock, 3 lb. minced chicken, 2 lb. ham, ½ lb. onions, ½ lb. butter, ¼ lb. salt, ½ lb. flour, 3 oz. powdered okra.

Vegetables (Mixed) Without Stock.—Many people would like vegetable soup during the winter season, but find it impracticable to secure the soup stock during the summer season when the vegetables are so abundant that they are rotting in the garden. It is suggested that the vegetable portion of the soup be canned during the summer and made available when the soup stock is prepared during the winter. It makes the preparation of soup a simple matter whenever the stock is available.

Soak 6 lb. lima beans and 4 lb. dry peas over night. Boil each ½ hour. Blanch 16 lb. carrots, 6 lb. cabbage, 3 lb. celery, 6 lb. turnips, 4 lb. okra, 1 lb. onions and 4 lb. parsley for 3 minutes and plunge quickly in cold water. Prepare vegetables and chop into small cubes. Chop the onions and celery extra fine. Mix all of the above thoroughly and season to taste. Pack in glass jars or tin cans. Fill with boiling water. Partially seal glass jars. Cap and tip tin cans. Process 90 minutes if using hot-water bath outfit; 60 minutes if using water-seal outfit or 5-pound steam pressure outfit; 45 minutes if using pressure-cooker outfit.

Checking List.—16 lb. carrots (small), 6 lb. cabbage, 3 lb. celery (stems and leaves), 6 lb. turnips, 6 lb. lima beans, 4 lb. okra, 1 lb. onions, 4 lb. parsley, 4 lb. dry peas, salt and pepper to taste.

Note.—These recipes are prepared for the canning of soups in the home and for home consumption. Families using these recipes for sale within the state should consult the Food Commissioner of the State. When the products are packed for interstate or foreign shipment, the packer should consult the Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C., for regulations governing measure, labels, trade-marks and contents. The Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C., should be consulted regarding meat-inspection regulations intended for interstate or foreign shipment when canned soups contain definite portions of meat.

5. *Canning of Windfall and Cull Apples*

The windfall and cull apples may be divided into two grades. For first grade use the whole, reasonably sound fruit; for second grade use the worm-eaten, partially decayed and injured fruit. Do not can any injured or decayed part nor allow apples to become over-ripe before canning.

Recipe for Canning Whole, Reasonably Firm Apples. Wash apples. Remove core and blemishes. Place whole apples in blanching tray or blanching cloth, and blanch in boiling hot water for two minutes. Remove and dip quickly into cold water. Pack in large, empty glass jars or gallon tin cans. Pour over the product a hot, thin sirup of about 18 per cent. density. Place rubber and top in position, seal partially, not tight. (If using tin cans, cap and tip completely.) Process one-half gallon or gallon containers 20 minutes in boiling hot water, in home-made or hot-water bath outfits; 15 minutes in water-seal; 10 minutes in steam-pressure outfit, with 5 pounds of steam pressure; 5 minutes in aluminum pressure-cooker outfit, under 15 pounds of steam pressure. Remove jars, tighten covers, invert to cool and test joints. Wrap in paper and store. The time will have to be varied according to ripeness and condition of the fruit. Use just enough time to sterilize perfectly, and yet not to change the color or reduce the pulp to sauce.

If the apples are firm and tart, the same recipe can be used in canning whole apples with both cores and peelings removed.

Daily Use of Canned Whole Apples.—1. Breakfast dish, with cream and sugar added. 2. Apple salad. 3. Apple dumpling. 4. Apple pot pie. 5. Baked apple. 6. Apple puddings, filling for pot roasts, etc.

Recipe for Pie Filling.—Use second grade of windfalls or culls. Wash, core, pare, and remove all decayed or injured spots. Slice apple quickly into a basin containing slightly salted cold water, to keep from discoloring. Pack fresh cold product in glass jars or tin cans. Add one teacupful of hot thin sirup to each quart of about 18 per cent. density. Place rubber and top in position; partially seal, but not tight. Cap and tip completely if using tin cans. Sterilize 12 minutes in hot-water bath, home-made outfit; 10 minutes in water-seal outfit; 6 minutes under 5 pounds of steam pressure; 4 minutes in aluminum pressure-cooker, under 10 pounds of steam pressure. Remove jars, tighten covers, invert to cool, and test joints. Wrap in paper and store.

Note.—When using this filling for apple pies, strain the sirup from the pulp and save for use, place sliced product on pie crust layer in the apple-pie tins, sprinkle with brown sugar, cinnamon or nutmeg, place pie dough over top, trim, and bake in a properly heated oven for 10 to 12 minutes. The apple pie baked from this product will be as good, if not better than the ordinary pie baked from fresh apples, and can be prepared and baked in less than half the time usually required when making pie from the fresh and more expensive fruit.

Recipe for Quartered Apples for Fruit Salads.—Select best grade of culls, firm and rather tart varieties. Core, pare and quarter. Drop into a basin containing slightly salted cold water. Pack these quartered pieces tightly in jar or tin container. Add a teacupful of thin, hot sirup to each quart. Place rubber and top in position; partially seal, not tight. Cap and tip completely tin cans. Sterilize 12 minutes in hot-water bath, home-made outfit; 10 minutes in water-seal outfit; 6 minutes under 5 pounds of steam pressure; 4 minutes in aluminum pressure-cooker under 10 pounds of steam pressure. Remove jars, tighten covers, invert to cool and test joints. Wrap in paper and store.

Keeping Apple Cider Sweet by the Home Canning Method.—Fill fruit jars with fresh apple cider. Add a tablespoonful of sugar to each quart. Place rubber and cap in position, partially tighten, or cap and tip the tin cans.

Sterilize in hot-water bath outfit for 30 minutes 180 degrees heat; in water-seal outfit for 20 minutes, same temperature. Do not undertake to sterilize apple juice or any other fruit juice under steam pressure or high temperature. Remove jars, tighten cover, invert to cool and test joints.

The average fruit farmer may not be able to make apple sirup commercially profitable, but during seasons when there are a large number of culls and windfalls, when markets are glutted, it is a matter of business economy to utilize by-products and reduce these apples to food value of some kind. The making of apple sirup for the family's winter use is then quite worth while.

Reducing Sweet Apple Cider to Sirup.—Wash apples, remove all decayed and worm-eaten spots. Use only sweet cider. The sterilizing, reducing vat or kettle should be a third larger than required to hold contents. Powdered calcium carbite is sometimes called carbonate of lime and is a low-priced, harmless chemical available at any drug store. It looks something like powdered chalk.

Recipe for Apple Sirup.—Add five ounces of powdered calcium carbonate to seven gallons of apple cider. Boil in kettle or vat vigorously for a period of five minutes. Pour the liquid into vessels, preferably glass jars or pitchers, allow to stand six to eight hours or until perfectly clear. Pour the clear liquid into preserving kettle. Do not allow sediment at bottom to enter. Add to this one level teaspoonful of lime and stir thoroughly. The process is completed by boiling down rapidly to a clear liquid. Use density gage or a candy thermometer and bring it up to 204 degrees F., or without thermometer reduce bulk to one-seventh of original volume. Remove, cool rapidly in cold water until it shows same consistency as maple sirup. Do not allow to candy. Pour sirup into fruit jars, pitchers, bottles, etc., and allow to cool slowly. (Slow cooling is important.) The sirup can be cooled effectively in fireless cooker or wash boiler. The white sediment which settles during the cooling process is called by chemists malate of lime, and is a harmless compound of lime or acid of the apple. After this process the sirup is ready to be poured into fruit jars or bottles. Place rubber, cap or cork into position and not tight. Insert containers in hot water and sterilize for 12 minutes in hot-water or wash-boiler outfit; 10 minutes in water-seal outfits; 8 minutes in steam-pressure outfits under 5 pounds of steam, or 5 minutes in aluminum pressure-cooker under 15 pounds pressure.

Apple sirup made by this method is a very pure and high-grade product. Orchardists who have a large amount of waste every year would do well to establish a local apple sirup plant or perhaps a group of orchardists could combine and secure building, steam retort canners and convenient apparatus, simplify the method and get most successful and profitable results.

6. *Tinning, Capping and Soldering Repair Work*

Tin cans.—The use of tin cans in the canning of the "get away" fruits and vegetables is entirely practical for the average farmer, trucker and fruit grower. The question of soldering and tipping the caps is a comparatively simple matter. Any child, twelve years of age or over, can easily learn how successfully to seal a tin can. It requires a hand capping iron and tipping steel, a little soldering flux, small brush, and a little practise. Self-heating capping irons are available and hand or automatic tin can sealers can be purchased or even rented by the year.

When tin cans are used for the canning of green vegetables, meats, fish, oysters, etc., it is sometimes desirable to use the lacquered or enameled cans.

Size of tin cans.—There are several standard sizes of tin cans in common use for canning purposes. They are denominated by number and with reference to the diameter of the opening. It is always necessary to state whether you desire plain tin cans, lacquered or enameled. In buying caps, always ask for the solder hemmed caps and give diameter of can opening. When buying tin cans to be used with the automatic sealing machine you will not need either solder nor heat. Simply buy caps and the metal rims with your cans.

Soldering equipment necessary.—Capping steel tipping copper, solder, sal ammoniac, a few scraps of zinc, two

Repairing leak in water-bucket.

and seven-sixteenths inch opening, tipping copper, solder, flux, a small brush, porcelain glass or stone cup in which to keep flux, a soft brick and a file. If using automatic sealer none of those things is needed.

Soldering flux.—Soldering flux, which may be purchased ready for use, is a solution of crude muriatic acid and zinc diluted with water and strained through a cloth.

Capping iron, showing position of hand and upright rod. Also how iron is applied to solder hemmed cap.

It is used for cleaning the irons and for brushing the tin and solder surfaces so as to make it possible for the solder in its melting condition to adhere to the tin. Powdered resin is sometimes used instead of the soldering flux. A soldering paste is also manufactured which is very serviceable. The following soldering preparation or flux has been found to be very desirable, and is cleaner than the old flux:

Zinc chloride	3.6	oz.
Ammonium chloride	72.0	grains.
Water	1	quart.

Tinning a capping iron.—Purchase 5 or 10 cents' worth of sal ammoniac at the drug store. Melt in this a little solder. Heat the capping iron enough so that it will melt the solder easily. Place the iron in the vessel containing the mixture of sal ammoniac and solder. Rotate iron in this until the soldering edge of the iron has become bright or thoroughly covered with the solder.

Tinning a tipping copper.—The tipping copper is tinned very much the same as the iron. Sometimes it is desirable, however, to file or scrape the tipping copper a bit so as to make it smooth and to correct the point. Heat the iron and rotate the tip of this iron in the mixture of sal ammoniac and solder until the tip has been covered with the melted solder and rendered bright as silver. The copper should be filed to nearly a sharp point. All particles of smudge, burned material, etc., should be removed from iron before tinning.

Capping a tin can.—When capping full cans, arrange them in rows upon the table while the capping and tipping irons are in the fire heating. Take a handful of solder-hemmed caps and place the caps on all cans, ready to be capped. Then take the flux jar and small brush.

Place finger on vent hole, hold cap in place, and run the brush around the solder-hemmed cap evenly, with light stroke of the hand. Do this with all cans ready to be capped. Then take capping iron from the fire. Insert the upright steel in center. Hold capping iron above cap until center rod touches cap and holds it in place. (See page 298.) Then bring cap down in contact with all four points

(A) Self-heating capping iron. (B) Flux jar and brush. (C) Solder-hemmed cap. (D) Ammonia bar for cleaning irons. (E) Wire solder. (F) Tipping copper and method of application.

of solder-hemmed cap and rotate back and forth about three strokes. Do not bear down on tipping iron. A forward and back stroke of this kind, if properly applied, will perfectly solder the cap in place. Remove capping iron and inspect the joint.

If any pinholes are found, repair or recap. It may be necessary to use a piece of wire holder or a waste solder rim from a cap to add more solder to the broken or pinhole places of a cap.

Tipping a tin can.—Now take flux cap and brush. Dip brush lightly in flux and strike the vent hole a side stroke, lightly, with brush and flux.

Use the waste solder-hemmed cap rim or wire solder. Place point of wire solder over vent hole. Place upon this the point of the hot, bright tipping copper. Press down in a rotary motion. Remove quickly.

A little practise will not only make this easy but a smooth, perfect joint will be the result.

Note:—After the fruits, soups and vegetables have been sealed and processed the required length of time, they should be removed and cooled quickly. When using tin cans, it is best to plunge them into cold water at once after the sterilization has been completed.

Use of soldering tools for repair work in the home.—By the use of the solder, flux, sal ammoniac, capping steel and tipping iron, it is possible in a few minutes of time to solder the leaks in wash boiler, tin pails, milk pans and other vessels of kitchen, creamery, etc. This will not only save time for the farmer and the housewife, but will oftentimes save considerable expense and worry.

PART III. SOIL

CHAPTER XXI

NATURE OF SOIL

IN our discussion of plants and crops we have constantly referred to the soil. What is *soil?* Whence does it come? What relation does it bear to plant life, and hence to our own lives? Take a handful of "dirt" and crumble it between your fingers; of what does it consist, what is its nature?

1. *Origin of the Soil*

Soil did not always exist as it is to-day. When the earth was young and the crust was forming there was no soil. There was only *rock*. And it is out of the weathering of this surface rock that the soil has come; and the process is still going on whenever rock is exposed. Soil is but *particles of rock,* to which has been added *organic matter* coming from the plants and animals that have lived on it or in it.

The weathering of rock.—Rock is made into soil by two different processes, *disintegration* and *decomposition.* By disintegration is meant the breaking up of rock into small particles without changing their nature. By decomposition is meant such breaking up by chemical action that the nature of the particles is changed.

The chief agencies causing the *disintegration* of rocks are sudden changes of temperature and the action of frost. When masses of rock are heated by the sun they expand; sudden cooling at night or from change of weather causes so rapid a contraction that they are rent asunder. Water freezing in crevices also constantly breaks masses of rock into smaller pieces.

Rocks undergo *decomposition* largely through changes due to the action of chemicals carried in water. The min-

A plowing contest.

eral substances in the rocks are dissolved, and new products formed.

Surface and subsoil.—The terms *soil* and *subsoil* are used to distinguish the top portion from the soil that lies underneath. The line between the dark humus-colored part and the lighter soil below is sometimes spoken of as the division between soil and subsoil. Another distinction made is to call all that lies below the depth of tillage subsoil. No such dividing line can be sharply drawn, however, as much organic matter is found below the humus line, and the depth of tillage does not mark a natural division in layers of the soil. Surface soil differs from subsoil chiefly in the organic matter it contains.

2. *Organic Matter in Soil*

Examine carefully a lump of common field soil. Pulverize it and spread it out on a paper. In addition to the grains of sand, silt and clay which represent the rock portions, note all the different *organic* particles, such as pieces of roots, fibers of plants, and parts of insects. Place it under a magnifier, and see whether you can make still further discoveries.

Need of organic matter.—Although the rock particles make up far the greater part of the mass of the soil, organic matter is of the highest importance to plants. Indeed, it is practically impossible to raise crops on soil lacking in organic constituents. All the upper layers of ordinary soil contain from two to five per cent. of organic material, coming chiefly from the roots and stems of plants.

Humus.—When vegetation decays on top of the ground it is really burned up as effectually as if put into a stove, only more slowly. The gases pass off into the air and only a little ash remains on the soil. From this process the soil receives comparatively little benefit. If, however, decay takes place under the surface, where but little oxygen is present, a substance is produced which is called *humus*. All soil on which plants are grown is therefore constantly producing humus from the roots, and from the stubble and stems if these are turned under. Dig up a piece of timothy sod and note the mass of roots—about two tons of roots to the acre on a good field. Blue-grass yields some six tons of roots to the acre. Soils that are cropped continuously with the common cereals and the crops removed without returning manure to the field become deficient in humus, and the yield is decreased.

Effects of humus on the soil.—The most easily noted effect of humus is in the darkening of the soil. The so-called "black" soils get their color from the abundance of humus they contain. The coloring is accomplished by the partially decayed and partially preserved black organic matter coating over the small particles of the soil. The depth to which humus extends, ranging from a few inches to several feet, can be noted at any wayside ditch by the line between the dark soil on top and the lighter soil beneath.

Humus serves several very important uses in the soil: (1) it acts as a storehouse for different kinds of plant food; (2) it increases the capacity of the soil to hold water; (3) it aids in both creating and conserving heat in the soil; (4) it favors the growth of bacteria helpful to plants; (5) it improves the physical condition of the soil, making it more porous and more easily cultivated.

Living organisms.—Reference has already been made to the influence of certain bacteria in the fixing of nitrogen in the soil. The soil harbors many different kinds of bacteria and other organisms. It is fairly teeming with life, some of which is hostile to plant growth, but more of which is necessary to successful plant development.

Other organic matter.—Besides living organic matter and that which has undergone chemical changes converting it into humus, most soils contain a certain amount of vegetable matter in the form of roots and stems of plants which have not yet begun the process of decomposition. These affect the soil chiefly in making it more accessible to air and light, and more permeable to water.

3. *Texture of Soils*

Secure samples of three different field soils, (1) a clay soil, (2) a silt soil, and (3) a sandy soil. Place each of these one inch deep in a bottle. Now fill all three bottles with water and shake for several minutes. Put the bottles in a quiet place and let the contents settle. Note which soil settles to the bottom most quickly. Keep a record of the time required for water to become clear in each bottle.

Meaning of texture.—By texture of soil is meant *the degree of fineness or coarseness of the particles* of which it is composed. The finest soil particles, which will remain in suspension clouding water for hours, are called *clay*. The next finest, which will settle in about one hour, are *silt*. The coarser particles, which will settle almost at once, are called *sand* or gravel.

Most crop soils have all three of these grades or sizes of particles in their make-up. The texture of the soil depends on the proportion of each in the mixture. Soils are named in accordance with the particular one of these elements that outweighs all others.

If the very fine particles are in excess, we speak of a *clay* soil; if the texture is intermediate, of a *loam* soil; and if coarse, of a *sandy* or gravelly soil. We also use the terms *clay loam, silt loam* and *sandy loam,* etc., to describe the texture.

Composition of three soil types.—A mechanical analysis of three types of soil texture made by the United States Department of Agriculture shows the following proportions of soil particles in each:

Type of soil	Fine gravel	C'se sand	Med. sand	Fine sand	Very fine sand	Silt	Clay
Norfolk sand (truck soil)	---3%	15%	22%	38%	10%	8%	4%
Wabash clay (riv. bot.)-	---0	1%	1%	3%	7%	49%	37%
Silt Loam (corn soil)--	---0	1%	1%	2%	8%	73%	15%

From this table it is seen that Norfolk sand, which is an excellent soil for truck gardening on the Atlantic, is eighty-eight per cent. sand and gravel, and only twelve per cent. silt and clay combined. Middle western silt loam, such as grows most of our field corn, is three-fourths silt, and fifteen per cent. clay and twelve per cent. sand. River-bottom clay soils are slightly more than one-third clay, and almost one-half silt.

4. *Structure of Soils*

Take a piece of clay in your hand. Try to crumble it into small particles. Do the same with a piece of loam; with a lump of sandy soil. Note that some soils plow up in great clods, while others break up into small pieces, producing what is called a mellow condition. Have you noticed that in some places the ground cakes and cracks open when it becomes very dry, while in other places it remains soft and unbroken no matter how dry it becomes? These differences are matters of soil *structure.*

Soil structure.—By soil structure is meant the mode in which particles adhere to one another, causing them to cling together in solid masses hard to break up, or forming but loosely joined lumps easily broken or pulverized.

Clay soils are of a heavy, dense, clinging structure, difficult to break apart, hence hard to plow. Silt loams and sand loams, on the other hand, are friable; that is, they are easily broken up. They plow or pulverize easily because they are not so adhesive. All soils that are lacking in humus tend to become dense and resisting in structure.

Causes affecting soil structure.—The chief adhesive force holding soil particles together in clusters, grains, or lumps is the *water films* that surround the particles. Each separate particle is covered by a thin film of water, whose effect is much the same as a film of rubber. Let a number of small soil particles, each surrounded by its water film, come into contact, and their individual films all merge into one, and by its tension unites these particles in a single granule, or cluster. These clusters are in a similar way joined into still larger clusters, and so on until, in fine clay soils, one continuous mass is formed. As clay soils dry out the films break, shrinkage occurs, and the surface cracks open.

The greater adhesive power of clay soils comes from the fineness of their particles. The larger the number of particles in a given mass of soil, the greater the aggregate surface of these particles, and hence the greater the amount of water films needed to bind the particles together. Sandy soils do not form into granules, or lumps, because the aggregate surface of the particles is not sufficient to supply the binding force of water films necessary to hold them together.

It has been carefully estimated that the particles of a cubic foot of soils of different textures have the following amounts of surface:

Coarse sandy loam	40,000	square	feet.
Sandy loam	65,000	"	"
Silt loam	100,000	"	"
Clay soil	150,000	"	"

From these comparisons it is clear that the water films are several times greater in area in clay soils than in sandy soils, hence the tendency to adhesiveness in clay soils is correspondingly increased.

Soil structure and tilth.—You have seen some seed beds that were granular or full of lumps, with very little fine earth for packing about the seeds. Others are finely pulverized, and favorable for plant growth. The condition presented by the soil with reference to plant growth is called its *tilth.*

Tilth depends chiefly on soil structure. Dense heavy soils that have a tendency to form into lumps when plowed, or that easily bake after rain, make it difficult to maintain a good tilth. On the other hand, a good tilth is equally hard to maintain on soils that easily burn out in a drought, or that for any reason are not good reservoirs of water.

5. *Erosion of the Soil*

Note the color of the soil on some cultivated hilltop and on the lower ground at the foot.

1. Why is the color on the hilltop lighter? Why is the crop yield less? Are there any slopes near by with gullies washed out?
2. Have you seen sheets of soft earth which have been carried by the wash from heavy rains and spread over low ground or along the courses of streams? Where does this soil come from? What is its texture, fine or coarse? What is the structure of this overflow soil, heavy and dense, or friable? Is such soil fertile? Must this fertility be lost from the ground from which the wash came?
3. Have you ever seen banks of soil built by the carrying of soil particles in the wind? Great masses of wind-built soil, called *loess,* are to be found in Illinois, Wisconsin, Iowa, eastern Kansas and Nebraska, and northern Missouri. These loessial soils consist chiefly of silt.
4. Which loses more soil from the action of the wind, hilltops or valleys? In certain western plains regions as much as an inch of top soil is sometimes removed in a single dust storm lasting for twelve hours.

Nature of erosion.—By *erosion* is meant the wearing or carrying away of soil by the action of running water and the wind. Erosion by running water takes place in some degree on all slopes; the hills are gradually but constantly being carried into the valleys. But it is on the steep hillsides where the velocity of the water is greatest that most damage is done. The reason for this is easily seen when it is remembered that the transporting power of water increases

A hillside, showing the effects of water erosion.

as the sixth power of its velocity. This means that doubling its velocity increases the carrying power sixty-four times; trebling its velocity increases the carrying power seven hundred and twenty-nine times, and so on.

The texture of the soil has much to do with erosion. All soils that permit ready absorption of water, as from rains or melting snow, leave less to run over the surface, and so are less subject to erosion than dense clay soils.

Effects of water erosion.—Erosion by running water not only produces gullies and ditches that interfere with cultivation, but greatly reduces the fertility of hilltops and slopes by general surface washing. For the best parts of the soil are carried away by erosion. Organic matter is relatively light, and so floats off; the finer clay and silt particles, as we have seen, remain long in suspension in water and are carried away, while the coarser portions are left behind. And it is just this organic matter and the finer soil particles that contain the best part of the plant food. No wonder then that the hilltops have a thin poor soil, and that the valleys are noted for their fertility.

Prevention of erosion.—While soil erosion can not be wholly prevented, it can be greatly checked. And nature suggests one effective remedy in covering all soil with vegetation. It is bare soil that washes and blows away. Even a steep hillside when covered with grass is reasonably free from erosion. For the stems tend to delay the downward rush of water, thus causing it to soak into the ground, and the roots bind the soil together. This indicates that steep slopes should be used for pasturage, meadows and wood lots rather than for cropping. The addition of organic matter in the form of manure also lessens the danger from washing, since it increases the capacity of the soil to absorb water, and also tends to bind the soil together.

Hillsides when tilled should be plowed along the slope rather than up and down, and in many sections it is necessary to terrace the hillsides. This delays the forming of rivulets and favors absorption of water. Every furrow leading down the hill is the beginning of a gully in lines of heavy rains. Even the marks left by the wheels of a corn planter, unless leveled over by harrowing, will serve as water channels and result in waste of soil and washing out of the seed or plants.

Gullies once started should be leveled immediately by use of the plow or other form of cultivation. Pack straw, hay, or manure at the head of the channel, or at intervals along its course, as this will do much to stop the erosion, especially if used in time. Sheet, or surface, washing is, however, a source of greater damage than the formation of gullies. For sheet erosion, though gradual, is constant on the slopes of all tilled fields.

Topics for Investigation

1. Select a spot on your home farm representing its typical soil, dig down with a spade or soil auger and take two samples, one from a depth of six inches, and one of twenty inches. How do the samples differ (1) as to texture, (2) as to organic matter, (3) as to structure? How deep does the humus extend? Bring samples to school, and compare with those from the different farms represented.

2. Place some of each sample in a bottle or glass of water and mix well. Allow the sand to settle (How long?), and pour the water off the top into a third receptable. Allow the clay to settle until the water becomes clear. (How long is required?) Now determine as nearly as you can what are the proportions of *clay, silt* and *sand* in the soils. How would you name the texture of the soil on your farm?

3. Secure a sample of the soil from some cultivated hilltop, and examine it for its texture, structure and the amount of organic matter. Compare with another sample taken from the foot of the hill. Explain the difference in color. Dig down with a spade and compare the depth to which the humus extends in each case.

4. Are there any cultivated hills on your farm so steep that erosion is considerable? If so, how does the yield on the hill compare with the lower land? Are there any gullies forming? If so, how long have they been washing out? What is being done to stop them?

5. Determine what kind of soil there is in your school yard, such as silt loam, clay soil, or sandy loam, and compare the aggregate surface of the particles of a cubic foot of it with the area of the school grounds.

6. What is a soil auger and for what is it used? What is a soil survey, and how and why is it made? Consider the possibility of joining with your classmates in making a soil survey and a soil map of your school district.

CHAPTER XXII

SOIL FERTILITY AND PLANT GROWTH

BOTH plants and animals depend on the soil for their existence. Since animals can not draw food immediately from the soil, they are dependent on plants, which have the power to live chiefly from the soil elements. Plants may therefore be looked upon as minute factories, each at work making living tissue out of soil materials. All human food comes either from the plants themselves, or from animals which feed on plants.

1. *Plant Food and Soil Fertility*

The soil is the home of the plant; there it must find the conditions necessary to its growth and development. The plant must have air and water for its roots, and for its food all the elements that enter into the tissues in its growth. The ability of the soil to supply the elements necessary for plant growth is called its *fertility.*

Food required by plants.—Agricultural plants require, in all, ten different chemical elements for their growth. These are:

Carbon Hydrogen Oxygen	Supplied by air and water.
Calcium Magnesium Iron Sulphur	Supplied by soil. Quantity inexhaustible.
Nitrogen Phosphorus Potassium	Supplied by soil. Quantity limited.

The first of these ten plant elements—carbon—is supplied in the form of carbon dioxide by the atmosphere, and hence forms no part of the soil's fertility. Hydrogen and oxygen, which are the elements that compose water, are taken up by the plant directly from the water of the soil. The next four of the list, calcium, magnesium, iron and sulphur, are found in practically all soils in quantities sufficient for ordinary plant growth. The fertility of the soil therefore depends chiefly on the supply of the last three, *nitrogen, phosphorus* and *potassium.*

Rich or fertile soils are those that contain an abundance of these three elements. Every crop removes some amount of *each* of the seven elements supplied by the soil; but since calcium, magnesium, iron and sulphur are practically inexhaustible, they do not have to be replaced in order to maintain the soil's fertility. Nitrogen, phosphorus and potassium, however, must constantly be returned to the soil if it is not to become exhausted and the crops reduced. As the strength of a chain is measured by its weakest link, so the fertility of the soil is for most crops measured by the plant element of which it has the least.

Danger of loss of fertility.—One of our chief agricultural problems is to maintain the fertility of the soil. We must all live from its products, no matter what our occupation. A large proportion of the tillable land of the United States is now occupied. Our people must be fed from the land; there is no other source of supply.

This means that we should not only keep up the fertility of the soil, but actually increase it as time goes on. It is estimated that our population is increasing five times as fast as our food supply. This fact explains in part, at least, the high cost of living.

Much land has been rendered almost valueless by means of single cropping, and by rental of land on short-term leases farmers have robbed the soil of its nitrogen, phosphorus and potassium. Farms located within a hundred miles of the great eastern and southern markets have recently been bought for from ten dollars to twenty dollars an acre, when middle western land is selling for one hundred dollars to two hundred seventy-five dollars an acre. Much of this eastern and southern land was originally as good as the western, and would be worth a great deal more per acre if it had been properly farmed to conserve its fertility and serve more fully the farm as factory or business institution.

There are three principal methods of maintaining the fertility of the soil or increasing its fertility when it has run down. These are: (1) *manuring,* either with barnyard manure or by plowing under such plants as clover, alfalfa, cow-peas, or some other green crop; (2) using *commercial fertilizers;* (3) *rotation of crops and diversification.*

2. *Barnyard Manure as a Fertilizer*

One of the best evidences of careful farming and good management is a well kept and well used manure heap. Manure should no more be wasted than any other farm product. The annual waste of manures in the United States is equal to our entire wheat crop.

The value of barnyard manure.—Barnyard manure is rich in all three of the elements in which the soil is likely to run short—nitrogen, phosphorus and potassium. It has been estimated by experts that if animals are kept in stalls or pens throughout the year, given a reasonable amount of litter for bedding and all the manure saved, the annual value of the manure from each animal will be: horses or mules, twenty-seven dollars; cattle, twenty dollars; hogs, eight dollars; sheep, two dollars. Differently stated, the value of

Field showing the effect of legumes and proper treatment of the soil. On the left manure was used; on the right, limestone, rock-phosphate and manure. .

The wrong way to handle barnyard manures.

the manure produced during the seven winter months on a farm keeping four horses, twenty cows, fifty sheep and ten hogs would be at least two hundred and fifty dollars. These figures are based on the cost of an equal amount of commercial fertilizer.

It is true that not all the fertility taken from the soil by farm crops can be returned by using the manure from the feeding of crops, but the greater part of it can. The manurial value of different farm products, based on the cost of commercial fertilizers, is shown in the following tables: (*Farmers' Bulletin* 193, United States Department of Agriculture.)

Value as fertilizer in one ton of farm products.

Product	Nitrogen	Phosphoric acid	Potash	Total
Meadow hay	$ 3.47	$ 0.57	$ 1.06	$ 5.10
Clover hay	6.83	.78	1.46	9.07
Wheat bran	8.35	3.82	1.14	13.31
Linseed meal	17.87	2.25	.99	21.11
Cottonseed meal	23.06	3.96	1.17	28.16
Wheat	6.38	1.11	.42	7.91
Oats	6.21	.87	.35	7.43
Corn	5.62	.83	.30	6.75

We see from this table that the farmer who sells a ton of meadow hay loses from his farm fertilizer value that would cost about five dollars if purchased in commercial form. If he sells clover hay, he loses almost as much value in fertilizer as his hay brings him. If he pays twenty dollars a ton for wheat bran he gets over thirteen dollars' worth of fertilizer, leaving the feeding cost about seven dollars.

Of course it is evident that these values will not be obtained from the feeding of farm crops unless the manure is carefully saved and properly used. Not only has manure great chemical value because of supplying the elements needed in plant growth, but it has *bacteriological* value as well. For manure contains an enormous number of bacteria, many of which aid in plant growth. Attention has already been called to the fact that the addition of manure improves the *physical* condition of the soil, making it more porous, and increasing the supply of humus.

Preventing loss from manure.—Loss of fertilizing qualities from manure is due principally to two causes: (1) *fermentation,* or heating, which reduces the supply of nitrogen; and (2) *weathering,* or leaching from rains, in which all the valuable elements in liquid form are lost.

The *fermentation* of manure is caused by two different kinds of bacteria, one of which works near the outside of the heap where there is air, and one deeper down where the air is excluded. A certain degree of fermentation is necessary to the best rotting of the manure, yet overheating, or the "fire-fanging" so common in horse and sheep manure, greatly reduces its value.

The rapidity of fermentation can be controlled in part by packing. If the heap is too loosely built, the air-working bacteria become active, the heat grows intense and nitrogen and humus-making material are lost. If, on the other hand, the heap is packed too closely, the decomposition is slow and the manure does not have the best effect when spread on the soil. Frequent sprinkling with water will aid in checking too rapid fermentation.

Great loss is suffered from *leaching* when manure is exposed to the weather. It has been found that six months' leaching of horse manure reduces its value fully one-half. The remedy lies in collecting manure under cover, so that it is not exposed to rains. It should also be provided with a water-proof kit and floor for the heap, so that the liquid parts which are fully as valuable as the solid, may not drain away into the soil. The profits from open-yard, badly leached manure are so small as hardly to pay for spreading it on the field. It is a careless, shiftless method of farming that allows this great waste, so easily prevented.

The application of manure.—For heavy soils, which need to be made porous by the addition of vegetable matter, it is well to spread manure on the field fresh from the stalls without waiting for it to rot. It should not, however, be

The better way. Manure carrier and spreader.

allowed to lie long before being plowed under, as much of its strength is lost in this way. For all lighter soils, and especially such as have a tendency to dry out, the manure should be rotted before being applied.

The practise of throwing the manure in heaps on the field and later spreading it is not good practise. For here also the leaching takes place. Some of the best elements of the manure are drained into the ground immediately under the heap, and some are lost by passing off in the air. The most economical and satisfactory method of spreading manure is by use of the manure spreader. This machine saves labor, and distributes the manure more evenly than is possible by hand.

The amount of manure to be used will depend on the strength of the manure and the condition of the soil. Five tons to the acre is a light application, ten or twelve tons average, and twenty tons a heavy application.

Topics for Investigation

1. Has the yield of the principal crops increased or decreased in your region within the last ten or twenty years? To make sure of this, ask your father, or some one who has farmed in the vicinity for some time.

2. Are there run-down farms in the neighborhood? If so, is the land naturally poor, or has it been depleted by single cropping or poor methods of farming? Learn the history of all such farms as accurately as possible, with reference to cropping, rotation, manuring, and so on.

3. Based on the figures given in section two, what was the approximate value of the manure produced on your home farm last year? (See p. 318.)

4. What care is given to saving the manure on your home farm? Is it collected under cover? Does it ever "fire-fang"? Is there a water-tight floor under the heap? Should the liquid manure be saved? How closely is the manure gathered up from the yards? What is the method of distributing it on the fields? How many loads are used to the acre?

5. How much hay, oats, corn and other farm products were sold from your home farm last year? What was the approximate manurial value loss to the farm?

3. *Green Manuring*

As already suggested, the returning of the barnyard manure to the soil, no matter how skilfully done, is not enough to maintain the fertility. Our soils are everywhere being gradually worn out. One of the most successful methods of supplementing barnyard manure is by *green manuring*.

Meaning of green manuring.—By green manuring is meant plowing under any green crop for the purpose of improving the soil. Green manures improve the soil both by adding to its fertility and bettering its physical condition. If the soil is light and sandy, green manure prevents it from drying out. On heavy clay soil green manure has quite the

Hogs in clover. After pasturing, this clover will be turned under as green manure.

opposite effect, because of admitting the air, loosening the soil, and improving its drainage.

Green manure crops.—For most purposes the best green manure crops are the nitrogen gatherers already discussed—the clovers, alfalfa, cow-peas, soy-beans, the vetches and other legumes. Rye, buckwheat, rape and turnips are among other crops used as green manures. This group, however, lacks the advantage of gathering nitrogen.

4. *Commercial Fertilizers*

Although proper systems of manuring and rotation of crops will insure fertility on naturally good soil for many years, the land will finally become exhausted under such treatment. This is for the simple reason that the crops remove from the soil each year more of the elements necessary to their growth than are returned to it. The deficiency must finally be made up if permanent fertility is to be maintained. This is accomplished by supplementing manuring and rotation with what are called the *commercial fertilizers.*

Increased use of commercial fertilizers.—Commercial fertilizers have long been used in a small way, but it is only recently that they are coming to be employed on a large scale. The farmers of the United States are now paying out considerably more than $100,000,000 a year for such fertilizers. There are at present more than five hundred manufacturers selling the various fertilizing products.

Since, as we have seen, only three of the elements necessary to plant production are likely to run short, commercial fertilizers are commonly limited to these three—*nitrogen, phosphorus* and *potassium.*

Commercial nitrogen fertilizers.—Nitrogen is the most expensive of the three essential fertilizers. Commercial nitrogen fertilizer is sold chiefly in three different forms: (1) *nitrate of soda* (Chile saltpeter); (2) *sulphate of ammonia,* which is a by-product of the manufacture of coke and gas; and (3) *dried blood,* ground or steamed *bone,* or other animal products from packing houses.

The nitrogen fertilizers cost from fifteen to fifty cents a pound. Instead of depending on them the intelligent farmer will therefore use every effort to maintain the supply of nitrogen in his soil through the nitrogen-fixing legumes, occasionally plowing under a crop of clover, alfalfa, cow-peas, vetches, or soy-beans. Where these can be grown successfully, there will be little need to buy nitrogen; it can be obtained from the seventy million pounds of free nitrogen in the atmosphere above each acre.

Commercial phosphorus fertilizers.—Phosphorus fertilizers are supplied commercially in the form (1) of the *bones of animals killed* at the slaughter-houses; (2) of *mineral deposits* in phosphate rock, immense beds of which are found in Tennessee, South Carolina, Florida, Wyoming, Utah, Idaho and Montana; and (3) of *slag* from the furnaces where certain ores containing phosphorus are smelted.

Bone phosphate is sold either as *ground* bone, which is raw bone ground up; or *bone meal,* which is made by grinding after the bones have been steamed under high pressure to remove the fats and oils.

Mineral phosphate is sold in two forms, (1) that first treated with sulphuric acid, and (2) the natural rock finely ground. The first form has the advantage of being more immediately available for plant use. The second form is considerably less expensive and, when mixed with organic matter like some form of manure, proves equally as valuable as the more expensive compound.

Commercial potassium fertilizers.—Potassium fertilizers are available in several commercial forms, none of which is produced in large quantity in this country. The potash mines of Germany have been the chief source of supply.

The crude potash may be used on the soil directly as mined, or it may be made into more concentrated form. It is sold commercially as a fertilizer (1) as *muriate of potash,* (2) as *saltpeter of potash,* and (3) as *kainite.* Since this product has to be imported it is naturally more expensive than if produced at home. From one hundred to two hundred pounds to the acre, applied at intervals of from one to three years, will, however, usually prove sufficient to keep up the supply.

The application of commercial fertilizers.—Because commercial fertilizers are so expensive, and also for the reason that the application of a fertilizer when it is not needed may do positive harm, the advice of your county agricultural agent or some other agricultural leader of the state should be sought before purchasing. An agriculturist, after a survey of your soil, may be able not only to suggest the best kind for local needs, but also the amount that should be used.

5. *The Use of Lime on Soils*

Lime can hardly be called a fertilizer, since it does not contain any of the elements in which the soil is generally lacking. Yet because of its action on certain other elements of the soil it is necessary to plant production. When lime does not already exist in the soil it must be added in commercial form if the fertility of the soil is to be maintained. The purpose of lime is to cure the soil of its *acid* condition.

Acid soils.—All soils have a tendency to become sour, or acid. This acidity comes about in several different ways: in the decay of organic matter in the soil, certain acids are produced; hence the soils rich in humus are likely to be acid. Plant roots give off acid in the process of their growth, and this acid remains in the soil. The action of the nitrifying bacteria also adds to the acidity of the soil. Heavy, non-porous clay soils which do not allow the entrance of fresh air are usually sour.

The degree of acidity of soils can be judged (1) by the *refusal of certain plants to grow* in them; for example, the legumes will not thrive in acid soils, and the failure of clover or alfalfa to do well should arouse a suspicion of too much acid. (2) The presence of such *weeds* as sheep-sorrel, horsetail rush, corn spurry, and wood horsetail indicate acid. (3) Blue *litmus paper* turns red when placed in contact with a soil containing acid. (4) Acidic test. (See *Wisconsin Bulletin* No. 249 for new method.)

Liming acid soils.—Lime is a certain remedy for acid soils. In some regions, especially where limestone abounds, the natural supply of lime in the soil is sufficient to overcome the surplus acid. In other regions, lime needs to be applied in commercial form. This is the only cure for acid soil within reach of the farmer.

Nearly all prairie soil is in some degree acid, especially on slopes where leaching of the soil has carried away the original deposits of lime, and wherever large supplies of humus have formed from the decay of organic matter. Thousands of acres of acid land would well repay the cost of liming by increased yields. Many farmers now look on liming as a regular and necessary requirement. Of course lime should not be applied unless needed, but the tests are so simple that this is easily determined.

Forms of lime used.—Lime is available for application to the soil in several forms: (1) Quicklime, or lime ready for use in making plaster, when finely ground may be applied at the rate of about one ton to the acre. (2) Air-slacked lime, or ordinary lime that has been exposed to the air, is an excellent form, and may be applied at the rate of two or more tons to the acre. (3) Ground or finely crushed limestone direct from the quarries is widely used in regions where it is easily obtainable. From one to two tons to the acre will usually correct the acidity.

The form of lime to be used will depend chiefly on which is most easily available and cheapest. The amount required is determined by the degree of acidity in the soil.

6. *Crop Rotation and Fertility*

The rotation of crops can not properly be said to increase the fertility of the soil. For every crop removes from the soil some quantity of each of the elements required for plant growth. Certain very definite advantages come from rotation, however, which at least save the rapid soil exhaustion resulting from growing one crop continuously. Rotation also brings increased yields. In this sense a proper rotation may have the same effect as the application of a fertilizer, though it can never serve as a substitute.

What is meant by rotation of crops.—By rotation of crops is meant a *regular order followed for a period of years, and alternating on different fields.* If this order is hit-and-miss, or the result of whim or chance, it can not be called a rotation. Rotations may be planned on a two-year, three-year, four-year, or any other cycle.

What is accomplished by rotation.—Rotation of crops improves the physical condition of the soil. Grasses and legumes have a larger supply of roots than most cereals, and so increase the organic matter. Different crops send their roots to different depths, and so use new portions of the soil. The cultivation of inter-tilled crops clears the soil of weeds, and opens it up to air and moisture.

Rotation also aids in destroying insects and other enemies of plants, as we have already seen. The pests that attack one kind of crop die out when another crop is raised on the field. The growing of the nitrogen-gathering legumes on every part of the farm in succession is allowed by rotation, thus saving the necessity of buying commercial nitrogen fertilizers.

The crops to use in a rotation.—It is evident that no universal standard rotation can be prescribed. Both the particular crops and the order must be decided by local conditions and requirements. The rotation is usually based on some one principal crop, such as corn, cotton, potatoes or wheat, the other crops being arranged to favor these. Where cotton or tobacco is the main crop, the following five-year rotation is considered a good one: First year, cotton or tobacco; second year, corn and crimson clover; third year, crimson clover; fourth year, small grains; fifth year, cow-peas or soy-beans.

A good five-year rotation to include trucking and fruit growing may be as follows: First year, cotton or wheat and cow-peas; second year, early potatoes and beans; third year, early potatoes and beans or other vegetables; and strawberries for the two succeeding years.

The table for the five-year rotation, showing distribution by fields, is as follows:

Year	Field A	Field B	Field C	Field D	Field E
First	Crimson Clover	Small Grains	Cow-peas or Soy-beans	Cotton or Tobacco	Cow-peas or Soy-beans
Second	Small Grains	Cow-peas or Soy-beans	Cotton or Tobacco	Corn and Crimson Clover	Cotton or Tobacco
Third	Cow-peas or Soy-beans	Cotton or Tobacco	Corn and Crimson Clover	Crimson Clover	Corn and Crimson Clover
Fourth	Cotton or Tobacco	Corn and Crimson Clover	Crimson Clover	Small Grains	Crimson Clover
Fifth	Corn and Crimson Clover	Crimson Clover	Small Grains	Cow-peas or Soy-beans	Small Grains

Note that the above system of rotation provides for both corn and cotton each year, but never in the same field for two or more successive years. It also provides for forage and cover crops and small grains for necessary feed for farm animals.

Principles of rotation.—In the southern states as a rule it will be found much more profitable to grow a crop of cotton or tobacco once every three, four or five years on the same field than every year. There are four kinds of crops that should be considered in every rotation. First, a *ready-money crop,* and upon this crop the rotation should be based. In the South these crops are usually cotton or tobacco, sometimes wheat. Second, there should always be a *fodder crop* available for necessary feeding of farm animals. Third, there should be at least *one legume* in the rotation in order to furnish humus for plant growth. Fourth, in every rotation there should be a plan for the growing of a *winter cover crop* to prevent the erosion and leaching of the soils. The latter is especially important in the southern states.

In working out a system of rotation no plan will be safe to follow for all states or all districts. It is therefore quite important that the farmer should consult the local experiment station and college of agriculture with reference to a suitable system of rotation. In general, the following principals of rotation should be carefully considered:

Rotation Rules.—1. Rotate the crop so as to give not less than one money market crop every year. When plenty of land is available, two or more money crops should be grown.

2. Rotate crops so as to have as much green feed as possible for the entire year.

3. Rotate the crop so as to make use for each succeeding year of the remains or residue of former crops, such as manures and other fertilizers.

4. Rotate the crops so as to secure as much nitrogen as possible from the air. Clover, alfalfa, cow-peas and other legumes will do this.

5. Rotate the crops so as to defeat or check the development of insect pests and plant diseases. Lack of this has been the chief cause of the rapid advance of the Mexican boll weevil in cotton territory.

6. Rotate the crops so as to make use of all tillable land every season.

7. Rotate the crops so as to secure an even distribution of labor for both man and beast during the entire year.

8. In southern territory rotate crops so as to provide for winter forage for live stock and cover crops to prevent leaching and erosion.

Topics for Investigation

1. What commercial fertilizers are used in your region? In what form is the fertilizer applied? What is the quantity used per acre? The cost? To what extent is green manuring employed? What crops are chiefly used? What is meant by a "5-8-7" commercial fertilizer?

2. To make the litmus-paper test for acid in soils, take a small piece of blue litmus paper and place it between pieces of thoroughly dampened soil, pressing the soil close and leaving it in contact with the paper for five minutes. If the paper turns red, the soil is acid and needs lime. Secure samples of soil taken at a depth of six inches from several different parts of your farm, including both upland and lowland areas, and make the litmus-paper test.

3. Draw a diagram of your home farm showing the different fields. Now work out several different crop rotations based on your principal crop, and taking into account the necessity for growing some legume for improving the soil. Compare with the rotations suggested by other members of the class.

CHAPTER XXIII

SOIL MOISTURE

WATER is as necessary to the growth of plants as fertile soil. All the food taken by plants from the soil must first be dissolved in water. The tiny root-tips suck in this food-laden water which circulates to every part of the plant, producing its growth.

The amount of water required by a growing crop is enormous. For every pound of dry matter made by the plant, from three hundred to eight hundred pounds of water must be drawn in by its roots and circulate through it. To produce a ton of dry hay on an acre of ground demands that approximately five hundred tons of water be pumped by the grass stalks from the soil. When the soil lacks water, plants are cut off from both necessary food and drink.

1. *Forms of Soil Water*

Gravitational water.—Soil that is thoroughly saturated contains a certain amount of free water that will drain off if there is some outlet. That is, the force of gravity pulls it down through the soil; hence its name, free, or *gravitational water.*

To watch how this works, place some soil in a funnel closed with a stopper. Pour water over the soil until it is completely soaked. Then remove the stopper and allow what will of the water to drain off. All the water that thus escapes is free, or gravitational water.

Plants can not use gravitational water for their supply. This is to say that they can not grow in a soaked soil. "Water-logged" soil excludes air from the roots, and the plants soon suffer for want of oxygen. Standing water also keeps the roots of most plants too cold for good growth. Hence the necessity of conditions that will allow the soil to drain readily after rains, so that the free water may escape.

Capillary water.—Soils will not drain entirely dry. After your funnel of earth has lost all the water that will run from it, it is still wet. This wetness is caused by what is called *capillary* water.

Capillary water exists in the form of thin films around the soil particles and in the spaces between them, as described in an earlier chapter. Each separate particle is surrounded by its own film, while larger films bind the separate particles together in granules. Since the particles of a given weight of soil of fine texture present a larger surface area than the particles of a soil of coarse texture, it is evident that the finer the soil the greater the amount of capillary water required to make up the films.

Plant growth and capillary water.—It is the capillary water of the soil that plants use in their growth. Their root tips come in contact with the water films surrounding the soil particles and drink this water in. One of the first requisites of soil to produce a good crop, therefore, is its ability to act as a reservoir for a large amount of capillary water.

2. *Capacity of Soils of Capillary Water*

Soils differ greatly in their capacity for capillary water. This can easily be shown by a simple experiment. Bake a pint of sand and a pint of clay until all the water is dried out; then place the samples in separate funnels over the lower ends of which are tied pieces of cheese cloth. Now slowly pour water from a graduate over each soil until the water begins to drip from the bottom of the funnel. Note carefully how much water was required in each case.

Soil texture and capillary water.—Because of the fineness of their texture, clay and silt soils have much greater capacity for capillary water than sandy or gravelly soils. Under average field conditions the difference in the amount of capillary water held in the first two feet of fully saturated soil is about as follows:

Sandy loam soil will hold	5	inches of water
Clay loam soil will hold	7½	" " "
Muck soil will hold	12½	" " "

This is to say that it would require a sheet of water five inches deep to supply the capillary water for the first two feet of saturated sandy soil; a sheet of water seven and one-half inches deep for the first two feet of saturated clay soil; and a sheet twelve and one-half inches deep for the first two feet of saturated muck soil.

Drawing ground water by capillarity.—A very simple experiment will test the capacity of different soils for drawing capillary water from below. Take four glass tubes at least one inch in diameter and from fifteen to twenty inches long, or four chimneys from student-lamps, and arrange them suspended in a rack. Tie over the lower end of each a piece of cheese-cloth. Fill the tubes with soils of different texture, from fine clay to coarse sand. Place a pan beneath the tubes, and pour water into it until the water stands half an inch above the bottom of the tubes. Now watch the water rise in the different soils. Keep accurate track of the time required, and of the height reached in each. What are your conclusions?

Humus and capillary water.—The capacity of any soil for holding capillary water is greatly increased by the presence of decaying organic matter. It has been carefully estimated that one ton of humus will absorb two tons of water and give it up as needed by growing plants.

3. *Tillage and Soil Water*

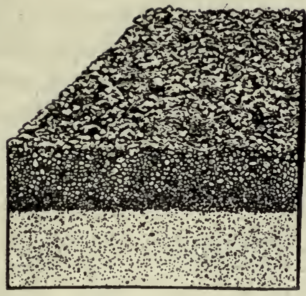
One of the chief problems of agriculture is to conserve the capillary water of the soil and make it available for plant growth. Capillary water is removed from the soil in two ways, (1) by evaporation, and (2) by being absorbed by the roots of growing plants. What is lost by evaporation is wasted so far as crops are concerned.

Tillage for conserving capillary moisture.—All loosening of the soil increases its absorbing power, and thus causes rain to soak into the ground instead of running off along the top. The deeper the plowing the greater this effect will be. Fall plowing, by opening the soil for the absorption of the winter snows, adds to the amount of soil water.

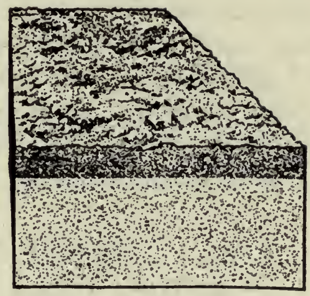
The most effective tillage for conserving capillary water, however, is the frequent cultivation during the growing season which results in a fine soil mulch over the surface. To see the truth of this, make the following experiment:

Effect of a soil mulch.—Fill two glasses nearly full of the same soil; if the soil is dry, add an equal amount of water to each, making the soil fairly damp, but not soaked; pack them equally by striking the glass gently down on the table. Now put a half inch of fine, dry road dust over the top of one, leaving the other without covering. Set the two glasses side by side, and note the time it requires for each to dry out by losing its capillary water through evaporation.

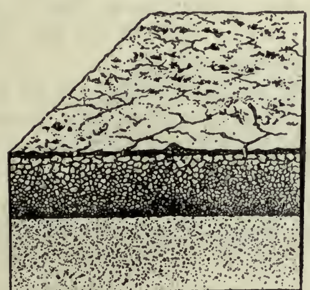
The fine mulch made by frequent harrowings and culti-



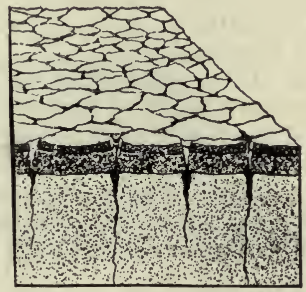
The right kind of mulch for moisture conservation is granular—that is, the dirt should not be pulverized too finely.



The wrong kind of mulch. The ground is almost dust. Such mulch blows away easily.



The granular mulch rained upon and left standing for a number of days. Observe that the ground is cracking and that moisture is escaping through these cracks. The crust can be easily broken.



Dust mulch rained upon and left standing in the hot sun. Note that the crust has cracked, and that the moisture is escaping very rapidly. It is impossible to work up this seed bed properly.

vatings has precisely the same effect on our fields. In dry regions summer fallowing is used for the purpose of collecting a supply of capillary water. Whatever rain falls is saved by keeping the surface covered with a fine soil mulch, and what moisture is drawn up toward the surface from the ground water by capillary attraction is also conserved for the crop that is to follow.

Topics for Investigation

1. Is there any ground on your home farm too wet or marshy for cropping successfully? If so, measure carefully the amount of land in such areas. Do any patches break the regularity of cultivated fields? How much land is practically wasted as far as any return in crops is concerned?

2. What is the value of your farm per acre? What is its rental value per acre? What is the value of all the land lost by being too wet to cultivate? What is its rental value? Have you any land under cultivation that is too wet at times to produce good crops? What do you estimate is the loss?

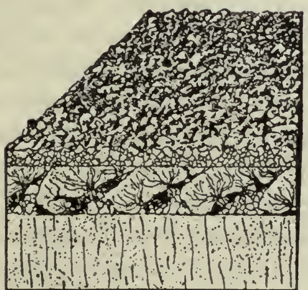
3. Draw a diagram of any pieces of marsh land on your home farm, showing the outlet for drainage and the distance the drain would have to run in each case. Are there any places where a shallow run would serve? Have you any low ground subject to rain floods from higher land? If so, could a shallow ditch be made to serve as an eavestrough to save the flooding?

4. *Soil Drainage*

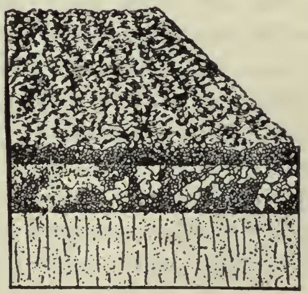
Necessary as water is to plants, however, much of our soil needs drainage to rid it of an oversupply of free or gravitational water. There are some eighty million acres of marsh lands in the United States. The greater part of this waste territory would make excellent farm land if properly drained.

Undisked stubble plowed. Observe that the ground is turned up in lumps; that there are open spaces at the bottom of the furrow which prevent the close compactness of the lower portion of the turned furrow with the soil beneath.

Disked stubble plowed. The mulch formed by the disk harrow fills up the open spaces at the bottom of the furrow, thereby forming a close connection with the subsurface.



This illustration represents the field above treated with a pegtooth harrow after plowing. The surface is in comparatively good condition, but the bottom is not compact.



This illustration represents the field above harrowed with a pegtooth harrow. The air spaces are still at the bottom of the furrow.

But perhaps fully as important is the occasional small piece of wet ground on farms now under tillage. In certain regions there is hardly a farm that does not have its low marshy places where crops drown out in wet times, or which are allowed to lie without cultivation. In nearly all cases this land could be made the equal of the remainder of the farm by drainage and proper management.

Surface drainage.—Surface drainage is never so thorough and satisfactory as underdrainage, yet it will often improve conditions enough to pay. By surface drainage is meant the opening of runs or ditches to allow the escape of surface water that otherwise would stand on the soil, flood over lower ground, or percolate down to add to the gravitational water already in the subsoil.

Low ground is sometimes plowed in narrow strips, the frequent dead furrows allowing surface drainage. If there is a slight slope and the furrows can open freely at the end, this will prove of great benefit. Where such simple drainage will not serve, it is sometimes necessary to construct open ditches, though these should give way to underdrainage when this is possible. For underdrainage is under most conditions a more successful way of removing the water, and it saves much loss of ground and the cutting up of fields.

Making surface drains.—Surface runs which are only required to remove surplus water during flood seasons may be made one and one-half feet deep and ten feet wide at the top at a cost of about twenty-five cents a rod, using a road grader for the excavating. Such shallow runs are often seeded, and the edges leveled off and cultivated, thus avoiding waste of land. Open ditches of this kind are often desirable in connection with underdrainage. They also serve as eaves-troughs to prevent flood water of surrounding uplands from entering lower areas.

Deeper ditches are required when the main drain is to receive the discharge of lateral drains. The size and depth will depend on the territory to be drained, and the fall of the ditch. In the Middle West, open ditches, many of them miles in length, are being constructed, each farm served paying its share of the expense. Open lateral ditches or underground tile then empty into this main drain. Under average conditions, the cost of opening a ditch seven feet deep and twenty feet wide at the top by means of a dredging machine is about one thousand dollars a mile.

Underdrainage.—Underdrainage has the advantage of carrying off the ground water to any desired depth. This is an important matter in the growth of most crops. For where the level of ground water is near the surface, plants will not strike their roots deep in the soil, but spread them out near the top. This leaves the crop at the mercy of drought later in the season, when the upper layers of soil dry out. Deep rooting is also necessary to make full use of the plant food of the soil.

Tile underdrains.—Burnt clay and cement are the materials chiefly used for underdrains in most regions. These materials are made into cylinders from three to thirty-six inches in diameter, and from twelve to thirty inches in length. For lateral drains, tiles four or five inches in diameter are most used. The main outlet drain usually requires tiles from eight to twelve inches.

Placing the drains.—Moderately heavy clay soils require laterals about four rods apart to carry off the rainfall. If the subsoil is sandy, the laterals may be as much as eight rods apart. Sometimes the marshiness of a piece of ground is caused by seepage leading to it from some higher area.

In this case, there should be a line of tile at the edge of the lower ground to receive the seepage.

Several lines of parallel drains are more economical than one central line into which diagonal laterals run. This is because with parallel drains there is less area receiving double drainage. Several parallel lines can often be carried into one line of larger tile, and all discharge through the same outlet, thus saving trouble and expense.

Depth of tile.—Tile should be placed deep enough that the level of ground water will not stand too near the surface, and yet not too deep to carry off the gravitational water without allowing it to stay too long in the soil. In clay subsoil the most common depth is about three feet. In partially sandy subsoils, the depth may be four feet. All tile meant to catch seepage should be as deep as four feet.

Gradient, or fall.—The larger tiles may be laid with a fall of an inch to one hundred feet. Laterals should have from two to three times this much fall. Lines for catching seepage should have still greater slope; as much as five inches to one hundred feet, if this is possible.

Cost of tiling.—The cost of tiling will, of course, vary with the size of tile used, the depth it is laid, and the character of the soil. The average cost under normal conditions is about as shown in the following table:

	Depth tile is laid			
Size of tile	3 feet	4 feet	5 feet	6 feet
4 inch	$ .30	$ .50	$ .80	$1.25
5 inch	.35	.55	.85	1.30
6 inch	.40	.60	.90	1.38
8 inch	.45	.65	.95	1.40
10 inch	.50	.70	1.00	1.45
12 inch	.55	.75	1.05	1.50

Topics for Investigation

1. Taking the cost of the drainage as shown in the table, figure what it would cost to tile out wet places on your farm, using four-inch tile for parallels laid four rods apart. The parallels are to connect across the lower end with a six-inch line, and this is to empty into the nearest available ditch or stream. Would it pay to put in tile on your home farm?

2. By digging down in several different places on your farm, see whether you can discover the level of ground water. Have you ever seen water gather in the bottom of a post hole? What does this indicate?

3. Study the texture of the soil in your school yard, and compute the approximate weight of the capillary water contained in the first two feet of its depth when the soil is well saturated.

4. Show how you can make a soil survey of your father's farm or home garden by the use of the soil auger and a diagram indicating the top soil, subsoil, elevations, lowlands, and drainage possibilities.

5. *Soil Demonstrations*

1. Show how to determine the kind and depth of soil of any particular spot.

2. Show how to test the soil for acidity. Show two methods if possible.

3. By the use of a glass of muddy water and the application of a little lime, show the value of lime to soils.

4. Demonstrate the value of shallow cultivation for the conservation of moisture in soils by the use of loaf-sugar and powdered sugar, a solid or well-packed piece of earth and a dust mulch placed on top. Apply water to each at the bottom.

5. Demonstrate how to test the capillarity of soils.

6. Demonstrate by the use of various types of soil and the same kind of seed the relations of types of soil to the germination of seed and its subsequent plant growth.

7. Show by demonstration how legumes tend to conserve the fertility of the soil.

8. Show by the use of different types of soil their respective merits in the conservation of moisture.

6. *Soil Play Contests*

1. Soil type naming contest.
2. Soil analysis contest.
3. Soil guessing games.
4. Soil sample getting contest.
5. Stone naming contest, in which samples of various types of native stones are placed before the contestants. The one who can name the largest number in a given time is to be judged the winner.

7. *Soil Fertility Club Projects*

The object of this club project is to organize the boys and girls into a cooperative group for the purpose of building up the soil fertility of a community. The pupils should pledge themselves to manage one or more acres of land during the season with the idea of not only making a net profit on the investment for the season, but of starting and carrying on a three- to five-year rotation of crops with a distinct plan of growing leguminous crops such as clover, alfalfa, cow-peas, etc.

Club membership.—This particular club work should be maintained for the members of the agricultural class and should not be open to those boys and girls who are too young to appreciate and undertake properly this line of work.

The basis of award for a soil fertility club may be as follows:

1.	The plan and management of rotation	20
2.	The average yield per acre	20
3.	The net profit on investment	20
4.	The fertile condition of the soil at the end of a three or four-year period	20
5.	Soil and crop records, story and soil chart of work	20
	Total score	100

PART IV. FARM ANIMALS

CHAPTER XXIV

FARM ANIMALS AND AGRICULTURE

FARM animals form one of the most important sources of wealth in the nation. The five most important groups of animals, ranked according to their market value, are *horses, cattle, hogs, mules* and *sheep*. If these animals should all be sold, they would bring the enormous sum of nearly six billion dollars, or sixty dollars for every man, woman and child in the United States.

1. *Work Animals*

Farm animals serve several important uses: (1) they provide food for man, (2) they work for him, and (3) they supply various useful products. The total market value of the working animals, horses and mules, is slightly greater than that of the food producing group, cattle, sheep and hogs.

Using animals for work.—Centuries ago man had not yet domesticated the animals and trained them to work for him. Since the uses of steam and electricity had not been discovered, all labor had to be done by men themselves. The implements used for cultivating the soil were all crude and ineffective, and could only be operated by hand. It then required much more time and effort to secure a living by agriculture than it does now.

One of the greatest lines of progress in America has been the substitution of animal and machine power for man power in doing farm work. In this we are far ahead of most other nations, even those of Europe. For example, we have in the United States almost twenty-five million horses, or approximately one to every four persons. In France, one horse has to serve ten people; in Germany, thirteen, and in Great Britain, twenty-six.

Saving in time by work of animals.—The use of work animals has resulted in great saving of time. It has been estimated that in 1830 each bushel of wheat grown in the United States required three hours of a man's time; it now requires less than ten minutes. In 1850 it took a man four and one-half hours on an average to grow, harvest and shell a bushel of corn; it now requires less than forty minutes. The greater part of this saving has come through the use of improved farm machinery drawn by horses or mules.

Where the peasants of European countries use shovels, hoes, scythes or other primitive implements, we employ gang-plows, disk harrows and self-binders. The great saving in human energy and time growing out of this difference is seen when it is remembered that one horse hitched to modern machinery can do the work of at least ten men with hand tools. Many an American boy with his four-horse team is therefore accomplishing the labor of forty European peasants with their hand work and crude tools.

The animals used for work.—Among the various animals that men have trained to work for them are horses, cattle, mules, buffalo, reindeer, camels, dogs and elephants. No animals, except horses, mules and cattle, have ever been extensively used for farm work in this country. The use of oxen for work has now been almost wholly discontinued.

During recent years, horses and mules have found a competitor in the automobile and the traction-engine. Thousands of farmers now own their cars, and the gasoline tractor is a common sight on many of the larger western farms. In spite of these facts, however, the number of horses and mules on our farms is constantly increasing, and the market for them is growing better and more uniform. The price of work animals is considerably higher than it was when automobiles and traction-engines began to come into use. Horses will always have an important place in the economy of the farm.

2. *Animals That Supply Food*

Meat and other animal products form a very important part of our food supply. Even vegetarians, who are opposed to the eating of flesh, depend largely on such foods as butter, eggs and milk.

Meat as food.—A great proportion of all our farm crops goes to the feeding of meat producing animals. The most progressive nations of the world are those that in addition to fruit and vegetables for the diet make much use of their domestic animals in supplying food products. Meat is a more expensive food than grains and vegetables, and people of the poorer classes can not afford to eat it. Millions of those living in oriental countries seldom taste meat in any form. Lack of nutrition and a balanced ration are shown in absence of ambition and enterprise.

According to careful estimates the food supply in American homes is divided among the different foods in approximately the following proportions (*Farmers' Bulletin* 391):

Meats and poultry	16%
Dairy products	18%
Cereals and their products	31%
Vegetables and fruits	25%
All other foods	10%

It is therefore seen that we derive more than one-third of all our food in this country from animals, either by con-

Making hogs of themselves.

suming their flesh or other products from them, such as milk, butter, cheese, etc.

Animals used for meat.—The animals whose flesh is chiefly used for food are cattle, hogs, poultry and sheep. So great has the industry of preparing their flesh for food become, that every city has its great stock-yards and slaughter-houses, where hundreds of thousands of animals are killed every year. Cold storage vaults are provided in which meats can be kept at a temperature below freezing for months at a time. Much of the meat that is now used on the farms is first shipped to the city packing houses for slaughter, and then bought back from retail dealers as needed, in the form of bacon, ham, canned or dried beef, or as fresh meats shipped in refrigerator cars. Many small towns also have their local slaughter-houses, where animals purchased from the farms are killed for home consumption.

Other food products from animals.—The other food products from animal life, such as milk, butter, eggs and cheese, are even more important. Milk and eggs contain more of the different food elements needed by the human body than any other foods; and butter is as necessary as meat.

The dairy and poultry industries are therefore among the most important enterprises connected with agriculture. Milk and butter are shipped to the cities in refrigerator cars or special trains. Hundreds of creameries are operated to save time for the farmer and insure him greater profit. Many train loads of eggs and butter are collected during the summer months and put in cold storage and kept for the winter supply.

3. *Other Animal Products*

The farm animals are useful in other ways than doing work and providing food for man. Many practical necessities are supplied by them.

Leather.—The skins of all the common farm animals are saved for leather. Cattle, horses, sheep and even pigs, contribute to the making of our shoes, gloves, mittens, harnesses, saddles, cushions and many other articles in common use.

Wool.—Sheep furnish one of the most valuable clothing materials known. Many sheep ranches are maintained chiefly for the fleeces, mutton being of secondary consideration. More than thirty-eight million sheep annually give up their wool in the United States for the making of clothing and other articles for the household.

Other products.—We owe many other articles of common use to some form of animal product. Our brushes are made from bristles. Buttons are cut from bone. Gelatin and glue are both animal products. Many soaps are made from animal parts not suitable for meat. Blood and bone, as we have already discovered, are used for fertilizers. So completely are all parts of slaughtered animals saved for some useful purpose that it is said nothing is lost of the pig when it is killed, except the "squeal."

It is estimated that the value for fertilizing purposes of the manure of all farm animals in the United States, if properly saved and applied to the soil, would annually reach the stupendous amount of more than two billion dollars.

Topics for Investigation

1. Make a careful list of all animals belonging on your home farm. Have your father help estimate what each one is worth, and compute the value of all live stock, and find the annual interest on this amount at six per cent.

2. How many bushels of corn were raised on your farm last year? On the basis of the time required for producing a bushel of corn in 1850, how many days of nine hours each would have been required to produce this crop with machinery then in use? Make the same computation with the wheat raised on your farm, comparing with the time required to produce a bushel in 1830.

3. Talk with your mother, and see whether you can estimate what proportion of the food used on your table comes from each of the classes shown in section two.

4. Make an investigation by reading and inquiring among people of the amount of meat, butter, eggs and milk used by the farming class in England, Germany,

France, Spain, Russia, China. Compare with our own country.

5. Is there any country where the buffalo is now used as a work animal? The elephant? The camel? Where are reindeer used, and for what purpose? What are the different lines of work in which dogs are employed?

6. Show on the map of the United States the most important regions for the production of the various types of domestic animals, such as the horse, dairy and beef cattle, the sheep, the hog and the goat. Consult the last census report with reference to increase or decrease of farm animals in the various states.

CHAPTER XXV

CATTLE

CATTLE rank second only to horses in market value in the United States. Our farms support some twenty-two million dairy cows, or one to approximately every four people. In addition, there are about thirty-seven million other cattle, chiefly calves and beef stock. The value of each of these two great groups is about the same, nearly a billion dollars, or almost two billion dollars for the whole.

1. *Dairy Cattle*

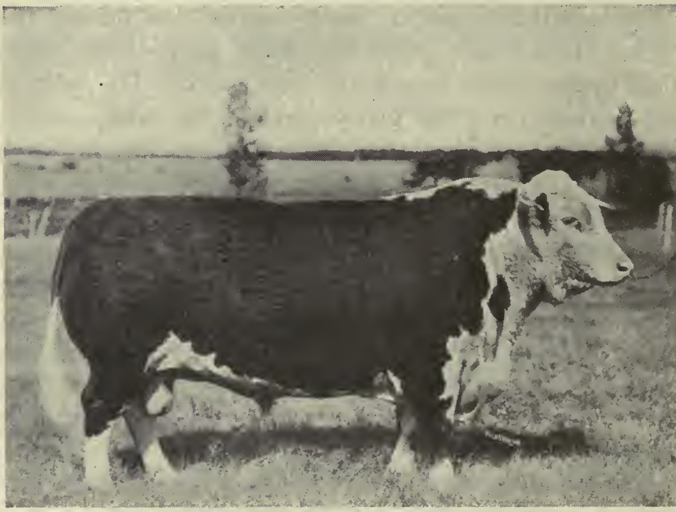
Dairying is one of the leading American industries. Each of six states, Wisconsin, New York, Iowa, Minnesota, Illinois and Texas, has more than a million dairy cows, and four other states, Pennsylvania, Ohio, Michigan and Missouri, have more than three-quarters of a million each. These ten states supply fifty-three per cent. of all our dairy products.

The following chart shows the percentage of all the farm dairy cows of the United States found in each of these ten leading dairy states:

Wisconsin	7.3%
New York	7.1%
Iowa	6.5%
Minnesota	5.5%
Illinois	5.0%
Texas	5.0%
Pennsylvania	4.6%
Ohio	4.2%
Michigan	3.9%
Missouri	3.8%

Profitable and unprofitable cows.—Whether a dairy herd yields a profit or a loss depends first of all on the milk and butter-fat producing capacities of the individual cows. A poor cow may require as much feed as a good one, and demands as much labor and attention.

It has been estimated that one-third of the dairy cows in the United States are kept at an actual loss. Twice



A champion Hereford.

every day, therefore, there are milked some seven million cows, mere "boarders," that not only return no profit, but use up the profit from good cows. How many cows of this kind are kept on your farm? How may you know?

Profit differences in herds.—It is estimated that the skim-milk, calf and manure from a dairy cow are worth the cost of caring for her. This leaves the milk to balance against the value of the feed. The difference between the best and the poorest cow in almost any herd is surprising. This difference is well shown in the following record of fifteen cows for one year in an Illinois herd:

No. cow	Lb. milk	Lb. fat	Per cent. fat	Profit	Loss
1	1204	49	4.07	----	$27.52
2	1236	50	4.05	----	27.20
3	2944	88	2.99	----	15.17
4	2597	91	3.50	----	15.38
5	2548	98	3.85	----	13.18
6	2475	99	4.00	----	13.18
7	2569	105	4.09	----	10.98
8	3164	117	3.70	----	8.37
9	2829	123	4.34	----	8.67
10	3380	149	4.41	----	1.58
11	4582	158	3.45	$1.41	----
12	4146	174	4.20	3.41	----
13	4103	177	4.31	5.41	----
14	4993	191	3.82	8.40	----
15	4435	200	4.51	10.21	----
				$28.84	$141.23
					28.84
				Loss	$112.39
Av.	3147	124	3.94		$ 7.49
Difference in profit between best and poorest cow, $37.73					

This was an exceptionally poor herd, so poor that it lost the owner $112.39 for the year—an average loss of $7.49 per cow. Either of the two poorest cows lost almost as much as the best five made their owner. Even the best cow of this herd is poor enough, but there is a difference of $37.73 in the year's record between the best and the poorest.

2. *Selecting Dairy Cows According to Type*

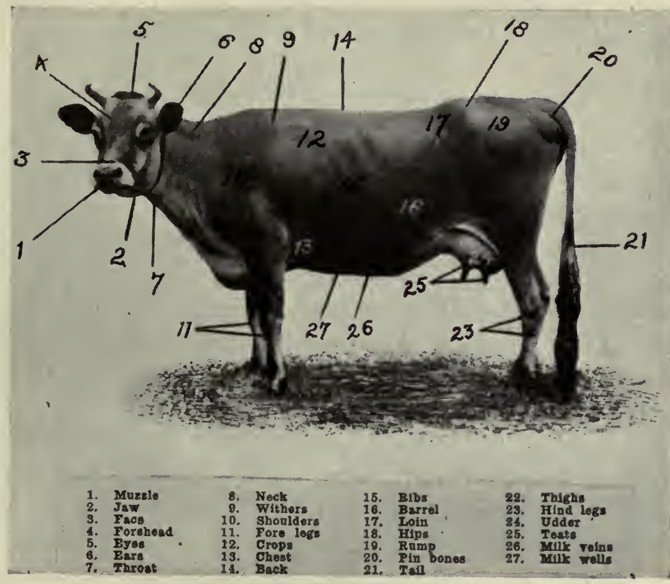
Dairy cows may be selected by two different methods: (1) keeping a record of the amount of milk produced, with the percentage of butter-fat it contains; and (2) judging whether the cow conforms to the physical type known as good dairy stock. The first of these is the only absolutely sure method. The second is also of great value, for cows are often bought without any possibility of learning their milk record. Every farmer should, therefore, know the points of a good dairy cow.

The dairy type of cow.—Dairy cattle and beef cattle present two rather distinct types as to form, or build, and appearance. In general, the frame of the beef animal is the shape capable of taking on the largest amount of flesh, while that of the dairy cow is adapted to the production of milk. Both types must be good eaters, for only the food above the amount required for maintaining the body can go to the production of either beef or milk.

The good dairy cow is spare of flesh, for the surplus food must be turned into milk instead of fat. She appears somewhat loose-jointed, but the muscles are well developed. The coat is smooth and soft, the eyes are bright, and the disposition is wide-awake and active. The jaw is strong, the stomach and other organs of digestion are capacious. The circulatory system needs size and strength, as it must supply abundance of material for the production of milk. The udder is well shaped and large.

Shape of the dairy cow.—The typical dairy cow has what is called a *wedge* conformation, especially if viewed from front to rear; that is, the body outline as a whole, whether viewed from side, top, or front, roughly resembles a wedge.

The *side* wedge has its base in a line formed by the depth of the body through the hips to the lower extremity of the udder, with the point of the wedge at the head. The *top* wedge has its base in a line across the width of the hips, and its point at the withers. The *front* wedge has its base



Parts of a dairy cow.

in a line across the floor of the chest, and its point at the top of the withers.

It is readily seen that the shape given the body by these three wedge conformations allows a generous amount of room for the digestive and circulatory systems and the udder. This form does not, however, give a frame capable of taking on a large amount of flesh, and is therefore not adapted to beef cattle.

3. *Judging the Dairy Cow*

Various score-cards are in use for the judging of dairy cows. Judging by use of the score-card trains one in accurate observation and judgment, and shows the relative value of the different points. Secure a score-card from your state college of agriculture or the United States Department of Agriculture and learn to use it in judging cattle.

4. *Selecting the Dairy Cow by Milk Tests*

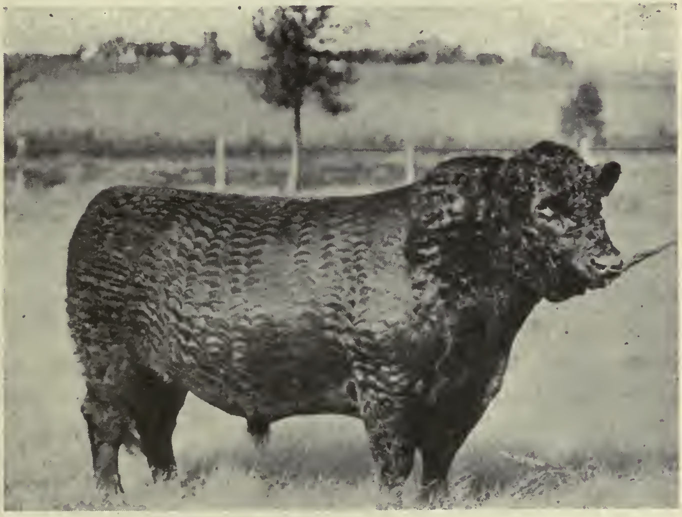
The profit from a dairy cow depends on two factors, (1) the amount of milk produced, and (2) the percentage of butter-fat in the milk. The first of these questions can be determined by weighing the milk; the second, by testing the milk with the Babcock milk test.

Testing the milk of different cows.—In order to determine the record of each cow of the herd, the milk must be weighed and tested regularly throughout the season. The testing and weighing may be done daily, though this frequent a test is hardly necessary for practical farm purposes. A plan followed by many farmers is *to weigh the milk daily, and test the butter-fat of both night's milk and morning's milk once a month.*

Making the Babcock test for butter-fat.—It is not the quantity of milk alone that determines the value of a cow. Practically all milk and cream now sold from the farm for butter-making purposes are paid for, not by weight or bulk, but by the amount of butter-fat they contain. The purpose of the Babcock test is to measure the percentage of butter-fat in milk. Every dairy farm should regularly use this test.

The *materials* for making the Babcock test are (1) a hand-power centrifugal tester; (2) two or more milk test-bottles; (3) a pipette to measure the milk; (4) a small glass measure for acid; (5) sulphuric acid with specific gravity of 1.82; (6) hot water. The necessary apparatus can be bought for about five dollars, though a fuller equipment may cost as much as twenty dollars. Full directions for making the test come with each set of apparatus.

Steps in the Babcock test.—The Babcock test is not difficult to make, nor does it require much time. Yet great



A Galloway prize winner.

care must be taken if the results are to be trustworthy. The following are the steps required in making the test:

1. Stir the milk thoroughly before taking the sample.
2. Fill the pipette to the height shown by the mark.
3. Empty the pipette into the test-bottle, blowing to drive all the milk out.
4. Fill the acid measure to the mark shown with sulphuric acid, and add to the test-bottle.
5. Shake the bottle to mix the milk and acid thoroughly.

6. Place the bottles in the machine, and whirl five minutes.

7. Add hot water to each bottle until filled to bottom of neck, and whirl one minute.

8. Add more hot water to bring the top of the fat nearly to the top of the marks on the neck of the bottle, and whirl one minute.

9. Read the per cent. of fat in the neck of the bottle; this indicates the quality of the milk.

10. Empty the test bottles and wash.

The percentage of butter-fat ought to be not less than three and five-tenths, and should range up to five or occasionally even six in the milk of the better cows.

5. *Dairy Breeds*

Dairymen are not agreed as to the type of cow that is most profitable. Some prefer what they call a "general-purpose cow," combining as far as possible the qualities of both dairy and beef breeds. Such animals are usually of large frame, take on flesh readily, and so are easily converted into beef when this is more profitable than milking. Other dairymen select the pure dairy breeds, preferring to get their profit out of the milk produced, rather than from the beef. Which is the better plan will depend on local conditions and demands.

Choosing the dairy breed.—It is impossible to select any one breed of dairy cattle as the best under all conditions. Some are noted for producing large quantities of milk, and others for producing milk rich in butter-fat. Some do best when allowed a wide range for foraging, and others when they are kept close and fed high. Some give a large flow of milk for a short season, and others a smaller flow for a longer time. The dairyman should decide what particular qualities are best adapted to his needs, and then select the breed that will meet these needs.

Leading dairy breeds.—Among the best-known breeds of dairy cattle are the Holstein, or Holstein-Friesian, as they are officially named; the Jersey; the Guernsey; and the Ayrshire. The Shorthorns are also a favorite class, combining in large degree both dairy and beef qualities. Records kept for one year in various experiment stations of the United States Department of Agriculture show the following average ratings as milk producers of the first four of these breeds in the station herds:

Breed	Pounds of milk	Per cent. of fat	Pounds of fat	Per cent. total solids
Holstein	8699	3.45	300	12.99
Jersey	5508	5.14	283	14.2
Guernsey	5509	4.98	274	14.2
Ayrshire	6533	3.85	252	12.98
Average	6562.25	4.355	277.25	13.5925

6. *Feeding Dairy Cows*

Just as the soil must contain the food elements needed in the growth of the plant, so the dairy cow's rations must contain the elements required to produce milk and upbuild the body. If proper food is not supplied, either the amount of milk or its quality will be sure to suffer. Only three different food elements, or *nutrients,* are likely to run short in the ordinary rations of the cow; these are (1) *protein,* (2) *carbohydrate,* and (3) *fat.*

Protein.—Protein is required in the animal body for the making of all muscular parts, blood and connective tissue. It supplies nearly one-third of the solid part of milk, going to form the curd and albumen.

It is fortunate that the nitrogenous plants so valuable in building up the soil are also rich in protein. Alfalfa,

"Banastine Belle de Kol," a champion Holstein cow with a record of 1,058.34 pounds of butter-fat in 365 days.

The 1914 dairy champion of the United States, "May Rilma," a Guernsey. Her record for 365 days was 19,639.5 pounds of milk and 1,059.59 pounds of butter-fat.

clover, cow-peas, soy-beans, the vetches and other legumes are therefore desirable as a part of the dairy ration. Bran, linseed meal, cottonseed-meal, gluten feed and oats are also rich in protein. Protein should make up approximately one-sixth of the cow's ration during the milking season; no other food can take its place. It is the most expensive part of the ration, and should be secured as far as possible from home-grown legumes.

Carbohydrates.—The carbohydrates are necessary to supply energy, heat and fat for the animal body, and sugar and fat in the milk. All the common grains are rich in carbohydrates, which are the cheapest nutrient of the cow's rations. Among the more common carbohydrate feeds are corn, corn silage, corn stover, oats straw, millet hay, sugar beets and dried beet pulp. In some cases sugar beet feeds have not proved satisfactory owing to their temporary effect upon quality of the milk. Timothy hay should not form a part of the dairy ration, as it has few of the elements required in producing milk.

Fat.—Fat is used for practically the same purposes as the carbohydrates in maintaining the body and producing milk. It is contained in some degree in all feeds, though in smaller quantities than carbohydrates, and in more concentrated form. It has been found that one pound of fat will serve the same purpose in the dairy ration as two and one-fourth pounds of carbohydrates.

The balanced ration.—By a *balanced ration* is meant a ration which contains the right digestible proportion of each kind of nutrient demanded by the animal. The term *nutritive ratio* is used when speaking of the relation of protein to carbohydrate and fat in the ration. The nutritive ratio of the dairy ration is 1 : 6; this is to say, one part of digestible protein to six parts of carbohydrates and fat combined. The following tables show several balanced and economical rations for dairy cows:*

Ration I.

Corn silage	30	pounds
Cow-pea hay	10	"
Corn stover	2	"
Corn	6	"
Cottonseed-meal	1.5	"

Ration II.

Sugar beets	25	pounds
Alfalfa hay	10	"
Corn stover	5	"
Corn	5	"
Dried brewers' grains	5	"

Ration III.

Clover hay	18	pounds
Corn	5	"
Wheat bran or oats	6	"
Cottonseed-meal	1	"

Ration IV.

Corn silage	30	pounds
Canadian pea and oat hay	10	"
Oats	5	"
Gluten feed	4	"

It must be remembered that, no matter what the feeds used to supply the protein, carbohydrate and fat, there must also be a certain amount of roughage in the ration. All browsing or grazing animals require bulky feed, and can not thrive on concentrated material alone.

Topics for Investigation

1. Are the cattle on your home farm of dairy breed, beef breed, or "general purpose" breed? Talk with your father and learn the lineage of each of your milk cows. Are they "blooded," "grade," or "scrub" stock? Is your herd being "selected" toward any pure breed?

2. Is the milk produced by your cows weighed and tested for butter-fat? If so, how does the record of the herd compare with the herds referred to in the chapter? If no tests are being made, talk with your father about getting the apparatus for the Babcock test. After making the test under the direction of the teacher, bring samples

*(*Purdue Ext. Bul.* No. 21.)

A champion Jersey cow with a butter-fat record of 999.14 pounds in 365 days.

A champion Shorthorn cow, a general purpose breed adapted both to beef and milk production.

of milk from home and make the test for several of your cows with the school tester.

3. Weigh the milk produced by each of your cows for a week, keeping a careful record. Now have your father help you estimate what each cow will produce during one year, taking into account the length of time each one milks, and the changes due to season, etc. Compare with the results found by other members of the class.

4. Weigh carefully the feed that is regularly given one of your cows for one day. Compare with the sample rations shown in the chapter. Are you feeding a balanced ration? If not, in which nutrient is it short? What should be done?

7. *Producing Clean Milk*

Milk is perfectly clean as it comes from the cow. It is easily tainted, however, either by filth that may fall into the pail during the milking, or from dirty utensils. Dirty milk makes dissatisfied customers, endangers the health of users, especially children, hastens souring, makes a lower grade of butter, and indicates shiftlessness and low standards of dairying.

The cow barn.—The cow barn should be constructed for the comfort, cleanliness and hygiene of its occupants. It should be well ventilated and have plenty of light. The floor should be of some hard material, preferably cement, and water-tight. The stalls should be the right length for the cows, and have a shallow gutter at the rear with slope enough toward one end to permit drainage. Instead of a feed manger in front, there should be a liquid-tight trough, also with a slight slope, that it may be washed out. All floors should be kept thoroughly washed by means of a hose and stiff brushes.

Cleanliness in milking.—Before the milking is begun, both the cow and the milker should be clean. If the cow is dusty, the dust should be well brushed out. The udder should be wiped clean, washed, or sponged off, as may be required. The milker's hands should be freshly cleansed, as it is almost impossible to keep the milk from touching them.

Special suits should be kept for milking, and should be frequently washed. The practise of putting on old, greasy and unwashed clothes, simply to save soiling other garments while milking, is too filthy to be permitted in any dairy. All utensils should be kept in a perfectly clean place, and well *scalded* once each day.

A careful analysis of the dirt contained in milk shows about nine-tenths of it to be cow manure. The other tenth is hair from the cow, dirt from the cow or the milker, particles of the feed used, and disease germs from the cow or hands of the milker. No dairyman should ask a consumer to eat such an array of filth as this.

Straining the milk.—Much of the dirt that gets into the milk can not be strained out, since it fully dissolves and will pass through the strainer as easily as the milk itself. A good strainer will, however, remove a considerable portion of the insoluble matter.

A wire mesh strainer should never be used. The strainer should be cone-shaped, with gauze and absorbent cotton forming the outlet. One thickness of the cotton is placed between four thicknesses of gauze, two on each side, and held in place by a ring which fits over the edges and attaches it to the bottom of the receptacle. The cotton should be destroyed after each straining, and never used a second time. The additional expense for this type of strainer is slight, and should keep no progressive dairyman from using it.

Cooling the milk.—After cleanliness, the next essential to good care of milk is quick cooling. So important is quick cooling to prevent souring of milk and keep it in good condition that a higher price is often paid for milk properly cooled than for uncooled milk.

For the best results some form of cooling apparatus is necessary. Various machines for this purpose can be had for from ten to twenty-five dollars. An average of about five cents' worth of ice is required for each hundred pounds of milk during the warm months. Milk should be cooled down to forty-five degrees in a few minutes of time.

Topics for Investigation

1. Make a careful study of the distinguishing marks of each of the chief dairy breeds, and learn to identify different breeds at sight.

2. Consider the conditions of your home dairy barn. Has it plenty of light? Is it well ventilated? Are the stalls the right length for the cows? Is the floor tight? Are the rear gutter and the feed trough of a good type? Is the barn *clean?* How would you disinfect the dairy barn?

3. What steps are taken in your dairy toward cleaning the cows each time before milking? Do the cows get soiled from the stalls? Are the milkers' hands washed before milking? What kind of a strainer do you use? Is your milk *clean* when it is ready for cooling.

4. Has your state a law requiring the tuberculin test for dairy herds? Has your father's herd had the test? If so, how often is the test applied? With what results? Have you any cows with a cough? With coats that look rough and dead? Are any of your cows losing in flesh or amount of milk without seeming cause? Have any of them lumps in their udders? All these things are symptoms of tuberculosis.

5. Write a discussion on how to improve dairy conditions and profits in your region.

6. Show how to keep a book account with the dairy and cattle interests of the farm.

7. Indicate on the map of the United States the dairy and beef producing sections. Consult the last census report and insert in each state the amount of beef and dairy production.

8. *Beef Breeds*

Larger profit can be secured from dairy than from beef cattle with the same amount of feed, but dairy animals require a much greater amount of labor and a more costly equipment. The work necessary to care for fifteen or twenty dairy cows will be sufficient to tend two hundred

Auchenbrain Brown Kate 4th, Ayrshire cow with a 365-day butter-fat record of 917.6 pounds.

beef animals. Properly managed, the raising and feeding of cattle for beef from home-grown feed can be made highly profitable.

The beef-producing type.—Beef and dairy cattle differ widely in their type. For the production of beef, the animal must be able to use a large proportion of its food in the putting on of flesh; it must also have a form capable of holding a large amount of muscle and fat.

The beef animal should have a conformation that (1) favors the production and carrying of flesh; (2) supplies the best proportion of good cuts of meat on the block; (3) indicates good constitution and feeding capacity.

The form of beef animals.—Instead of the wedge conformation of the dairy cow, beef cattle should in their shape present a series of *rectangles;* that is, they should be "blocky." The body is reasonably long, and deep, with short sturdy legs. The whole form presents a plump, full-shaped appearance. The back is broad and straight, with ribs well arched to give breadth to the body. The quarters are well filled and thick. The skin is pliable, rather thick, and the coat smooth and glossy.

Judging beef cattle with the score-card.—Because of the difference in type between dairy and beef cattle, it is best to use separate score-cards in judging them. Secure a score-card from your state college of agriculture or the United States Department of Agriculture. After studying it and judging one or more animals under the direction of the teacher, each member of the class should judge several beef animals from the home herd, asking his father to help in the judging.

Beef breeds.—Among the chief breeds of beef cattle in the United States are Shorthorns, or Durhams, Herefords, Aberdeen-Angus, and Galloways. Several different breeds have also developed a polled, or hornless type. Except for the lack of horns, the polled breeds closely resemble the parent breed from which they were derived.

Feeding beef cattle.—Feeding grain and roughage to beef cattle is a more profitable way to market them than to sell them off the farm. In this way the fertility of the soil is also conserved, and better crops produced.

The fattening ration for cattle is slightly different from the dairy ration, the *nutrient ratio* for beef being 1:7 as against 1:6 for milk production. That is to say, that the fattening animal should have a balanced ration consisting of one part protein food for every seven parts of carbohydrates and fats.

9. *Diseases of Cattle*

Tuberculosis is a common disease among cattle. It is more common among dairy cattle than beef cattle. This is probably because dairy cows are kept to a greater age than beef cattle, and are more closely confined in barns. The effects of tuberculosis in a dairy herd are (1) lowered milk production and final loss of the tuberculous animal by death, and (2) danger of giving the disease to people, especially children who use the milk.

Prevalence of tuberculosis in herds.—There is no way of telling the exact number of cattle affected by tuberculosis, as comparatively few herds are examined for the disease. It is not uncommon to find as high as seventy to eighty per cent. of the cows in a herd diseased, some with the disease just starting, others with it well along, and still others in the last stages. Since tuberculosis is contagious, it is evident that when it once gets started in a herd it is hard to stamp out.

The tuberculin test.—It is impossible to make certain of the presence or absence of tuberculosis in a herd by any set of symptoms. The only sure way is by the *tuberculin test.* This test is required by law of all dairy herds in many of the states. Experts have shown that tuberculin, if properly used, will reveal the presence of tuberculosis in at least ninety-eight per cent. of the cases.

Tuberculin is a fluid in which tubercle germs have been grown, but from which they have all been removed. This fluid is injected with a hypodermic needle under the skin of all the animals of a herd which is being tested. It will not injure well animals nor give them the disease. Animals that have tuberculosis reveal this fact by a feverish condition which arises from eight to twelve hours after the tuberculin is administered. Well animals show no such reaction.

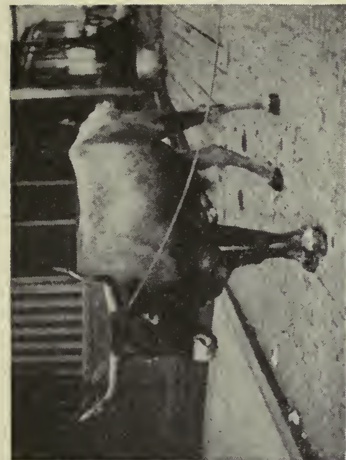
Suppressing tuberculosis in cattle.—Little can be done in the way of treatment to cure tuberculosis in cattle. Those that have contracted it in a mild form often recover. Animals found to be well advanced with the disease should at once be slaughtered. All diseased stock should be separated from well animals, and kept in different barns and pastures.

The milk from mildly diseased cows may be used, providing it is first carefully *pasteurized*. To pasteurize milk, it is kept at a temperature of one hundred and forty-nine degrees for twenty minutes, or one hundred and seventy-six degrees for five minutes. This heating is sufficient to kill the germs of the tuberculosis.

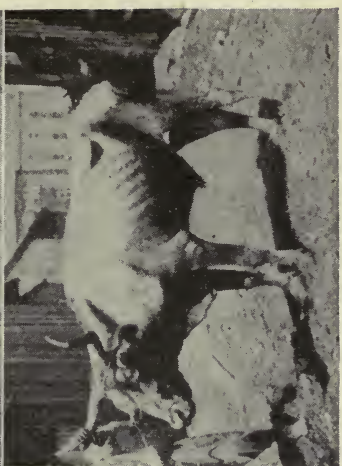
10. *Texas, or Tick, Fever*

A troublesome cattle disease common throughout the southern states is *tick fever,* sometimes called Texas fever. The disease is caused by a small animal parasite carried to the affected animals by a small tick. The parasite works in the blood of the animal, causing a high fever.

Loss from the Texas fever ticks.—Not only does the tick carry to the animal on which it lives the parasite that causes serious disease, but it lives off the blood of its host, decreases its vitality, and reduces the amount of milk or beef produced. It is estimated that the annual loss to the South from this one species alone has amounted to more than forty million dollars.



Same steer free of ticks.



Tick infested steer.

Dipping cattle to eradicate tick.

Cattle tick.

Freeing cattle of ticks.—Treatment of animals sick with tick fever is usually not satisfactory. The remedy lies in prevention, which means getting rid of the ticks. Several methods are used for freeing cattle of ticks: (1) The ticks are picked off by hand, or scraped off several times until the animals are free from the pests. (2) The cattle are sprayed or rubbed with cottonseed oil, fish oil, or a mixture of kerosene and oil. (3) A dipping vat is used containing a carefully prepared disinfecting solution. Care must be exercised not to pasture cattle on land infested with ticks.

Foot-and-mouth disease.—This is a highly contagious disease greatly dreaded by farmers. It attacks not only cattle, but hogs, sheep, horses, dogs, cats and poultry. Human beings may also take the disease, especially children who drink the milk of diseased cows. Men who take care of diseased stock have occasionally become affected.

The first symptoms in animals of the foot-and-mouth disease are loss of appetite, and chills followed by fever. In a day or two eruptions the size of a pea make their appearance over the linings of the mouth and tongue; these small vesicles contain a yellowish watery liquid. The feet become swollen, sore and inflamed. Eruptions may then appear around the feet, and on other parts of the body.

Foot-and-mouth disease is not always fatal, but the effects in loss of milk, the stoppage of growth and interference with fattening for beef are so serious that the most stringent efforts are made to check the disease wherever it makes its appearance. Affected herds are often slaughtered under the direction of government officials, and the carcasses burned or buried. Rigid quarantines are established, and no live stock, meat, hides or other animal products capable of transmitting the disease are allowed to be shipped from the territory affected. In 1914 and 1915 fifteen states, including many dairy herds of large cities, were quarantined in whole or in part because of the foot-and-mouth disease.

To prevent contagion, there should be absolutely no passing between diseased herds and other territory. Visitors should stay away from affected farms; dogs and cats should not be allowed to roam about; even birds such as have the habit of alighting in barnyards may carry the germs. The pasteurizing of milk renders it less dangerous, and this precaution should never be neglected at times and places where the foot-and-mouth disease prevails.

11. *Demonstrations, Related to Cattle*

1. Demonstrate how to make a butter-fat test with a milk-testing machine.
2. Show by the use of the blackboard or chart a good and a poor dairy type of cow.
3. Show by drawing or chart a good type of beef cattle. Diagram the beef unit so as to show the various grades and cuts of meat.
4. Show how to keep a record of the Babcock test of butter-fat for five cows.
5. Demonstrate how to cool milk and cream.

Other demonstrations can be carried on in connection with the cattle industry, such as butter making, cheese making, showing the use of milk in various kinds of food, pasteurizing milk, cleaning cows, mixing various types of feed and making tuberculin tests.

12. *Cattle Play Contests*

1. Cattle judging contest.
2. Breed naming contest.
3. Record keeping contest.

4. Milking contest.

5. Story writing contest on "Origin and History of Cattle" and other subjects.

13. *Cattle Club Projects*

There are three very practical and interesting club projects possible in connection with this subject. The first and most important perhaps is the dairy club, where club members agree to test for butter-fat a certain number of dairy cows or the entire herd on their father's farms. The basis of award may be as follows:

1.	Number of cows tested	30
2.	Records and helpful deductions	30
3.	Skill in making test, shown in demonstration	20
4.	Essay "How To Make the Test, Its Importance to Dairy Farmers"	20
	Total score	100

The baby beef club project.—The object of this project is to encourage the production of beef cattle and to teach the proper methods of management and feeding of beef stock so as to secure the maximum returns for money, time and energy expended. The baby beef club member should be required to take a calf at a certain age, a yearling, or two-year-old, and care for it, keeping a record of all expenditures, daily rations, and cost of feed for six months or a year, with a view to showing maximum results from the management for the beef market. It is advisable as far as possible to have members grow their own feed, or at least a part of it, and to keep an accurate account of the cost of production of this feed as applied to the baby beef club project work. The basis of award may be as follows:

1.	Condition of beef at end of period, judged by score-card of beef standard cattle	30
2.	Net profit and cost of production	30
3.	Records and story on the club project	20
4.	Selection of breed for beef purposes	20
	Total score	100

Dairy record club project.—The object of this club project is first to teach methods of keeping accurate records of cost of management, feed, pastures, and milk production for each individual cow in the dairy herd, and through these records in connection with the butter-fat test to show the difference between a profitable dairy cow and a "boarder."

It is possible to combine the dairy herd club project with the butter-fat testing project. The basis of award in this particular record keeping club project may be:

1.	Number of cows of which complete records were kept	30
2.	Condition of records, neatness, accuracy, etc.	30
3.	Conclusions and valuable recommendations	20
4.	Oral or written discussion of "How I Kept My Records and Importance of Such Records"	20
	Total score	100

CHAPTER XXVI

HORSES

MORE than twenty million horses are to be found on the farms of the United States. These horses on the farms alone are worth the enormous sum of two and a quarter billion dollars, or more than all our cattle, both dairy and beef. The raising of horses is therefore one of the leading industries connected with agriculture.

1. *The Leading Horse Raising States*

Slightly more than fifty-two per cent. of all the horses found on the farms of this country are raised in the following ten states: Iowa, Illinois, Texas, Kansas, Missouri, Nebraska, Ohio, Indiana, Minnesota and Oklahoma. The farms of Iowa and Illinois support approximately one and one-half million horses for each state; Texas, Kansas, Missouri and Nebraska have more than a million each, and Ohio, Indiana, Minnesota and Oklahoma, more than three-fourths of a million each.

Proportion supplied by each state.—The proportion of all the horses found on our farms which is supplied by each of these ten leading horse states is shown in the following chart:

Iowa	7.05%
Illinois	7.0%
Texas	5.5%
Kansas	5.0%
Missouri	5.0%
Nebraska	5.0%
Ohio	4.4%
Indiana	4.2%
Minnesota	4.1%
Oklahoma	3.7%

Horses are adapted to a wide range of climates, and can be successfully produced in every state. The market for horses is good and, under skilful management, they can be be raised with profit on almost all farms.

1. Make a list of all the horses on your farm, and have your father help you estimate the value of each. Now compare the value of your horses with the value of your cattle; your hogs; your sheep.

2. After each member of the class has made the computation asked in No. 1, put all the results together and make similar comparisons for the value of different farm stock for all farms represented. Compare the relative values of horses, cattle and hogs for your region with the relative values of these animals for the entire country, taking the necessary figures from the respective chapters of this book.

2. *Classes of Horses*

Class and grade.—Regardless of breed, horses are classed in the markets according to the uses to which they are suited. The different classes are: *draft* horses, *chunks, wagon* horses, *carriage* horses, *road* horses, *saddle* horses and *ponies*. Animals are graded within each class as *choice, good, medium, common* and *inferior*. The class to which a horse belongs depends on (1) weight, (2) height, and (3) conformation, or build, and (4) quality.

Draft horses.—To be in the draft class a horse in good flesh must weigh from one thousand six hundred pounds to more than a ton. The height ranges from 15-2 to 17-3 hands. The form of draft horses is broad, compact and rugged, with legs short as compared with the depth of the body. This build brings the weight close to the ground, where it can exert the greatest power in drawing a load. Draft horses are used largely for city teaming, for logging and the like.

Chunks.—The form of this class of horses is indicated by their name. Chunks are heavy-set, short legged, compactly built horses, of lighter weight than draft horses. Their weight varies from eight hundred pounds among the lightest of the southern chunks to one thousand five hundred and fifty pounds in the North and East. The height is from

A pair of draft horses.

15 to 15-3 hands. The typical farm horse belongs to the chunk class.

Wagon horses.—Wagon horses are required to combine weight with action and endurance. City delivery and express, fire and artillery horses are selected from this class. They must have sound feet; strong clean legs; broad deep chests; and show good constitution and quality. Their weight is from one thousand and fifty pounds to one thou-

A fine type of draft horse.

A good pair of chunks, and their offspring by pure-bred sires.

sand seven hundred pounds; and their height from 15 to 17-2 hands.

Carriage horses.—The carriage, or heavy harness, class are required to have good action, a fair amount of speed, and to be of an elegant form and carriage. The head should be small, and well-set, on a long arching neck. The body should be smooth and rounded, the back short and well coupled, with a long level croup, and the

A good team of heavy carriage horses, showing fine character and action.

hindquarters strong and well developed. The height ranges from 14-1 to 16-2 hands, and the weight from nine hundred pounds to one thousand two hundred and fifty pounds. The carriage class supply the coach, park and cab horses.

Road horses.—Road or light harness horses are lighter in build, more angular in form, and possess better action than the carriage class. They must have good speed, life and quality. They are used for light and fancy driving, and for racing. Their weight is from nine hundred to one thousand one hundred and fifty pounds, and their height from 14-3 to 16 hands.

Saddle horses.—Saddle horses are built for ease of action, strength and sureness of foot. They are also required to have mettle, coupled with a good disposition and intelligence. The withers are high and thin, and the shoulders oblique. The back must be short, well muscled, and strongly coupled, and the gait easy. The height runs from fourteen hands for polo ponies to sixteen hands for hunters or cavalry horses. The weight may vary from eight hundred and fifty to twelve hundred and fifty pounds.

Ponies.—Ponies are chiefly used for children, and must therefore first of all have good dispositions. To be in the pony class, the height must be under fourteen hands. The body is deep and well rounded, the legs and neck are short, the croup is level, and the quarters are strong and well developed.

These different classes of horses often merge into one another so that it is difficult to tell in which of two classes a certain animal belongs. For market purposes it pays to breed for well marked classes, as these always bring higher prices than mixed stock.

1. Study each horse on your home farm, and decide the *class* to which it belongs. If the type is not clearly marked in any case, decide what two classes it resembles.

2. Also *grade* each horse as choice, good, medium, common, or inferior in its class. Remember that to be "choice" the animal must be entirely sound, in good condition, and possess in the highest degree the ideal qualities of its class. The "inferior" grade is the very worst of its class. The other grades lie in between these two extremes.

3. *Breeds of Horses*

While the breed to which a horse belongs has little bearing on its market value if the *class* marks are strong and the *grade* high, yet the only way to secure class and grade is by pure breeding. Millions of dollars are being lost by American farmers every year through the breeding of grade or scrub horses.

The value of breeding.—An excellent illustration of the difference in market value between pure-bred and grade-bred horses is shown in the case of Wisconsin horses (Bul. 186, Wis. Ag. Exp. Sta.):

	Average value of horses by ages				
	4 to 6 months	1 year	2 years	3 years	4 years
From pure-bred sires	$78.77	$132.84	$196.84	$218.00	$303.00
From grade sires	51.25	85.00	127.50	156.45	200.20
Difference in favor of pure-bred sires	27.52	47.84	59.34	61.55	102.80

This table is very convincing when it is remembered that it costs no more in care and feed to raise a well-bred horse than a scrub. The farmer who uses only pure-bred sires for his breeding will get almost fifty dollars more for his colts as yearlings than if he uses grade sires, while if he does not sell until the colt has reached maturity he will receive at least one hundred dollars more. If pure-bred dams are also used, the difference will be greater still. Will it not pay well to "breed up" our horses?

Draft breeds.—The chief breeds of draft horses in the United States have been imported from Europe. The favorite of these is the *Percheron*, which comes from France. The Percherons have good spirit, are strong-boned, and have sound feet. They show good action, have a high degree of intelligence, and respond well to training.

The *Clydesdales* come from Scotland. They are longer in build than Percherons, have smaller bodies, and less rugged constitutions. They are strongly marked by a heavy growth of hair on the lower part of the leg, especially at the fetlock. For use in wet and muddy times this excess of hair is a disadvantage, since it is hard to keep dry and clean.

The *Belgians* come to us from Belgium, and the *English Shires* from England. Both are excellent breeds, though

A good saddle horse.

they have not yet come into the favor enjoyed by the Percherons, or even the Clydesdales.

It is chiefly from the heavier breeds that come all our draft horses, chunks, wagon horses, carriage, or heavy harness horses. A comparatively small proportion of horses in any of these classes is as yet pure bred, most of them being a cross with grade or common stock.

The lighter breeds.—Relatively few farmers have undertaken the raising of the lighter and speedier breeds of horses. This has been left to special breeders and stock farms that make a specialty of horses. The heavier breeds are better adapted to the farm, since the dams can then be

Typical of the American trotter breed.

used for general farm work, and thus serve a double purpose and thereby add to the profit.

Among the lighter breeds raised in this country, the English *Hackney*, the French *Coach*, and the German *Coach* are the favorites for the carriage class. For lighter road use the breeds most favored are the *American Trotter,* the *American Saddle* horse and the *English Thoroughbred.*

4. *Judging Horses*

The horse is to many people the most interesting animal on the farm. The satisfaction and profit from horse raising depend very largely on the breed, class and grade. For these reasons all who are interested in farm animals should learn to judge horses readily and accurately.

The score-card.—Before undertaking to use the score-card in actual judging, the pupil must become thoroughly familiar with all its points, understanding fully the requirements for a perfect score under any point. With this ideal in mind, the animal is to be examined, and the score put down on the card. Do not be afraid to mark off for all bad points. It takes a good animal to grade eighty per cent. when marked by a trained judge, and an exceptional one to grade ninety per cent. Judges do not usually mark closer than one-fourth per cent. on any point.

5. *Common Defects and Unsoundness in Horses*

Any defect or unsoundness lowers the value of a horse. All who have to do with horses should be able to identify the more common faults, and know their causes. (See *Purdue Circular,* No. 29.)

Defects of head, eyes and ears—

1. Poll evil; sore on top of head, caused by bruises.
2. Blindness; either with or without defects of eyeball.
3. "Blue-eyed"; a peculiar bluish color, may indicate blindness.
4. Over-mobile ears; showing viciousness or blindness.
5. Immobile ears; showing deafness or lockjaw.

Defects of the mouth—

1. Nose discharge; indicating catarrh, glanders, diseased molars.
2. Bit sores, showing tender mouth, or abuse.
3. Diseased molars; affect health and interfere with eating.
4. "Parrot" mouth; upper jaw too long, front teeth project over lower.
5. Undershot jaw; lower jaw short; front teeth do not meet.
6. Clipped tongue; tip cut off to prevent lolling.

Defects of neck, withers and shoulders—

1. Neck sores; caused by collar wear on top of neck.
2. Fistula; running sore on withers on shoulders.
3. Collar sores and boils; dirty and ill-fitting collars.

Defects of feet and legs—

1. Shoe boil; sore at elbow from injury by shoe while lying down; also sore from harness band.
2. Splint; (desoribe.)
3. Broken knee; bent backward from injury.
4. Buck knee; bent forward from stiffening of tendons.
5. Capped knee; (what is meant?)
6. Greased heel; sores which refuse to heal.
7. Scratches; sores under fetlocks from filth or dampness.
8. Windgalls; puffs around fetlock joint from hard driving or standing on hard floors.
9. Cocked ankles; ankles bent forward from misuse.
10. Navicular disease; contracted foot, favored in action.
11. Toe cracks; transverse checks across the hoof.
12. Quarter racks; split in hoof extending up to heel.
13. Corns; (what? where?) (describe cause.)
14. Thrush; usually caused from standing in damp, filthy stalls.
15. Knocked-down hip; one hip lower than the other from blow.
16. Spavin; either bog, or bone, indicating sprain or injury.
17. Thorough-pin; (describe cause.)
18. Curb; enlargement at back of hock from sprain.

General defects—

1. St. Vitus's Dance; twitching of muscles.
2. Crampness; tendency for muscles to cramp.
3. Springhalt; one or both hind feet lifted too high.

4. Roaring; a wheezing, roaring sound in breathing; from bad wind.
5. Heaves; spasmodic breathing.

Vices—

1. Cribbing; habit of biting mangers, posts, etc., caused by teeth trouble.
2. Windsucking; habit of biting, and at the same time sucking in air.
3. Halter pulling; habit of pulling back when tied.
4. Biting; vicious tendency to bite people or other horses.
5. Balking; refusing to move when commanded.
6. Rolling in stall; likely to become "cast" and cause injury.
7. Kicking; showing vicious temper.
8. Striking; with front feet to injure attendant.

6. *The Care of Horses*

The horse is the most intelligent and companionable of the farm animals. It quickly shows the effects of ill treatment or lack of care and, on the other hand, easily responds to training and good usage.

Unsoundness due to ill usage.—Not a few of the defects common to horses should be blamed to their owners or users. For example, *poll evil* is frequently caused by striking the head against a door or stall beam that is too low. *Bit sores* indicate either a careless or a cruel driver, or a bit unsuited to the horse on which it is used. *Neck* and *shoulder* sores seldom occur if the collar is a good fit, and if kept clean. *Fistula* on withers on shoulders comes from collar bruises. *Sweeny* is the result of a wrench or strain, often due to ill-fitting collars.

In similar way, *splints, spavins, curbs, thorough-pins* and other injuries to the legs are often caused by excessive driving or pulling, especially of young horses. Misshapen knees and ankles are an evidence of hard usage. *Greased heel,* *thrush* and *scratches* come from damp and filthy stalls. *Roaring* is the result of driving until the wind is "broken"; *heaves* usually come from eating dusty feed; *cribbing* is a sign of the neglect of teeth that need attention.

The effect of training.—The vices which reduce the

A typical Percheron.

value of many horses and make them unpleasant to handle are usually due more to training than disposition. *Halter pulling* commonly begins in the colt being frightened and made to break loose when tied, or else being tied with an old and easily broken halter that encourages pulling on it. *Balking* often indicates lack of intelligence and patience on the part of the trainer fully as much as stubbornness on the part of the horse. *Biting* may be started by teasing; and *kicking* often has its beginning in fright from something loose about the harness or vehicle before the colt is well broken.

Treatment of horses.—The horse should be treated with kindness and firmness. The driver who strikes or jerks because of his anger or petulance deserves the contempt of all lovers of animal life, and should not be entrusted with horses. One who will work a team in the heat and dust and then allow them to stand over night without cleaning shows either lack of intelligence about horses or cruelty. To drive a team until they are sweaty and then allow them to stand in a cold wind unblanketed reveals not only heartlessness but bad business management.

The horse can not be taught like a person. Therefore, only one single word of command should ever be used for the same act. *Whoa* should always mean an immediate and dead stop; *back* should mean to step backward, and not merely to stop. Some *one* signal alone should be used to start, and the horse never allowed to start without this signal. Care in such simple points as these would result in much better broken and safer horses.

7. *Feeding Horses*

The feeding of farm work horses is a different problem from the feeding of most other farm stock. This is because the horse is fed for *work,* while other animals are fed for meat, milk, eggs and so on.

The ration for horses.—The ordinary farm ration for working horses is some form of hay for roughage, and one or more cereals, such as oats or corn. The particular kind of hay fed is not important, so that it is in good condition and free from dust. If dusty hay must be used, it should be sprinkled with water as it is fed. Horses seem to find timothy hay more palatable than most other kinds, but red clover, alfalfa, meadow fescue and other grasses have been found satisfactory. It is thought that less grain is necessary to keep up the weight of horses at hard work when alfalfa is fed instead of some other hay.

Grain ration for farm horses.—Oats are the choice of the cereals for horses wherever they are obtainable. They are relished better than most grains, and seem especially suited to the horse as a nutrient. Horses fed on oats also seem to show better mettle than those fed on other grains.

In the corn producing region corn is usually a more economical feed for horses than oats, and has therefore come into quite general use as a part of the ration. Corn and alfalfa hay make a satisfactory ration, at least for a limited time, and are cheaper than oats and timothy hay. A very satisfactory and rather heavy daily ration for a horse weighing from one thousand two hundred to one thousand three hundred pounds, and employed at general farm labor is:

7½ pounds of whole corn.
7½ pounds of whole oats.
1 pound of oil meal.
3 pounds of wheat bran.
7½ pounds of timothy hay.
7½ pounds of clover hay.

Other rations that have been proved satisfactory by experiment are as follows:

1. Corn, 6 pounds; gluten feed, 6 pounds; bran, 2 pounds; timothy hay, 10 pounds.
2. Corn, 8 pounds; bran, 7 pounds; timothy hay, 10 pounds.
3. Oats, 6 pounds; corn, 4 pounds; bran, 2 pounds; hay, 12 pounds.

These rations are the amount that should be fed daily to a horse at regular work and weighing from one thousand two hundred to one thousand three hundred pounds when at work. Larger horses should receive more, and smaller horses less, according to weight. It is also to be noted that some horses require more feed than others of the same weight.

A horse market, showing a type of horse for which there is a great demand.

How to feed.—For horses with good teeth it is not essential whether the grain is ground or fed whole, except that the same amount will yield somewhat more nourishment if ground. This difference may sometimes be as much as one per cent. in favor of ground feed. On days when work horses are allowed to stand idle the amount of grain should be reduced about one-half. If the idleness continues beyond three or four days, the amount of grain may gradually be increased, but should not reach the full work ration.

Most of the hay should be fed at night and in the morning, as there is not enough time at noon to secure the necessary nourishment from roughage. The noon feed of grain may be slightly heavier than that for night or morning. About twice as long is required for horses to eat ground grain fed dry as when it is dampened.

Watering horses.—Much difference of opinion exists concerning the best time for watering horses, some preferring to water before feeding, and others after. Careful experiments have shown that the time of watering is not highly important. If horses come from the field thirsty, it is reasonable to suppose that they will relish their meal better if they have had a drink. If the feed consists largely of dry roughage it also seems best to water before feeding. Whatever system is adopted should be followed *regularly*, as changing about often injures the appetite or produces some other derangement. Horses should never be given a large amount of water when highly heated from working or driving.

Topics for Investigation

1. What breeds of horses are favored in your region? Let each student find out just what breeds are represented in the horses on his home farm, with the percentage of pure-bred blood in each animal. Sum up the results for the entire district.

2. If it costs fifteen dollars more to sire from pure-bred than grade horses, what would be the net gain by using pure-bred rather than grade sires in raising for market two teams and selling them at four years of age on the basis shown in the table on page 382.

3. After studying the score-card for judging draft

horses and judging one or more animals under the direction of the teacher, judge independently at least two other horses, having your work tested and criticized by the teacher or other competent judge.

4. Master thoroughly the list of defects common to horses, and then watch for an example of each on different animals until you have learned to identify any unsoundness at sight. Examine carefully each horse at your home for unsoundness.

5. Write a detailed account of the care that should be given a working team each day, including stall, feeding, watering, cleaning, blanketing, and so on.

6. Weigh the ordinary daily ration or feed given to one of your working horses and compare with the rations suggested on page 390. At current prices, just what does it cost a day to feed one of your work horses?

7. Show how to keep a bookkeeping record of the cost of keeping, feeding, and use of a team of heavy draft horses for farm purposes, covering a period of six months through the working season.

8. Show upon the map of the United States the approximate number of horses in each state. Secure records from the last census report on horses. Where were the wild horses originally found? Where are horses now raised extensively on farms and ranges?

8. *Demonstrations With Horses*

1. Demonstrate how to halter-break a colt.

2. The proper method of judging a horse.

3. Show how to handle a buggy horse; harness, hitch and start.

4. Demonstrate the proper method of mounting a saddle horse, with and without the saddle.

5. The proper method of currying a horse, training the mane, and tying up the tail for muddy roads.

6. Demonstrate miscellaneous interests in horsemanship. In this particular case contestants may be allowed

to bring their own horses and demonstrate values and tricks such as prompt obedience to master's command, and peculiar and valuable traits of their animals.

7. Demonstrate the practical rope knots and splicings of especial value in the handling of horses, such as the halter-hitch, clove-hitch, slipknot and timber-hitch. (See pages 491-497.)

8. Demonstrate how to harness and hitch a team to a double wagon.

All of the above demonstrations should not only show skill, accuracy and speed, but kindness in the handling of the horses.

9. *The Play Contests With Horses*

1. Horse mounting contest, judged by skill, largest number of mountings in five minutes and showing of kindness to animal in mounting.

2. Horse judging contest, driving contest in single, double, or four-horse team.

3. Oral story, giving the life history of the horse.

4. Essay writing contest on the subject: "The Horse and Its Relation to Agriculture."

5. Recipe and remedy giving contest, showing the proper methods of treatment for unsoundness, defects, blemishes and vices of the horse.

6. Oral or written contest in giving description of defects and blemishes and statement as to causes.

10. *Colt Club Project*

The object of organizing a colt club is to get boys and girls interested in the raising and proper management of colts as an economic factor on the farm. The work should cover a period of from nine to twelve months in the management, feeding and keeping of records of a colt. The basis of award may be as follows:

1.	Management shown by training of colt	25
2.	The cost of keeping	25
3.	Condition of the colt at end of period	25
4.	Story of "My Year's Work with the Colt"	25
	Total score	100

CHAPTER XXVII

SWINE

HOGS outrank every other farm animal in number in the United States, and are exceeded in value only by horses and cattle. There are more than sixty million hogs on our farms, or nearly two porkers for every three of the population. The aggregate market value of swine is about two-thirds that of dairy cattle, and not far from equal to the value of beef cattle. American farmers own more than six hundred million dollars' worth of hogs.

1. *The Pork Producing Region*

A large proportion of our hogs is produced in the states forming the corn belt. This is natural, since corn is one of the cheapest and best grains for raising pork. Many other regions can grow hogs as successfully as the corn states, however, and the industry is spreading.

Hogs in the South.—Southern farmers have not yet entered very largely upon the raising of hogs, though they can be produced as cheaply in the South as in the North. The southern people consume more meat per capita than the people of any other section. Millions of pounds of fresh meats are annually shipped to southern markets from northern and western farms. This means a double loss to the South. For money is paid out for what could well be raised at home, and a most profitable industry is thus neglected on the southern farms.

The leading states in hog production.—Sixty per cent. of all our pork is raised in ten states. In the order of their importance in pork production these states are: Iowa, Illinois, Missouri, Nebraska, Indiana, Ohio, Kansas, Texas, Wisconsin, Georgia. The percentage that each of these states supply of all hogs produced in the United States is shown in the following chart:

Iowa	13.4%
Illinois	7.5%
Missouri	6.7%
Nebraska	6.2%
Indiana	6.1%
Ohio	5.2%
Kansas	4.3%
Texas	4.1%
Wisconsin	3.3%
Georgia	3.1%

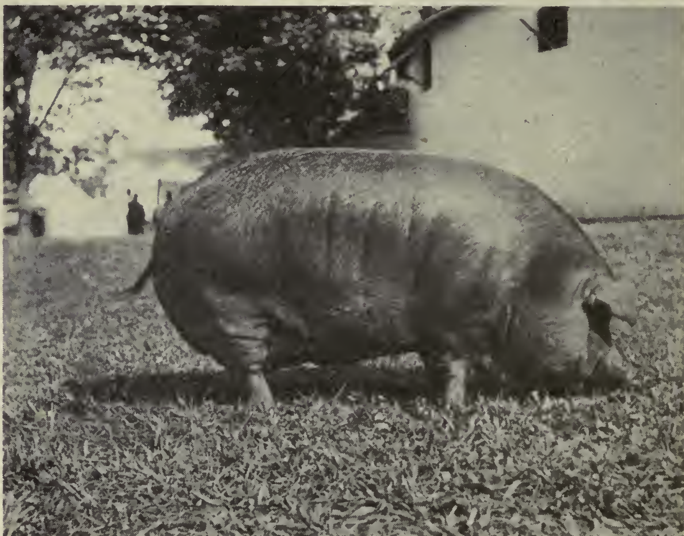
The number of swine in these states runs from about two million in Georgia to nine million in Iowa.

2. *Breeds of Hogs*

Many of our important breeds of cattle and horses originated in Europe, but we have ourselves developed nearly all our chief breeds of hogs. The breeds most favored in the United States are Poland-China, Duroc-Jersey, Chester-White and Berkshire. The Berkshire, the only imported breed, came from England. Other less well-known breeds are the Yorkshire, Cheshire, Suffolk, Hampshire and Essex.

Poland-China.—Poland-China has long been a favorite breed of hogs, especially in the corn states. They are black in color, with irregular white markings on almost every part of the body. The ears are drooping. The Poland-Chinas make a rapid growth, and reach good size. They are rather small of bone, and not so good foragers as some other breeds. Some fault has been found with them for not producing larger litters.

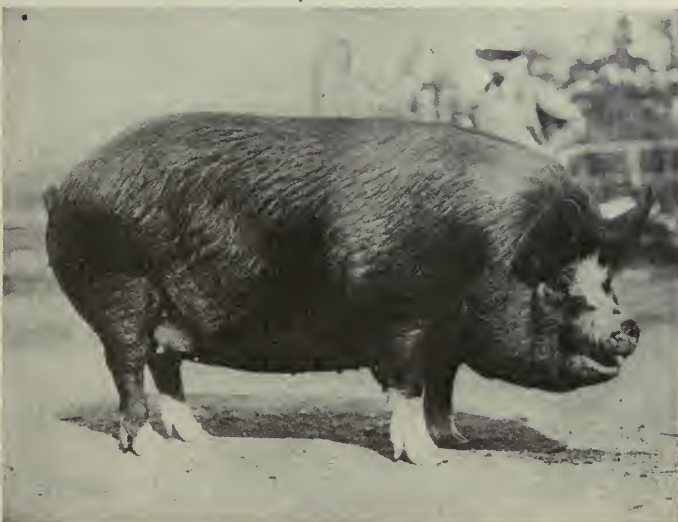
Duroc-Jersey.—The Duroc-Jerseys are easily recognized by their reddish color. They are one of the most prolific and vigorous breeds, somewhat slow in developing, and strong of frame. Their bones are large, and they reach good size and weight. They have large drooping ears, are good foragers, and thrive well on pasturage, or when following a herd of fattening cattle.



A fine Duroc-Jersey sow.

Chester-White.—The Chester-White breed are of large frame, rather slow in maturing, and possess good constitutions. They are white without markings, and have drooping ears. They are raised more in New England than in the corn region.

A Chester-White sow in show condition.



A Berkshire.

Berkshire.—Berkshires resemble the Poland-China breed in color and markings, being black with white markings. They may be distinguished by their erect ears. They have a compact frame, are good feeders, and make a quicker growth than most other breeds. The Berkshire has long been a favorite breed, especially throughout the Middle West and is fast becoming the favorite in the southern states.

3. *The Care of Hogs*

Pigs are generally considered not so cleanly in their habits as some other farm animals. A fact made possible because of neglect of owners. Consequently many farmers think that it does not matter how they are kept. Nothing could be a greater mistake. Hogs thrive only under hygienic conditions of feeding and housing. Millions of dollars are thrown away every year by failure to give hogs the care they require.

Need of good housing.—Hogs are the most poorly housed of our farm animals. Any kind of place is thought good enough for them on many farms. Yet hogs are far more sensitive to cold than horses or cattle, which have thick fur coats to protect them, while the hog has almost none. Hogs lie down more than most animals, and need a better bed. They live close to the ground, and easily breathe in dust and impurities. They need sunshine more than do horses and cattle, yet little is provided for them.

Hogs take cold very easily. Little pigs, especially, need to be kept warm, dry and away from drafts, if they are not to have their growth checked, or even lose their lives by catching cold. Neglect of these simple rules indicates shiftless farming, and causes great loss.

Hog-houses.—Every farm that makes a business of raising pigs will find a well-built hog-house a paying investment. The most economical and convenient hog-house has a row of pens along each side of a central alley which, in larger buildings, should be wide enough to drive through. This allows the hauling in of straw for bedding, and corn or slops for feeding, thereby saving much labor. It also provides for the easy removing of manure.

The separate pens should be from five to eight feet wide, and from eight to twelve feet long, depending on the use to

An excellent type of hog-house with outdoor pens.

be made of them. Pens for brood sows need not be larger than eight by ten feet. If feeding is to be done in the pens they should be larger, or, better still, the partitions should be removable. The floor may be of cement, though for farrowing sows a temporary board floor should be laid over the cement, because of the coldness of a cement floor. Woven wire stretched over the top of the ground to prevent rooting is sometimes used as a floor. Such a floor, however, is likely to be either dusty or wet. Board floors are expensive and drafty if built above ground. They also harbor rats, which not infrequently kill young pigs. A double trough may supply each pair of pens. Young pigs should have their own troughs outside the main pens.

Lighting and ventilating hog-houses.—It is not uncommon to find hog-houses that cost several thousand dollars built almost without windows or other means of admitting light, air and sunshine. Other houses are built with windows in unfavorable positions, so that the sunlight can not fall on the floor of the pens where it is needed by the pigs.

The hog-house should run east and west, so that it may have one full side exposed to the sun. This arrangement will necessitate having one row of pens along the north side. In order to get sunlight into the north pens, the "broken roof" style of building is used. Care must be taken to place both upper and lower windows at such a height that the sunlight will reach the floor during the winter and early spring months, or during the farrowing season.

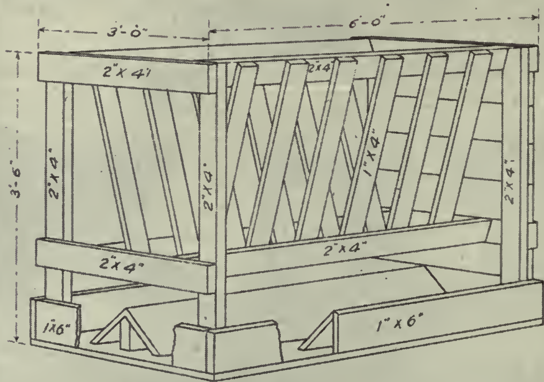
To do this, the angle of the sun, say in February and March, and the width of the building must be carefully computed. At the latitude of southern Iowa, or central Illinois, Indiana, Ohio and Nebraska, the tops of the upper windows of a hog-house twenty feet wide should be ten and one-half feet from the ground. The windows should be placed higher in southern and lower in northern states. If the north pens are eight feet long, and the alley is four feet wide, the sunshine will just reach the back line of the pens at ten o'clock and at two o'clock on the first of March. Care to such details will save the lives of many young pigs farrowed in the northern states during early spring.

Individual hog cots.—Many hog raisers are now providing two types of hog-houses, the large permanent house for farrowing purposes, and the small individual cot for the sows and their litters as soon as the pigs are old enough to be put out-of-doors. The individual cots may be scattered about the lot or pasture, and moved as often as necessary to keep the quarters clean. For winter service the cots can be collected side by side in a sheltered place, banked and used for sleeping quarters.

Individual hog cot, on runners, so that it can be drawn from place to place.

The feeding floor.—The use of a sanitary feeding floor should be much more common than it is. It is a great waste of grain to scatter it in the mud or dust of a dirt yard. This mode of feeding is also injurious to the health of the pigs, for it compels them to breathe in a great amount of dust and to eat impurities in order to get the grain. The effect is seen in such diseases as "thumps" and "wheezes," and in the greater liability to colds, tuberculosis and other troubles.

The best feeding floor is made of concrete, slightly raised above the level of the ground, if made outside the hog-house, and sloping slightly so that it can easily be washed off.



Rack for Feeding Alfalfa Hay to Hogs.

Such a floor is not expensive, and will pay for itself many times over in the feeding of hogs.

Topics for Investigation

1. Make a census of all the hogs on your home farm, classifying them into the following groups: brood sows,

suckling pigs, young shoats, and fattening hogs. Have your father help you estimate the value of each group, and compute the value of all.

2. What different breeds are represented on your farm? Are the breeds pure or mixed?

3. At what time of the year are the pigs farrowed? At what age are they weaned? At what age is fattening started? Are the young pigs allowed the range of a pasture? If so, what grass is used? What feed is used in addition?

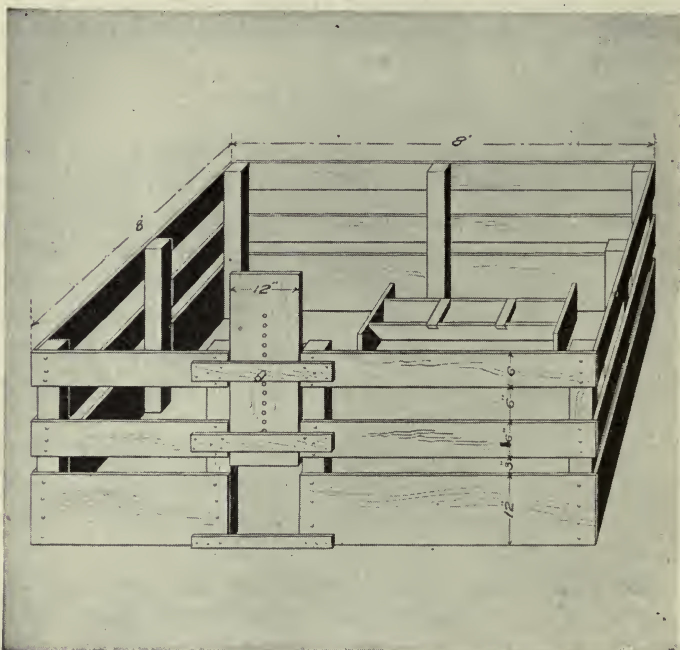
4. *Feeding Hogs*

Hogs are probably the best money makers on the farm, if properly handled. The same amount of feed will produce a greater value of pork than any other meat. The returns also come in sooner than with most other farm animals. Money invested in hogs can be turned rapidly, as pigs are marketable when eight months old. The yearly sales from a herd of hogs should be from two to four times the original investment. Much of the profit depends on intelligent feeding.

The feeding of pigs requires the consideration of three stages in their development, (1) from farrowing to weaning, (2) from weaning to fattening, and (3) fattening for market.

Feeding young pigs.—Little pigs do not need any food other than their mother's milk for the first two or three weeks of their life. When they have reached this age, they will begin to nibble on shelled corn. A little of this should be fed them in a place outside the pen. By the time they are from three to four weeks old, they may be fed a small amount of skim-milk, in which has been mixed a little ground feed, such as shorts. They should have a trough of their own where it can not be reached by the mother.

The amount of mixed feeds and shelled corn given small pigs may be increased till they are ten weeks old, when they should be weaned. When they are deprived of their mother's milk, which up to weaning time supplies the basis of their nourishment, it is very important that they be fed a

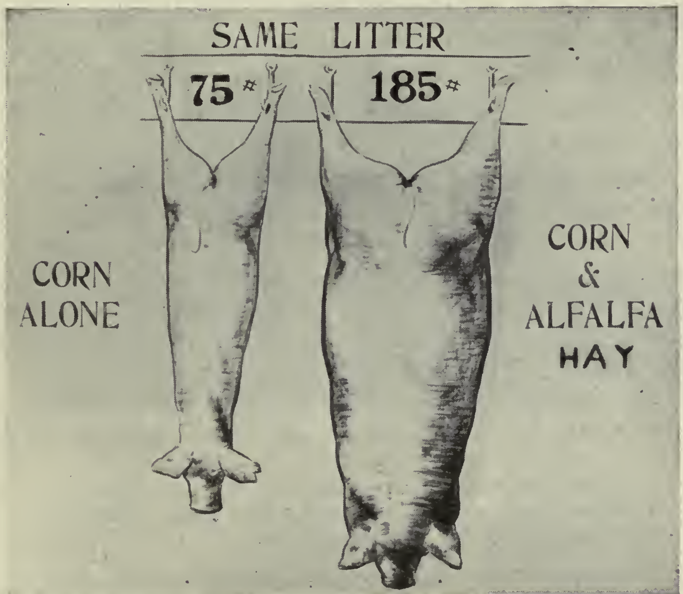


A good type of feeding pen for small pigs.

ration capable of producing the most rapid growth and best health.

Feeding pigs after weaning.—At the time of weaning, the feed should not be greatly changed, except to increase the amount, until the pigs have become accustomed to the loss of the mother's milk. If pasture is available, the quantity of corn may be increased. If the pigs must be kept in a dry lot, a larger proportion of soft feeds should be used.

It is to be remembered that the purpose in feeding pigs from the age of two months up to the age of six or seven months is not to fatten them, but to cause them to grow large frames and develop good constitutions. If they are



fattened too early, it stops their growth, and reduces their vitality, thereby making it unprofitable to continue feeding them up to full maturity.

Pasturage for growing pigs.—Growing hogs, therefore, require muscle and bone making food, instead of a ration that will fatten them. They need exercise to promote their growth, and give them strong vigorous frames for the taking on of fat. For these reasons, pasturage should supply the basis of the young hog's ration. Clover, alfalfa, peas, rape, vetch and other succulent plants are the cheapest and best feeds for the period between weaning and fattening time.

To this green feed will need to be added a certain proportion of corn, or other grain, in order to make a balanced ration. But the poorest and most expensive way to grow pigs is to shut them in a dry lot and feed them a ration of corn alone, as is so often done. The farm lacking in well arranged hog pastures is not ready for the business of making money out of pork.

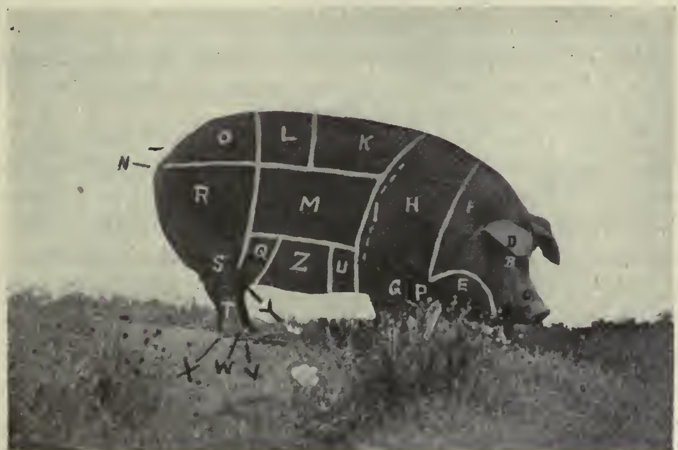
Balanced rations for young hogs.—No matter what other ration may be fed pigs, milk is always desirable. For milk is highly palatable to hogs, and it contains more of the necessary food elements than any other food. The following are suggested as rations suitable for growing hogs that have, in addition, access to good pasturage:

1. Corn, 60%; shorts, 30%; tankage, 10%; or
2. Corn, one-third; wheat, one-third; oats, one-third, ground; or
3. Corn, one-half; shorts, one-half; or
4. Corn, 60%; shorts, 20%; linseed-oil meal, 20%; or
5. Corn, one-third; milk, two-thirds.

It has been shown by careful tests that if pigs must be fed in dry lots, ration one, consisting of corn sixty per cent., shorts thirty per cent. and tankage ten per cent., will produce double the gain that can be secured from corn alone.

Fattening hogs.—Pigs should be ready for fattening by the time they are from six to six and one-half months old. When fattening begins, the ration should have a much larger proportion of corn. In fact, hogs may be profitably fattened on corn by the addition of milk to the ration.

While being fed for fattening, the hog does not require the amount of exercise needed during the growing period. It is not best, however, to shut feeders up in a close pen, for a certain amount of exercise is necessary to keep the hog in a healthy condition and with good appetite.



Parts of a hog.

A. Snout	K. Back	S. Hock
B. Eye	L. Loin	T. Hind leg
C. Face	M. Side	U. Fore flank
D. Ear	N. Tail	V. Foot
E. Jowl	O. Rump	W. Pasterns
F. Neck	P. Breast	X. Dew claw
G. Fore leg	Q. Hind flank	Y. Stifle
H. Shoulder	R. Ham	Z. Belly
I. Chest line		

Snapped corn is preferable to husked ears on account of the greater amount of work demanded of the hog, and the slower eating required. Where the fields can be properly fenced off, the best of all ways to feed corn to hogs is to allow them to do their own harvesting. This method of feeding, called "hogging down" corn, gives the hogs about the right amount of exercise, allows them to eat whenever they desire, and saves the farmer the labor of husking, hauling and feeding. The same amount of corn will also produce more pork.

Topics for Investigation

1. Is attention given on your home farm to feeding hogs a balanced ration? If so, what are the feeds used? What is the ration used for fattening?

2. If, when pigs are allowed to "hog down" corn it takes eight pounds of corn to produce one pound of pork, but requires ten pounds of corn to make a pound of pork when the corn is fed in a pen, what will be the difference in the value of the corn fed twenty hogs while they are making an average gain of seventy-five pounds each, corn being worth fifty-five cents a bushel?

5. *Diseases Affecting Hogs*

Young pigs are not particularly liable to any one disease, but easily fall prey to troubles arising from improper care. Cold, wet, dirty pens cause the death of many new-farrowed pigs. Dusty floors, filthy mud-holes and uncleaned troughs are always harmful. Exposure to extreme cold or to burning heat is sure to tell in loss of health or weight. It is safe to say that half the troubles attacking the younger pigs, at least, could be saved by providing them with more sanitary surroundings.

Thumps.—This is a disease that manifests itself in a spasmodic manner of breathing, which suggests the name. It is usually a digestive trouble caused by over-feeding and lack of exercise. Certain worms may also cause thumps. The best preventive for thumps, especially with young hogs, is plenty of pasture with green feed. The treatment for thumps is to reduce the amount of feed, give a laxative, and make sure that the pigs get exercise.

Scours.—Scours, or too great laxness in the digestive tract, are caused in young pigs by overfeeding, a feverish condition of the mother sow, soured feeds, dirty troughs, or some other unsanitary condition connected with their feeding. The first step in applying a remedy is to find and remove the cause. If the trouble continues, each pig may be given a few drops of laudanum.

Worms.—Worms are a source of great trouble in raising pigs. Through rooting in the dirt, and being fed on dirt floors, young pigs pick up certain kinds of worms which continue to live in their digestive organs. Pigs never thrive when afflicted with worms. The coat shows rough, growth is hindered, the general health affected, and a large proportion of the feed wasted. A simple remedy is to give one teaspoonful of turpentine to sixty or eighty pounds of hog, and repeat the dose in three days. Another remedy is five grains of santonin combined with three grains of calomel for each sixty or eighty pounds of hog. This should be followed by an effective physic. Whatever the remedy employed, the pigs should be starved for twelve hours before being dosed.

Lice.—Many hogs are lousy. The lice can easily be detected by looking between the legs or behind the ears. Hogs suffering with lice will make a slower growth and fatten less easily than clean hogs. So important is this matter that many hog raisers provide as a part of their equipment a *dipping tank,* in which some form of crude oil or coal tar is used as a bath. Where the dipping tank is not available, or in the case of young pigs, the remedy should be sprayed or rubbed on.

Tuberculosis.—Hogs, like various other animals, are subject to tuberculosis. Many hogs have this disease in some form. Its effects are seen in a stoppage of growth, a general run-down appearance, loss of appetite, and in some cases, death. Because hogs are kept so short a time, and tuberculosis is so slow a disease, there is comparatively little loss owing to deaths from tuberculosis. But many animals when slaughtered are found to be unfit for food because of the disease.

Two hogs: one a pure bred, the other a "razor-back." The large one was owned and raised by the club boy, receiving good care and a balanced ration. The small one, owned by a farmer with old notions and habits, had poor care and a narrow ration.

Tuberculosis is caught either from diseased pigs, or from drinking the milk of tubercular cows. It is probable that most of the tuberculosis in swine comes from the latter cause. Many hog raisers now pasteurize the milk before feeding it to the pigs. This is the only sure preventive against tubercular milk.

Hog cholera.—By far the worse disease scourge affecting hogs is cholera. It not infrequently wipes out entire herds within a few weeks. The average yearly loss from hog cholera in Indiana is estimated at three million dollars. In one single "cholera year" one single state lost at least twenty million dollars from this cause. Other states suffer in like proportion. It is, therefore, of the highest importance that the causes of cholera, and the modes of prevention be well understood.

Hog cholera is a germ sickness caught by infection from hogs that have the disease. It is not necessary for well animals to come in direct contact with cholera hogs in order to catch the infection. The germs may be carried by dogs; by pigeons, crows, or other birds that alight in the hog lot to pick up grain; by men who have tramped through a lot where cholera hogs have been; by new stock brought into the herd; and by streams that have become infected. When hog cholera is in the region, therefore, it is necessary to observe every precaution to keep infection away from the herd.

Effects of cholera.—The disease is so marked in its symptoms that it is not hard to distinguish from most other hog sicknesses. In hog cholera, the lymphatic glands, lungs, intestines, kidneys and liver are highly inflamed. Red blotches appear on the skin. Appetite is lost, the gait becomes staggering, the eyes inflamed. Not infrequently bleeding at the nose and vomiting occur. The temperature is usually from one hundred and seven to one hundred and eight degrees Fahrenheit. The first ones of the herd to be stricken commonly die within a few days; those that take the disease later may live for several weeks, or even recover.

Treatment.—No absolute cure has been discovered for hog cholera. Nearly all animals that take the disease usually die. A method of preventing well herds from contracting cholera has, however, been discovered. This is to give well hogs anti-cholera serum; or, in effect, vaccinate them, as is done with people for smallpox and diphtheria.

The hog cholera serum is secured by drawing blood from a hog which has first been rendered immune to cholera, either by having had the disease or being given a special treatment for the purpose of immunizing, and then having had cholera germs injected into his veins. Each animal of

I had serum.

I wish I had.

the herd to be treated is given by hypodermic injection a certain quantity of this serum in proportion to its size.

If the treatment is successful, it will immunize the herd against cholera for several weeks. When the serum is given to well herds, a cholera hog is sometimes brought among them, or its carcass even fed them, at the time the treatment is given. This method is thought to make the immunity more certain.

Success of the serum treatment.—The success of the serum treatment is still questioned by many. It seems reasonably certain, however, that where failure has followed its use, it was because the serum was improperly prepared or not skilfully administered. Various experiment stations have found that there is a loss of only about ten per cent. of the hogs treated in herds already infected, and of only one or two per cent. in well herds where the serum treatment has been carefully used. The manufacture of serum by the state, or official inspection of its manufacture by private plants, will make its use as a cholera preventive still more effective. No one is justified in neglecting to treat his herd with the serum when hog cholera threatens.

Topics for Investigation

1. Have you any hogs that do not seem to be thriving? If so, can you judge what is the matter? Do they cough? Do they lack appetite? Do they look rough coated, and run down? Is it likely that they have tuberculosis? That they have worms? Have they the thumps?

2. Examine several hogs out of your herd for the presence of lice. Are your hogs ever treated for lice? Why is it that lousy hogs never thrive well?

3. Compare all the different types of hog-houses used in your neighborhood. How many are clean, light, well ventilated, and have the windows so placed that the pens receive the sunlight during the spring farrowing season?

4. Discuss the value of the cholera serum as a preventive for hog cholera. How would you proceed to get state and government help for the care of hogs if any of them showed symptoms of hog cholera? What are some of the symptoms?

5. Show how to keep a book account of a pen of pigs, five in number, for a season of six months. The items should include labor costs, feed and equipment.

6. Show upon the map the relative standing of the hog states of the Union. Has there been a falling off or an increase in hog production during the last ten years? Refer to the last census report of the United States Department of Agriculture.

6. *Demonstrations*

1. Demonstrate upon the blackboard or with pasteboard or paper, how to make a hog-house; also a hog pen with feeding floor; then make a miniature outfit for the club festival or school fair.

2. How best to move hogs from place to place. Would you drive, lead, or coax them?

3. Demonstrate by diagram the proper divisions of a hog for the butcher's meat block.

4. Demonstrate the proper method for the vaccination of hogs for hog cholera. (Consult *Farmers' Bulletin* No. 379.)

5. How to make feeding and watering troughs for hog pens, in a simple inexpensive way.

7. *Play Contests*

1. Contest in hog judging.

2. Naming and giving five characteristics of each of the various types or breeds of hogs.

3. Spelling contest, in which words relating to the hog industry are used.

4. Essay writing contest on one or more of the following subjects: "The Origin of the Hog"; "The Care and Feeding of Hogs"; "Treatment for Diseases of Hogs."

5. Drawing contest of hogs, hog pens, equipment, etc.

8. *Pork Production Clubs*

The pork production club work can easily be combined with the corn or grain club. Each member takes pure-bred pigs to raise in connection with the corn or grain crop, keeping, of course, separate records of each interest and charging against the hog at market price all grain or other feed used, from the club acre. Careful records of observation, receipts and expenditures should be kept in connection with the club work and the project should cover nine or twelve months of work.

The basis of award in this particular project may be as follows:

1. The exhibit of the hog and relation to its purpose judged by score-card	25
2. Average gain per day or month	25
3. Net profit, and cost of production	25
4. Records and story on "How I Raised My Hog"	25
Total score	100

Note.—If combining crop production with pork production in the club work, use basis of awards as outlined in crop chapter. Add the two scores and divide by two and you have the average score for the crop and pork production club work.

CHAPTER XXVIII

SHEEP

THE raising of sheep has never received the attention it deserves in most regions. There are at present only a little more than fifty million sheep on the farms of the United States. Almost sixty per cent. of our sheep are found in ten states, seven of which are in the far West, one in the South, and only two in the middle and eastern states. According to their importance in sheep raising, these states are: Montana, Wyoming, Ohio, New Mexico, Idaho, Oregon, California, Michigan, Texas and Utah. Other states having important sheep interests are Missouri, Indiana, Kentucky, Iowa and Illinois.

1. *Importance of Sheep on the Farm*

Sheep could be raised with good profit on thousands of farms where they are now unknown. They are among the most hardy of the domestic animals, and will thrive in almost every part of the country.

Sheep as foragers.—Sheep have no equal among the farm animals as foragers. They will eat a wide range of roughage, much of which is not of value to other stock. Certain weeds not palatable to most animals are eaten by sheep, and they therefore aid in keeping pastures, meadows and fields clean. Sheep will graze steep hillsides not accessible to horses or cattle, and will feed from the foliage and twigs of brushland pastures. They find a good living on stubble-fields, and will clean up the waste leaves, husks and stalks of corn-fields, being able to thrive in fields where cattle and horses have gleaned all that they can well find. Sheep can therefore obtain a considerable part of their living from material that would otherwise be lost.

Sheep grazing in Washington.

Sheep require little labor.—Comparatively little labor is required in caring for sheep. In order to maintain the fertility of the soil, we need to raise more stock on our farms. Half a dozen sheep will produce as much income as a dairy cow, and demand much less labor for their care.

Their heavy coats enable sheep to live in relatively open sheds in the winter, providing they are kept dry. The cost of shelter is therefore low.

One of the chief practical difficulties in sheep raising is that the fences suitable for horses and cattle will not hold sheep. The present tendency, however, is to build closer fences, so that fields will be available for both hogs and sheep. In some regions serious loss of sheep occurs from vicious dogs, wolves and coyotes. Sheep-killing dogs should be relentlessly shot.

Sheep bring quick returns.—Sheep are almost as good as poultry for quick returns. For ordinary farm purposes dual purpose breeds are usually selected to produce both wool and mutton. In this way a double yield can be secured—fleeces from all the flock, and either lambs or mutton in addition.

It is estimated that the fleece from good sheep should pay for their feed, thereby leaving the lambs raised or the mutton produced as profit. Lambs are ready for market at from seven to twelve months of age, thus allowing the money invested in them to be turned quickly.

2. *Breeds of Sheep*

Sheep, like cattle, are kept for two purposes. Just as cattle include both the beef and the dairy breeds, so sheep comprise *mutton* breeds and merino, or *wool,* breeds.

Mutton breeds.—Mutton breeds of sheep correspond to beef breeds of cattle—their forms must be such as to yield the best results on the butchers' block, and they must be able to change their feed profitably into mutton.

Mutton breeds are divided into two classes in accordance with the length of their wool: (1) *medium wool,* or down type, of which there are eight different breeds; and (2) *long wool,* of which there are three breeds.

Medium wool breeds—	Long wool breeds—
Shropshire	Leicester
Southdown	Cotswold
Oxford	Lincoln
Hampshire	
Dorset-Horn	
Cheviot	
Tunis	

Sheep grazing, typical of western states.

The mutton breeds are more commonly used for the general purposes of the farmer than are the breeds that are classified as merino.

Merino breeds.—The merino breeds of sheep correspond to the dairy breeds of cattle. The build is more angular than that of the mutton breeds, and the general form such as to give the largest surface for the attachment of fleece. On the pure wool breeds the skin often hangs in folds on certain parts of the body, thus increasing the area for the growth of wool. The three chief merino breeds are:

American Merino
Delaine Merino
Rambouillet

Market classes of sheep.—Wholly regardless of breed, market demands divide sheep into three groups or classes. These are (1) *fat,* or mutton sheep, or those ready for slaughter; if the animals are less than one year old, they are called lambs; (2) *feeders,* or animals ready to be fattened; and (3) *breeders.*

3. *Feeding Sheep*

What has been said about the ability of sheep to forage for a great part of their food must not be understood to mean that it does not matter what sheep are given to eat. For sheep are exactly like all other animals in requiring the right proportion of nutritive elements in their food. Lacking a proper ration, they will be checked in growth, delayed in fattening, or short on the quantity and quality of wool.

Feeding ewes kept for breeding.—Ewes that are to produce lambs in the spring may be fed through the winter on a cheaper ration than that required for the feeders. The ewes need more of the muscle-forming, and less of the fat-producing foods. Their rations may therefore consist more largely of roughage, and less of grains than for the fattening lambs.

For breeding ewes weighing from one hundred and twenty-five to one hundred and fifty pounds, the following daily rations have been tested by the Minnesota Experiment Station and have been found to be economical and satisfactory:

Ration No. 1.	Ration No. 2.
3.5 pounds of corn stover.	2.0 pounds of clover hay.
2.0 pounds of roots.	1.4 pounds of corn stover.
0.4 pounds of oats or shelled corn.	0.4 pounds of oats and corn mixed.

Feeding for market.—The ration for fattening requires a larger proportion of fats and carbohydrates than

Montana sheep ready for shipment.

the ones just described. It has also been found that lambs fatten best with a mixture of succulent food along with the usual roughage and grain.

The Cornell University Experiment Station has tried extensive experiments in fattening different lots of lambs during a period of one hundred and ten days. Each of the following rations served fifty lambs for one day:

Ration No. 1.	Ration No. 2.
60 pounds of silage.	65 pounds of mixed hay.
50 pounds of mixed hay.	35 pounds of corn.
35 pounds of corn.	15 pounds of oats.
13 pounds of oats.	5 pounds of brewer's grains.
5 pounds of brewer's grain.	

Ration No. 3.	Ration No. 4.
65 pounds of mixed hay.	60 pounds of silage.
10 pounds of corn.	50 pounds of mixed hay.
20 pounds of brewer's grains.	10 pounds of corn.
20 pounds of gluten.	20 pounds of brewer's grains.
5 pounds of oats.	20 pounds of gluten.
	5 pounds of oats.

It should be understood in studying these rations that at the beginning of the feeding period a larger proportion of roughage and a smaller proportion of grain were fed. By the end of the one-hundred-and-ten-day period this proportion had been reversed. The rations as given are the daily average for the whole time.

The actual amount of nutrients is the same for each of these four rations, yet the results differ considerably both as to cost and the amount of fat produced, as is shown by the following comparisons:

Ration	Average gain per sheep in 110 days	Cost per pound of gain
1	22.7 pounds	10.6 cents
2	15.7 "	15.9 "
3	18.9 "	13.2 "
4	25.1 "	9.6 "

It will be noted that the most rapid gains, and at the lowest cost per pound were from the rations that contained silage. It is also seen that the lowest gain, and at the highest cost per pound, was from ration No. 2, where all succulent food was lacking, and most of the grain ration consisted of corn and oats.

Topics for Investigation

1. Make a study of the sheep raising industry in your vicinity, determining (1) how many sheep are kept, (2) what breeds are most used, (3) whether mutton or wool is depended on for the chief source of profit, and (4) what method of feeding and housing is principally followed.

2. Which would probably add more labor on your farm, increasing your dairy herd by five cows, or keeping a flock of thirty sheep? How would the profits probably compare? What is the basis for your judgment?

3. Suppose the cost of the nutrients making up the fattening rations shown on page 423 was as follows: Hay, ten dollars a ton; silage, two dollars and fifty cents a ton; corn, sixty-five cents a bushel; oats, forty-five cents a bushel; distiller's grains, thirty dollars a ton; gluten, twenty-five dollars a ton. Figure what it would cost to feed fifty lambs with each ration for one hundred and ten days.

4. After judging one or more sheep under the direction of the teacher, judge several animals independently, and then have your markings criticized and corrected.

5. Write an argument of three hundred words showing why sheep raising should be extended as an industry in your neighborhood and county.

6. Show how to keep a record of labor costs, pasture rent, feed and shearing of ten sheep.

7. Indicate on the map of the United States the sheep areas and the approximate number of sheep in each state as shown by the last census report.

8. Enumerate in your note-book the various products supplied by sheep.

4. *Sheep Demonstrations*

1. Demonstrate the proper method of shearing sheep.

2. Show how to make a balanced ration for sheep for the month of January in your locality.

3. Demonstrate how to judge the sheep. Use drawing, photograph or chart.

4. Demonstrate how to judge a lamb for mutton purposes. Use an animal in this case if possible.

5. Show how to judge sheep for wool purposes. Use the animal in this case.

5. *Sheep Play Contests*

1. Breed naming contests.

2. Wool fabric judging contest. A number of small pieces of various kinds of wool cloth, mixed with half wool and half cotton pieces, and some cotton pieces can be placed before the pupils with a view to teaching them how to distinguish between all-wool, part-wool, or cotton goods.

3. Essay writing contest on "The Life History of Sheep."

4. Sheep or lamb judging contest.

5. Five-minute extemporaneous speaking contest. In this contest have club members obtain all kinds of information with a view to making a speech either for or against the production of sheep on the average farm of the community. The object of this is to have them use the information obtained from the text, investigations, etc., and apply this by means of argument to their own farming conditions.

6. *Sheep Club Projects*

There are two practical club projects in connection with this line of work: the mutton production club, and the wool production club.

Mutton production club.—In connection with this club project the members are to take from one to a dozen spring lambs and care for them, keeping a record for a definite period of time, with a view to preparing them for the mutton market. The basis of award for this project may be:

1.	Net profit or cost of production	30
2.	Condition of lamb, judged by score-card	30
3.	Records of cost of labor, feeding, etc.	20
4.	Story of "How to Produce Mutton Profitably"	20
	Total score	100

Wool production club.—This may consist of taking care of one or more sheep for a year's time, and may require the club member to select the sheep on the basis of high wool production. Keep records and accounts of labor and feed, as well as wool receipts. The net profit on investment is to come from the returns from the wool rather than the mutton. The basis of award may be:

1.	Net profit or cost of production	30
2.	Condition and quality of wool produced	30
3.	Exhibit of graded samples of wool	20
4.	Records and story of "How to Produce High-grade Wool Economically"	20
	Total score	100

CHAPTER XXIX

POULTRY

THE raising of poultry is considered of rather incidental importance on most farms. A few chickens are kept for supplying the table with fresh eggs and an occasional fowl. Perhaps a flock of turkeys, ducks or geese are added for the sake of variety. Little attention is usually given to the possibility of large profits from the sale of eggs and poultry.

Yet, in spite of this somewhat haphazard method of treating the poultry industry, its aggregate returns are very large. For more than five and one-half million farms have a flock of chickens or other fowl. In addition, not a few people in villages and towns keep enough fowl for home use.

1. Take a census of all the fowls on your home farm, dividing into chickens, ducks, geese, turkeys, etc.
2. How many of each class are in their first year; second year; third year, etc.?
3. Carefully estimate the value of each class of fowls, and compute the total value of all.

1. *Distribution of Poultry Production*

Nearly five hundred million fowls are kept on the farms for our population. Considerably more than one and one-half billion dozen eggs are produced annually. This is enough to supply every man, woman and child with fifteen dozen eggs per year. The value of the eggs is in excess of three hundred million dollars a year, or sufficient to pay nearly three-fourths of the running expenses of all our public schools. The fowls themselves are worth above two hundred million dollars.

The ten leading poultry states.—Ten states supply about fifty-four per cent. of all the eggs we produce. These states are Missouri, Iowa, Ohio, Illinois, Kansas, Indiana, Texas, Pennsylvania, New York and Michigan.

The percentage of the entire egg crop produced by each of these ten states is as follows:

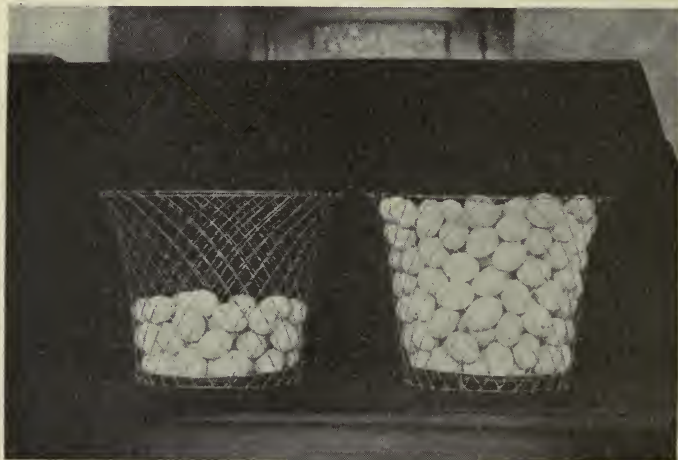
Missouri	7.0%
Iowa	6.9%
Ohio	6.3%
Illinois	6.3%
Kansas	5.1%
Indiana	5.1%
Texas	4.9%
Pennsylvania	4.7%
New York	4.6%
Michigan	3.8%

2. *Poultry Raising as a Farm Industry*

There are several good reasons why the raising of poultry should occupy a more important place than it now does on most of our farms all over the United States, especially in the South and West.

Increasing demands for eggs and poultry.—Eggs form one of the most necessary and palatable articles of food. With improved methods of shipping, parcel post service and cold storage they have increasingly become a staple on almost every table, city as well as country. The prices are high, a dozen eggs bringing the farmer about as much as a pound of butter. The demand for fowl as a supplement to other kinds of meat has also greatly increased, and there is now a ready market throughout the year for all kinds of poultry suitable for the table.

Low cost of feeding poultry.—A fair-sized flock of poultry can be kept on the farm with but little expense for feed. This is because fowl will gather up the greater part of their living from material that would otherwise be wasted. Scattered grain from the feed lots; undigested grain from farm animals; weed and grass seeds; grass and various



A year's product of an average hen and a good hen. The average hen laid 75 eggs, the good hen 223 eggs.

green plants about the barn lots, worms, bugs, grasshoppers and other insect pests form a large part of the diet of farm poultry during most of the year.

The labor of caring for poultry is light.—The labor connected with poultry raising is much lighter than with other farm animals. Much of the work is suited to the strength and interest of children, and gives the training in responsibility which every child needs. With a little oversight, children from ten to eighteen years can successfully take almost entire charge of poultry raising and make it highly profitable. This has been fully demonstrated in many boys' and girls' poultry clubs in every state.

Quick profits are realized.—The profits from a well managed flock of chickens are not only liberal and certain, but quick. Chickens are ready for market within a few months from the time they are hatched, and hens are at their best as layers during the first and second years of their life. And the eggs afford a continuous source of income to meet the expense of any feed or other supplies that are bought, or to add to the bank account.

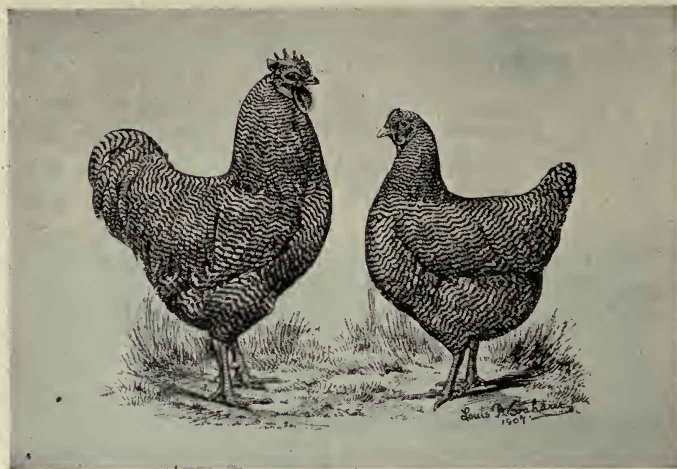
Almost all boys and girls could become expert chicken raisers and, by making arrangements with their parents to receive a share of the income from the flock, earn their own money for a farm, clothes, books, schooling, travel or whatever else they may desire.

3. *Breeds of Chickens*

According to experts there are one hundred and four standard varieties of chickens raised in the United States. There are many other varieties not sufficiently developed to be called standard. For practical purposes the standard varieties may all be grouped in four classes: (1) General purpose breeds; (2) meat or table breeds; (3) egg breeds; (4) ornamental breeds.

General purpose breeds.—The general purpose breeds are the result of an attempt to combine egg-laying with good table qualities. The favorites of these breeds are:

Plymouth Rocks, Barred, White and Buff.
Wyandottes, Silver, Golden, White, Buff, Black, etc.
Javas, Black and Mottled.
Dominiques, Rose-comb.
Rhode Island Reds, Single-comb and Rose-comb.
Buckeyes, Pea-comb.
Orpingtons, Buff, Black and White.
Houdans, Mottled.



Barred Plymouth Rocks.

Single-comb Rhode Island Reds.

Meat breeds.—The meat, or table, breeds are chiefly raised for the large markets. They must be of good shape and size, quick growers and ready fatteners. The principal breeds of this class are:

Brahmas, Light and Dark.
Cochins, Buff, Partridge, White and Black.
Langshans, Black and White.
Dorkings, White, Silver-gray and Colored.
Indians, White Game.

Egg breeds.—The prime consideration in the egg breeds is that they shall be good layers, begin laying young, and continue for a considerable period of time. The chief breeds are:

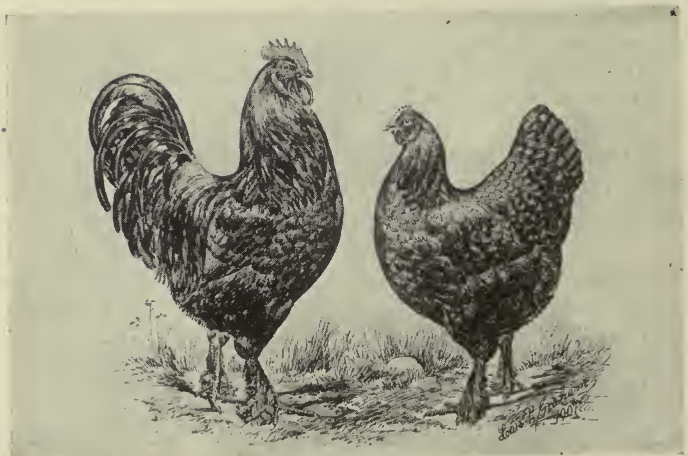
Leghorns, Brown, Buff, White, Black, etc.
Minorcas, Black and White.
Spanish, White-faced Black.
Andalusians, Blue.
Anconas, Mottled.
Hamburgs, Gold and Silver Spangled, White and Black.
Redcaps, Rose-comb.

Ornamental breeds.—The ornamental breeds are not important for practical farm purposes. Some of the favorites of these breeds are:

Polish, White-crested Black, Golden, Silver, White, Golden.
Crevecoeurs, Black.
La Fleche, Black.
Bantams.
Games.

It is best not to mix breeds of chickens. First one should decide what class is desired, whether egg, meat, or general purpose. Then a pure breed of this class should be selected, and the strain kept free from mixture with other breeds.

Single-comb Buff Orpingtons.



Black Langshans.

1. Are the chickens on your farm pure bred, grade, or scrub? What breed or breeds do you use? Is this an egg, meat or general purpose breed?

2. What steps could be taken to improve the breed? Would this not pay? Do egg or table breeds return most profit under farm conditions?

4. *Producing Chickens*

A successful hatch depends (1) on securing fertile uninjured eggs, and (2) on proper incubation.

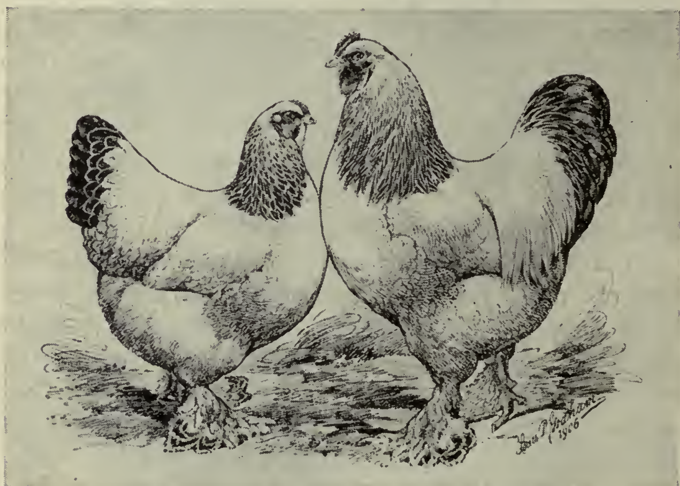
Eggs for hatching.—Heredity has its effect in fowl as well as other animals. The eggs for hatching should therefore come from the choicest and most vigorous members of the flock. The best plan is to separate from the main flock a sufficient number of desirable hens to produce the eggs required for setting. These can be kept by themselves until the hatching season is over.

In order that eggs may hatch at all they must be *fertile*. They are made fertile by the presence of a male bird in the flock during the laying season. One male should be supplied for every ten or twelve hens. Since one-half of the heredity of the entire flock is dependent on the male bird, he should be pure bred, the best of his kind, young and vigorous.

Care of eggs before setting.—Eggs should be fresh when they are set, never more than two weeks old, and better if not more than a few days from the nest. They should be kept rather cool, a suitable temperature being between fifty and sixty degrees Fahrenheit. Eggs that have been badly chilled will not hatch. It is necessary, therefore, that eggs intended for hatching shall be gathered at frequent intervals during cold weather. Many poultrymen think it is best to turn the eggs over every day or so during the time they are stored before setting. They should never be jarred or shaken.

Hatching with the hen.—Eggs may be successfully hatched either with a hen or an incubator. If the hatch is not to consist of more than from one hundred to two hundred chicks, and if the hens come of a breed of good setters, it is doubtful whether it pays to use an incubator.

Only quiet, motherly hens of good disposition should be used for setting. The nest should be made of a box from fourteen to sixteen inches square, and six inches deep. Four



Light Brahmas.

inches of earth should be placed in the box, hollowed slightly, and covered with chaff or straw. The broody hen should be removed to the nest at night and given a few china eggs for a day or two to make sure that she is in condition for sitting. From thirteen to fifteen eggs may then be given her for the hatch. It is well to dust both hen and nest with insect powder to destroy vermin. The sitting hen should be well fed on such grains as corn, wheat, or oats, have plenty of fresh water, and be let off the nest a short time each day for exercise and a dust bath.

Hatching with the incubator.—Although there are many different makes of incubators, they all supply the heat

A home-made egg tester.

necessary for hatching by one of two methods, either *hot air*, or *hot water*. All of the standard makes will be found satisfactory, though the hot-air type seems less likely to get out of order.

Success with the incubator depends much more on the operator than the machine. For unless the temperature and ventilation are kept right, the eggs properly turned, and other necessary conditions met, the hatch is sure to fail. The directions supplied with the machine must be faithfully followed, else one need not hope for success.

Testing for infertile eggs.—About the sixth day after setting the eggs should be tested and the infertile ones removed. The testing may be done by placing a small lamp or a lantern in a box through one side of which just opposide the light a hole has been cut somewhat smaller than an egg. The testing should be done in the dark, preferably at night. The egg is held against the opening in front of the light. As the light shines through, the infertile eggs will appear clear, while the fertile egg will show a network of threads leading out from a center, and floating about as the egg is turned. If a number of hens were set at the same time, and many infertile eggs are found, one hen may be released, or given a new supply, and the fertile eggs distributed among the others.

Care of newly hatched chicks.—The chicks first hatched from a setting should be removed from the nest in about twenty-four hours. If they are not, they will begin to leave the nest themselves, and the hen is likely to desert the nest before all the eggs are hatched. The chicks must be kept warm and comfortable until the mother is ready for them.

When the hatching is done in an incubator, the chicks are left for twenty-four hours after hatching and then removed to the brooder, which must be at a temperature of from ninety to ninety-five degrees Fahrenheit. By the time the chicks are a month old the brooder may be brought gradually down to seventy degrees.

1. Is any care taken in raising chickens on your farm toward selecting eggs from the best hens for setting? Is care taken to use only the best male birds?

2. Draw a plan for a suitable nest for a sitting hen, showing covered runway.

3. Do you make the test for infertile eggs after the hens have been set about a week? How do you tell whether the egg has started to hatch?

5. *Feeding Chickens*

Feeding young chickens.—For the first forty-eight hours after hatching the young chick needs no feed of any kind. Nature had provided for this period by having the yolk of the egg absorbed into the abdomen of the chick just before it is hatched. This food must be used up before the chick is ready for more.

The first food given the chicks may be stale bread soaked in milk and squeezed dry; hard boiled eggs chopped fine, shell and all; or cracked corn, wheat or oats. A good grain ration for chicks is made of equal parts of cracked corn, cracked wheat and cut oats fed five times a day. An excellent supplementary ration to hasten growth is the following: Bran, ten pounds; shorts, ten pounds; cornmeal, five pounds; meat scraps, five pounds; charcoal, two and one-half pounds; grit, one and one-half pounds. This mixture may either be fed wet or dry. Plenty of sour milk will add greatly to the effectiveness of the ration. Green foods should also be supplied from the first.

Feeding laying hens.—Hens, like other animals, do best on a ration balanced to meet their needs. There is no one best ration, since the necessary food elements can be obtained from many different sources. It is certain, however, that fowls require grain, meat, or milk, mill feeds such as shorts, or bran, green foods, sharp grit, shell and water.

The following is recommended as a well balanced laying ration, though wheat may be left out and more corn and oats added, or milk supplied instead of the meat scraps. (*Purdue Extension Bulletin,* 10.)

Grain	Dry Mash
10 pounds of corn.	5 pounds of bran.
10 pounds of wheat.	5 pounds of shorts.
5 pounds of oats.	3½ pounds of meat scraps.

The grain is fed in a litter of straw night and morning, and the mash left before the fowls the greater part of the

A well-arranged interior, showing nests and feeding equipment.

day. Green food is added to this ration. Grit, charcoal and oyster shells are to be fed in a hopper to which the fowls should have access all the time.

Feeding chickens for fattening.—Chickens should be specially fattened for market. Not only is weight added, but the quality of the meat greatly improved by fattening, and a higher price obtained. When unfattened chickens are selling at ten cents, the same fowls when fattened will bring fifteen cents in the city markets.

Both the *pen* and the *crate* method of fattening are used. Pen fattening requires less time and attention than crate fattening. The fattening pen should be kept darkened except at feeding time, in order that the chickens may remain quiet. A suitable ration is fed at regular intervals, and in as large quantities as the fowls will eat in from twenty to thirty minutes.

Crate feeding.—More rapid fattening is possible by placing from six to nine chickens in a crate. The fowls are given a regular ration, and kept from all exercise. About two weeks is the average time required for fattening. An excellent fattening ration may be compounded as follows:

10 pounds of cornmeal.
5 pounds of shorts.
5 pounds of ground oats.
40 pounds of buttermilk.

Cramming.—Poultrymen who make a business of fattening for city markets often use the *cramming* system of feeding. This method is based on the fact that chickens will not eat so much as they can assimilate and use in making fat. The fowl is taken from the pen or crate and held while soft food is pressed down the throat into the crop, or passed into the crop by means of a tube attached to a cramming machine. This forcible feeding will considerably hasten the fattening process.

6. *Producing and Marketing Eggs*

Properly handled eggs are the most profitable part of the poultry business on the farm. It is therefore well to study the conditions necessary to the largest production of eggs. The number of eggs produced by a flock depends (1) on the breed, whether of the laying, or meat, type; (2) on the feed, whether it consists of a balanced ration containing the elements required by the egg; and (3) the housing and care.

Profitable layers.—There is a great difference in the laying qualities not only of different breeds, but also of individual hens. An average grade or scrub hen will lay about seventy-five eggs in a year; a high-class hen of a laying breed, more than two hundred. These two hens eat the same amount of food, take the same amount of room, and require the same amount of care. The one hardly pays for her keep, the other makes possible a handsome profit. It will pay every farmer to weed out the poor layers from his flock, and fill their places with productive hens.

Age and egg production.—Young hens are the best layers. Only in the case of exceptional layers should hens be kept after they are two years old. Hens that have passed their second year will continue laying and produce a fair number of eggs, but younger hens will produce *more* eggs, and should therefore take the place of the older ones.

Pullets should begin laying in the fall of their first year. In order that they may do this, it is necessary to have them hatched out early in the preceding spring, preferably not later than March or April, and about two months earlier in the South. They should then lay throughout the winter, and be at their best the following summer.

The quality of eggs.—Eggs are rated commercially according to size as *extras* when the weight is from twenty-six to twenty-eight ounces to the dozen; as *firsts* when they weigh from twenty-four to twenty-six ounces to the dozen; and as *seconds* when they weigh less than twenty-four ounces. In some places eggs are now sold by weight. For these reasons the size is of great importance.

To command the highest price, eggs should also be uniform in shape and color, the shell smooth and free from spots, and clean without having been washed. Tested with the candler the air cell should be no larger than a dime, thus indicating freshness; the contents must appear opaque, the yolks barely visible, and free from any discoloring; the white must show thick and compact, the yolk not floating about.

1. Make a candler test as described in the text, and learn to tell fresh from stale eggs; fertile from infertile eggs.
2. Score the eggs collected for several days from your farm hens. How many *extras; firsts; seconds?* How many were dirty? What was the average score?

Effect of infertility on quality.—No eggs except those intended for hatching should be fertile. This is because infertile eggs keep much longer and in better flavor than fertile eggs. If a fertile egg is allowed to stand in a warm temperature for two or three days it begins to develop blood-rings; that is, it begins to develop the young. This process is sure to go on during the marketing and shipping, thus greatly reducing the value of the eggs. The infertile egg is free from all this difficulty, and will keep fresh much longer.

It is estimated that the loss from allowing eggs to become fertilized is more than fifteen million dollars annually in the United States. All male birds should therefore be kept away from laying hens when the eggs are to be used or sold. This will have no effect on the number of eggs produced.

Rules for egg production.—The following rules for egg production are given by the Poultry Division of the United States Department of Agriculture:

1. Keep the nests clean; provide one nest for each four hens.
2. Gather the eggs twice daily.
3. Keep the eggs in a cool dry room or cellar.
4. Market the eggs at least twice a week.
5. Market, kill or confine all male birds as soon as the hatching season is over.

7. *Housing the Poultry*

There are almost as many different styles of poultry houses as dwelling houses. The exact form of the poultry house is not important, though some types are more pleasing in appearance and less expensive than others. Every state agricultural college has plans for poultry houses adapted to the region and will be glad to supply these to citizens of the state. No matter what the style, however, certain fundamental requirements should be met by all poultry houses.

Drainage.—Poultry are especially sensitive to unhygienic surroundings. Impurities arising from ground saturated with unclean seepage, and dampness coming from undrained soil are sure to injure the fowls. The poultry house should be built on well drained ground. Drain tile should be used to carry the water away if necessary.

Room.—In many instances a flock of chickens are crowded into a space far too small for them, and the owner then wonders why they do not thrive well or lay eggs. The amount of floor space should be from four to five square feet for each bird. If there is free access to a sheltered yard, somewhat less than this may serve, but better sell part of the flock than overcrowd them in small pens.

Ventilation.—Chickens require far more air according to their weight than larger animals. Confinement in close, ill-smelling rooms is certain to lower their vitality, bring on diseases, and interfere with laying. In climates

Brood coops set on clean fresh ground. This flock is in little danger of disease.

A practical hen house for the farm. Amherst, Massachusetts.

where the poultry house can not have an open front, two or more sashes should be covered with muslin instead of being glazed, and hung on hinges so that the window may be thrown open in good weather. In bad weather the sash may be closed and yet admit sufficient air. Drafts should never strike chickens either while they are on the roost or the floor.

Sunlight.—Sunlight is the best of disinfectants. The poultry house should front the south, and have a reasonable number of glazed windows besides the muslin sashes. Too much glass makes the house excessively hot in the summer and very cold in the winter; too little glass leaves the quarters dark and gloomy, hinders the chickens in feeding, and encourages disease.

Freedom from dampness.—When frost gathers heavily inside the poultry house in cold weather it shows too great a degree of dampness. This may come from the ground floor, or lack of ventilation and sunlight. If a soil floor is used, there should first be filled in several inches of broken rock. On top of this may be placed a coating of cinders, and over the cinders a layer of soil. The soil floor at its best is hard to keep clean, dry and free from odors. Cement makes an excellent floor, as it can easily be washed. Over the cement should be spread four inches of straw or hay.

Comfortable roosts.—Fowls spend much time on the roosts. It is therefore important that the roosts be comfortable. Roosts may be made from two-by-two-inch stuff, rounded on the upper edges; they should be placed about two and one-half feet from the floor. Eight inches below the roosts should be a removable board or floor to catch the droppings.

Nests.—The nests may be built in a series along the side, or, better still, under the dropping board. Hens lay best in a secluded place. The nests should therefore be covered, and sufficiently enclosed to make them partially dark. Openings through the outer wall large enough to admit the hand into the nests will allow the gathering of the eggs without entering the building. Care must be taken, however, to provide a way to close these holes so that drafts may not strike the nests.

Colony houses.—Colony houses are small buildings intended for from fifteen to twenty-five fowls, and are

Colony houses and runs for ducks. Massachusetts.

movable. They may be constructed on the same plan as the larger building, and are placed on sills or runners so that they may be dragged from place to place with a team. Poultrymen who use colony houses move them frequently, thus securing better hygienic conditions. The colony house is especially desirable for hens with broods of chickens. Many large poultry raisers use both the permanent building and the colony house for their flocks.

8. *Poultry Diseases*

The poultryman's aim should be to prevent diseases rather than cure them in his flock. For a fowl sick with any serious disease is hard to treat, and the bird should usually be killed at once to save time in caring for it and the danger of infecting others.

Sanitation in the poultry yard.—Chickens are subject to a number of diseases that depend chiefly on lack of cleanliness around the premises. Lice and various parasitic mites attack little chicks or older fowls alike. Frequent whitewashing of the poultry house, washing the roosts with kerosene, and spraying with kerosene emulsion such as is used for fruit trees, are some of the preventives for these pests.

A simple and effective lice powder is made of one pint of tobacco dust mixed with two quarts of fine road dust. Sulphur may be used in place of the tobacco dust, and finely sifted hard coal ashes in place of the road dust. The soil of a poultry yard should occasionally be sprayed with kerosene emulsion, or coated with whitewash after all refuse has been removed. If the ground is plowed or spaded late in the fall and allowed to freeze during the winter many parasites and disease germs will be destroyed.

White diarrhea.—This is a disease affecting young chicks within the first four days of their life. They are most subject to attack the first twenty-four hours, and immune after ninety-six hours. The disease is caused by a bacterium found in the egg laid by a hen that carries the germs in her body. It may also be caught by contagion from chicks that have the disease, or from contact with incubators where the germs have lodged. There is at present no successful remedy. A good measure of prevention is to keep incubators, brooders and all feeding utensils disinfected.

Doctor Knapp, of the North Carolina Experiment Station, recommends the following as a good remedy for the disease:

Zinc sulphocarbonate	15	grains
Calcium sulphocarbonate	7½	grains
Sodium sulphocarbonate	7½	grains
Bichloride of mercury	6	grains
Citric acid	3	grains

This amount is considered one dose, and should be mixed with one gallon of water and used for drinking purposes during the first month. After this the chicks should have it two times a week for two weeks.

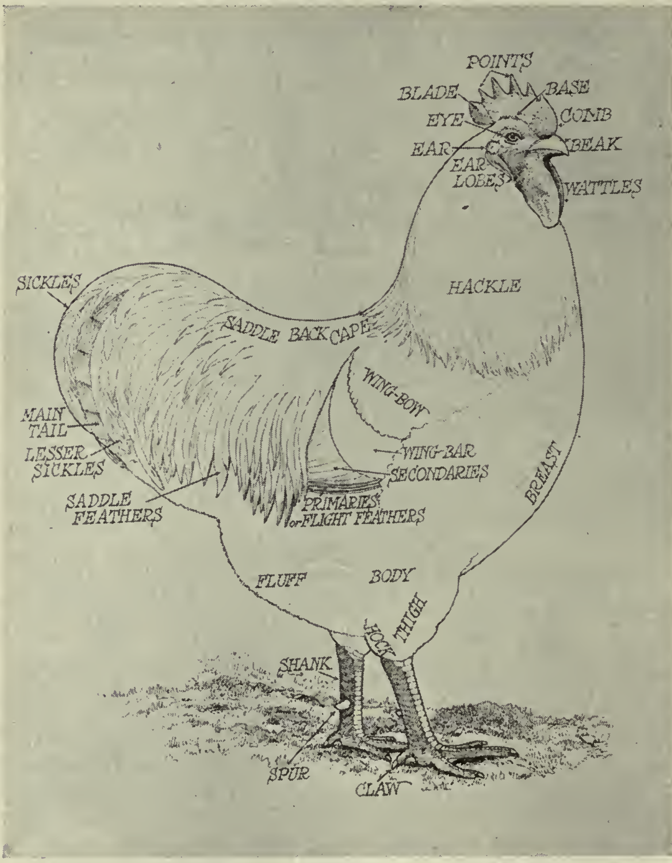
Gapes.—Gapes is another disease attacking young chicks. It is caused by a small worm picked up from the soil. The worms attach themselves to the inner walls of the windpipe, where they draw their food from the blood of the chick, thereby weakening it, and also clogging the passage so that the chick gasps for breath.

Here again prevention is a question of sanitation. If the soil is free of the worms, there will be no gapes in the chickens. It is well, therefore, to keep the young chicks on clean new ground on which former broods have not been raised.

Cholera.—Several different kinds of germs commonly found in the intestines of chickens may, under certain conditions, cause diseases known as cholera. True chicken cholera is caused only by one particular germ, however. Cholera is contracted by contact with fowls sick with the disease, by germs carried by new birds brought into the flock, by germs brought by wild birds that alight in the poultry yard, or dogs and other animals that roam from place to place.

It does not pay to try to cure fowls that have contracted the disease. It is best to kill them at once, burning or deeply burying the bodies. Care should mostly center on prevention. First of all, the flock must have sanitary surroundings—good air, sunshine, quarters that are dry and clean, and should have suitable food.

The poultry house and yard must be frequently disinfected. New fowls brought into the flock must be kept by



The parts of a chicken.

themselves for a week to make sure they do not carry infection. Stray animals should be shut from the chicken yard. The careful following of these simple precautions will greatly lessen the danger from chicken cholera.

Roup.—This is but another name for a kind of contagious catarrh among poultry which closely resembles influenza, or grippe, in man. Roup is thought to be contracted only by contact with infected birds. It attacks the membranes of the eye, mouth and throat, causing inflammation and a sticky discharge. The disease is accompanied by high fever. Roup may be brought into the flock by newly purchased birds, by fowls that have been taken to poultry shows, or by pigeons and other wild birds.

Roup is one of few poultry diseases that may be successfully treated. The sick fowl should be separated from the flock and given a warm, dry, well-ventilated place. All the affected parts should be washed with some antiseptic mixture. This may be done with a spray, or by plunging the head into the liquid wash. The following are suitable washes:

1. Boric acid, 1 ounce; water, 1 quart, or
2. Permanganate of potash, 1 dram; water, 1 quart, or
3. Peroxide or hydrogen 1 ounce; water, 3 ounces.

Topics for Investigation

1. Taking into account both what the chickens on your farm are fed and what they pick up, make a list of what goes into the ration of your flock. Compare with the rations given in the chapter. Is any element lacking in what your chickens are getting?

2. Estimate as carefully as you can the value of the feed given your chickens in one year; now estimate the value of the eggs and meat yielded by your flock. What do you conclude? Would it pay to keep a strict account of the expense and income of your flock for several months or a year, so you would know how you are coming out?

3. Estimate as closely as you can the number of eggs produced in a year by your flock. How many eggs does this average per hen? Is this a good average?

4. If the average egg production from your flock is low, what is the cause: breed, age, care, or feeding? What

would need to be done to improve the record? How many hens have you more than two years old?

5. Suppose you have for market fifty chickens that, without special fattening, will average five pounds each, and will bring ten cents a pound. Now also suppose that by two weeks of crate or close-yard feeding you can increase the average weight one pound for each bird, and get fifteen cents a pound for the lot. If the feed used is just balanced by the increase in weight, what would be the gain from fattening?

6. Select several fertile and several infertile eggs, and place them where they will keep at a temperature of eighty to ninety degrees; examine with the candler after twenty-four hours; after forty-eight hours; after seventy-two hours; after ninety-six hours. What do you conclude as to the keeping qualities of fertile eggs, and that of infertile eggs?

7. Make a drawing of your farm poultry house, showing all doors, windows, roosts, dropping boards, nests, etc. How does the building compare with the requirements given in the chapter? What needs to be done?

8. Talk with your father and mother about allowing you to take charge of a part or all of the poultry for a season, sharing the income. Then study all the helps you can find, and make a record for yourself and big profits for both.

9. Show proper methods of keeping poultry records. Include in the items, cost of labor, feed, marketing, trade marks, egg stamps, parcel-post cases, egg production, receipts from spring settings of eggs, cold storage costs, and poultry equipment.

10. Show on the map of the United States the poultry sections, and indicate the poultry production both in number of poultry of various kinds and the egg production, as shown in the last census report.

9. *Poultry Demonstrations*

1. Demonstrate how to make equipment of various kinds, such as water and feeding troughs, colony house, trap nests, roosts and dropping boards.

2. Demonstrate how to test eggs by candling, using a pasteboard box and a lamp.

3. How to pack eggs to ship by parcel-post and for cold storage. How to mark or stamp individual eggs.

4. How to operate an incubator.

5. How to handle a sitting hen.

A Minnesota club boy with his flock and colony house.

10. *Poultry Play Contests*

1. Egg race, conducted on the same plan as potato race.

2. Poultry judging contests. Use score-card.

3. Egg scoring contest. Use commercial score-card.

4. Breed variety naming contest.

5. Drawing contest. In this contest all kinds of equipment, different breeds of poultry, poultry houses, runs, etc., may be used as a basis.

11. *Poultry Club Project*

One of the most interesting club projects to be undertaken by the boys and girls is the poultry club work. The project may start with three settings of fifteen eggs each, or the management of a pen of chickens consisting of seven pullets and one cockerel for a full season or year.

A four-year project.—The poultry club work should include, if possible, a four-year project in order to encourage the use of the first year's results to the greatest possible advantage. The second year club members should raise at least fifteen pure-bred pullets and two cockerels, and hatch at least four settings of eggs from the fifteen pullets. The third year the project should be based on twenty-five pullets and two cockerels and the hatching of at least five settings of eggs. The fourth year, thirty pullets and three cockerels and the hatching of at least six settings of eggs.

Exhibit and award.—For the first year club members must agree to exhibit one dozen eggs from the club poultry and a pen of at least five chickens—four pullets and one cockerel—and each subsequent year, two dozen eggs and a pen of at least four pullets and one cockerel at the state, district or county fair. The basis of award for each succeeding year should be determined as soon as project is started. Secure the poultry club instructions from the state college of agriculture and use the basis of award furnished by your state director of boys' and girls' extension work.

It is recommended that whenever possible a pen of chickens be kept on the school grounds as property of the school, and turned over to the care of certain club members during the summer vacation period.

PART V. FARM ECONOMICS

CHAPTER XXX

FARM AND HOME MANAGEMENT

FARMING, like banking or running a railroad, requires good business management. Not only hard work, but careful planning is necessary to success. Brains are coming to be quite as essential on a modern farm as muscle.

1. *Planning the Farm and Its Work*

In Europe, land is high and labor cheap; in the United States, land is comparatively cheap and labor expensive. The first principle for the American farmer therefore is so to select his farm and organize its enterprises as to make the best possible use of the labor available upon it. This is to say that the farm enterprise should be so diversified as to give the largest possible number of working days during the year to the family, hired help, teams and machinery. Idleness soon eats up the profits of labor, whether it be that of man, beast or machine.

Selecting and planning the farm.—The farm should be carefully selected with reference (1) to its soil; (2) its adaptability to the enterprises to be entered into, such as stock raising or cropping; (3) its nearness to markets, school, church and neighbors; (4) the length of season and favorable climate; (5) its general suitability for being made into a pleasant and profitable homestead where an attractive home can be established for the entire family.

The equipment.—With the nature of the farm enterprises in mind, the buildings, fences, divisions of fields and all other improvements should be planned with great care to fit into the general farm unit. The machinery should be adapted to the soil and the crops and should receive the best of care. Too much machinery means too large

It pays to build good fences.

an investment, and too little means poor farming and loss of labor.

Crops and animals.—Many farmers are wearing out their soil and obtaining poor crops because of lack of sufficiently diversified farming. They do not manage well if they neglect to include in their system the legumes, orchard, garden and wood-lot products, or other crops adapted to their locality. Or, perhaps certain crops are raised or animals kept even at an actual loss, thus neutralizing the profits on other crops or animals. This all suggests the need of adjustment and better management on such farms.

2. *Administration of the Farm*

The general tendency among American farmers is to introduce the handling of too many enterprises and the cultivation of too much or too little land. As a rule, our farms are larger than those of any other country, and the amount produced per acre is less than in most other countries.

Planning to get the most out of labor and soil.—Good administration gets the most out of every day of labor and out of every acre of land. Each piece of work is carefully planned. Fields are tilled and crops harvested at the right time. A faulty machine is repaired before it breaks down. Unprofitable cows and horses are disposed of and not kept at a loss. Fertilizers are used whenever they will pay. Gardens and orchards are pruned and sprayed when necessary. No poor seed is ever planted. Herds and flocks are kept in good health by care and sanitary conditions. The home is comfortable, convenient and well equipped. Members of the family are given opportunity for general culture, recreation and amusement as a means of improvement and rest from labor.

Farm bookkeeping.—Every enterprising farmer should keep a system of records or book accounts. These need not be elaborate, but they must be accurate. Without this it is impossible to determine the sources of profits or losses, and hence impossible to manage crops or stock intelligently.

A system of book accounts will show whether the farm is returning to the owner fair wages and reasonable interest on the investment. A farmer who can make average day wages, and in addition five per cent. interest on the money invested, is ranked as a good farmer. Many make much more than this, while others make less.

The set of farm books should show an inventory at the beginning of the year of all stock, grain, roughage and the like on hand. At the end of the year another inven-

Good machinery is a profitable investment.

Well-arranged cattle yards.

tory, with an itemized *cash record,* one list of bills *owed others,* and another list of bills *due from others* will serve the purpose very well on the average farm.

Marketing farm products.—Farmers find that it pays well to give careful attention to the grading, crating and standardizing of farm products for the market. It is good business as well as a matter of pride to establish a uniformity of standard, using a particular type of box, crate or parcel-post pack marked with the owner's special label and trade mark. Merchants, packers or customers will soon show their appreciation of a standard product by being willing to pay more for it than for ungraded products.

The farmer's need of information.—Intelligent handling of farm business requires that the farmer should be thoroughly abreast of the times in information. He will need a daily paper giving market quotations and crop reports. He should also be familiar with the best farm journals, a few standard books on agriculture, and the bulletins and circulars of the United States Department of Agriculture and his state college of agriculture and by means of these be able to obtain much of daily value for all farm interests and activities.

Ten important points in farm administration.—Doctor W. J. Spillman, of the Office of Farm Management, United States Department of Agriculture, gives the following factors as underlying successful farming:

1. Low real estate prices for the land cultivated.
2. Production of commodities for which the supply is less than the demand.
3. Management of the business on as large a scale as capital and managerial ability will permit.
4. Production of commodities of the highest quality.
5. A reputation for reliability.
6. Location for good markets, and ability to buy and sell profitably.

7. Keeping only animals of highest productive capacity.
8. Large yields with relatively little labor and fertilizer.
9. Production at low cost.
10. Production of staple commodities for permanent profits.

The following ten commandments for southern agriculture were taught by the late Doctor Seaman A. Knapp. They will be of value to all who are interested in southern farm management.

TEN COMMANDMENTS OF AGRICULTURE

"At an early period it was found necessary to evolve from the mass of ethical teaching a few general rules for living, called *The Ten Commandments,* by which a man could be moral without going through a course of theology. Just so, in order to instruct the average farmer how successfully to conduct his farm operations so as to secure a greater net gain from the farm, it is necessary first to deduce from the mass of agricultural teachings a few general rules of procedure. They are called *The Ten Commandments of Agriculture,* by the practise of which a man may be a good farmer in any State without being a graduate from a college of agriculture."

1. Prepare a deep and thoroughly pulverized seed bed, well drained; break in the fall to the depth of eight, ten or twelve inches, according to the soil, with implements that will not bring too much of the subsoil to the surface (the foregoing depths should be reached gradually).

2. Use seed of the best variety, intelligently selected and carefully stored.

3. In cultivated crops, give the rows and the

plants in the rows a space suited to the plant, the soil and the climate.

4. Use intensive tillage during the growing period of the crops.

5. Secure a high content of humus in the soil by the use of legumes, barnyard manure, farm refuse, and commercial fertilizers.

6. Carry out a systematic crop rotation with a winter cover crop on southern farms.

7. Accomplish more work in a day by using more horse power and better implements.

8. Increase the farm stock to the extent of *utilizing all the waste products* and *idle lands* of the farm.

9. Produce *all the food required* for the men and animals on the farm.

10. Keep an account of each farm product, in order to know from which the gain or loss arises.

Topics for Investigation

1. Name all the different enterprises on your home farm.

2. What is meant by seasonal distribution of labor? Name some of the things that a farmer and his men can do on rainy days in the summer and on stormy days in the winter.

3. Make an inventory of your farm supplies at the present time, such as stock, machinery, grain, hay, etc. Make a list of purchases in these lines during the last year. Make a list of the sales. Talk with your father about keeping under his direction a set of farm records for a year.

4. Choose some farm in the neighborhood and, under the teacher's direction, make a plan for reorganizing its management as to cropping, stock, machinery, buildings, drainage, laying off of fields, fencing, etc., with a view to better results.

3. *The Farm Home*

Successful farming must make the home the center of all interest and effort. The final purpose of increasing the fertility of the soil, raising good crops, and producing fine herds and flocks is to make a better *home* thereby. Little is gained by making more money, buying more land and raising more stock if the home is not made to share in the prosperity.

The farmhouse.—The farmhouse should be comfortable and attractive. There is little excuse in this day for building houses that are ugly and repellent; for even moderate priced buildings can be planned to look well and at the same time be convenient and homelike. The home, whether large or small, should be one in which every member takes pride, where happiness and contentment may reign, and where the spirit of home may be fully realized.

Plan and equipment.—The farmhouse should be planned for convenience. For there is much hard work to be done by the housewife, and every care should be taken to save her time and strength. A well organized kitchen, with running water, a good sink with drainage, a kitchen cabinet, plenty of table space, cupboards, oil or gas heater for summer use, and a steam pressure or fireless cooker, is one of the first requirements in planning a house.

Practical conveniences.—The farm home should have a well lighted basement with cement floor, a fully equipped laundry with water-pipes and stationary tubs connected with a drain, to save the lifting and carrying of water. Suitable vegetable bins should be provided and so arranged that they may be cooled from the outside. A bathroom is a practical necessity on the farm as well as city home and can be supplied with water from an elevated windmill or cistern tank. A toilet and lavatory should also be a part of this equipment. The telephone now belongs to the farm as much as to the town, and electric lighting and power, even, are now being made available to many farms through the small independent plants or the extension of trolley lines.

A hand separator.

All these things can be had without great cost. They require chiefly thrift, a spirit of enterprise and a little careful planning.

Labor-saving devices.—The wise farmer buys good machinery to till his land and harvest his crops. His wife should also have the advantage of modern labor-saving devices in her work. The best of cooking utensils, fruit and vegetable canning outfits, electric or automatically heated flat irons, cleaning devices, hardwood floors, sanitary floor coverings, rugs and other similar helps to good housekeep-

A fine homestead, but lacking in trees.

ing should not be wanting. For such equipment now belongs in every modern home and will save much time and drudgery.

Recreation and culture.—Most farm homes can afford a supply of good books and magazines. These lead to efficiency, education and enjoyment. Good pictures and harmony in furnishings of rooms also add much to the home spirit. Musical instruments are within the reach of most of our farm homes, and prove one of the best investments. Many interesting games can also be secured at little cost.

The back yard.—The back yard should be quite as clean and attractive as the front yard. No refuse or litter, unsanitary chicken coops, garbage heaps or mud-holes should be tolerated. Closed garbage cans should be used, and everything done away with that will attract flies or mosquitoes, or be the breeding place for disease germs.

Drainage.—No farm house is complete without a drain leading out through the basement and on to a cesspool some distance from the house. Cesspools can be constructed at almost no expense except for the labor, and so made as not to endanger wells in the vicinity.

4. *Other Farm Buildings*

Much time and labor can be saved by a proper arrangement and placing of farm buildings. While barns should not be located too near the house, neither should they be so far away as to cause unnecessary steps in going back and forth. In the North, where winters are long and severe, arrangements may be made to connect the house with the barn in some way.

Making a plan.—Before barns, poultry houses, hog-houses or corn cribs are erected a plan for the whole system of buildings likely to be needed should be made. The distance for carrying feed, water and milk should be carefully considered, and all other conditions taken into account in placing the structures. The buildings themselves should be planned with the greatest convenience and economy of labor, time and energy.

Barnyards.—The appearance of a barnyard is one of the best tests of a good farmer. The yard should, first of all, be clean and free from filth. All low places that collect pools of water should be filled. Manure should be kept in the pit or cleaned up and spread on the fields. No old machinery, piles of boards, and scraps of rubbish should litter the place. The entire set of farm buildings, yards and fences should show taste and good management and be pleasing to the eye. To accomplish this does not add materially to the expense of operating the farm; in the long run it does not even require more time than to allow the

Well-kept barns.

homestead to run at loose ends. A well kept homestead is largely a matter of thoughtful planning, and a desire to make the farm home attractive as well as profitable.

Topics for Investigation

1. Make a study of the plans of several farm homes, and discuss the advantages and disadvantages of each plan, finally selecting your favorite plan.

2. Take a look at your home door yard, and decide whether any improvement is necessary. Do the same for your barnyards. Is there old machinery or rubbish about

that needs cleaning up? Are there any fences or gates that need repairing?

3. Make a plan of your farm homestead, locating all of the buildings. Now suggest any rearrangement that would make the homestead more convenient or attractive.

4. Make a plan showing how water could be brought by underground pipes from an elevated tank from your windmill or silo, (1) to the kitchen of your house, and (2) to your barns. Also make a drawing of a drain leading from your basement to a cesspool; show a plan also of the cesspool. What is a *septic* tank?

5. Consider carefully what practical project you could carry out for the improvement either of the appearance or the convenience of your farm homestead, and talk with your father about undertaking it. Show a detailed estimate of any expense involved, including labor and material.

CHAPTER XXXI

THE HOME GROUNDS AND WOOD LOT

NO home place is complete without trees, plants and shrubs. Even with costly and pretentious buildings a homestead may look barren and inhospitable from lack of the decorative and comfortable effect of shade trees, groves, climbing vines and blossoming plants. One should learn not only *to make his farm pay but to make it interesting and attractive to members of the family and neighbors.*

1. *Beautifying the Home Grounds*

The house lot and lawn of the farm home can be made especially beautiful and interesting. For there is more room on the farm than in the town or city, and the trees and plants needed for its decoration will cost but little except a reasonable amount of care. Well kept grounds add a great deal to the market value of a farm, and contribute even more to the beauty and comfort of the home.

Plan for setting.—To produce the best results, the setting of trees and shrubbery should follow some complete and well devised plan. The effect of the most beautiful vegetation may be lost by careless or improper placing. When used for decoration or shade, trees should usually not be set in rows, unless along a driveway or boundary line; nor should they be so blocked together that they shut off the view of the house. They may stand as single isolated specimens, or in irregular groups. Trees often are placed too near the house, thus excluding the sun and causing dampness.

Shrubs, likewise, appear to best advantage when set in clumps, or irregularly to make a border for the lawn. Climbing vines can be used to screen porches, cover garden fences, hide unsightly sheds and outbuildings, or clamber over stumps, rocks or barren banks.

Selecting varieties.—One can select from an almost

The shrubs and trees add much to this farm home.

endless variety of trees, shrubs and vines. Each variety has its own peculiar individuality, which should be studied and known before the selection is made. A plant, once given a place on the grounds, becomes a permanent part of the home-place, and should therefore be chosen with as much care as are our friends.

Shade trees should be hardy, well-shaped, broad leafed, grow to a good size, and attract no troublesome insects. Elms, maples, oaks, ash, basswood, catalpa, locusts, nut and fruit trees, and, in the South, magnolias, orange, pecan, sycamore, the redbud and live oak, are among the favorites.

Shrubs are to be selected both for their foliage and flowers. With care, provision can be made for the appearance of blossoms during each month of the summer, and for an attractive variety of foliage throughout the season.

Flowering plants.—The plan for the home grounds

A fine homestead management, showing wood lot, orchard and a good set of buildings.

should include a few beds of flowering plants. Most of these may be perennials, which will require but little care after the bed has become well established. With the addition of a few varieties of hardy bulbs for annual planting, beautiful effects can be produced with practically no cost and with the expenditure of very little time.

The lawn.—Nothing adds more to the appearance of a homestead than a well kept lawn. The lawn should first of all be well smoothed, the low places being filled and all obstructions removed. The soil should be rich and well drained. For the greater part of the United States, a mixture of blue-grass and red-top, with perhaps a small amount of white clover, makes a good lawn covering.

The lawn must be close-mown if it is to produce a pleasing effect. If allowed to grow up, the grass becomes tufted and coarse, besides looking ragged and unkempt. Farm stock should not be pastured on the lawn. Their trampling will produce unevenness that interferes with the lawn-mower, and plants, shrubbery and young trees are sure to suffer from being browsed.

Topics for Investigation

1. Draw a plan of your home grounds, locating all the trees, vines and shrubs, and giving the names of varieties.
2. In your drawing also show the position, size and shape of all the flower beds, specifying the varieties of plants, and whether annuals or perennials.
3. Make a complete plan for the decoration of your home grounds, taking into account the trees, shrubs, and plants already set out. What varieties should be added? Are any trees or shrubs in such positions that they should be removed?
4. Make a plan for decorating the school grounds, specifying by variety each tree and shrub, and showing its location.

2. *The Farm Wood Lot*

Every farm place should have its own wood lot. It costs little to start, requires but little care after the first year or two, and yields large returns.

Uses of the wood lot.—Poles, timbers and posts are constantly needed on every farm. When there is no wood lot to supply them, they must either be bought, or the farm suffer for their lack. Lumber, posts and timbers of every sort are becoming more expensive from year to year as our forests are being depleted. Fire-wood raised on the farm costs very much less than if bought in the market, and so scarce is it becoming in many regions that it can not be had at all unless produced at home.

The wood lot can often be so placed as to serve for a

A good lot of Hampshire Downs and a fine wood lot.

windbreak for the farm buildings, and at the same time add to the beauty and value of the homestead. When the trees are grown they afford welcome shade for animals, contributing both to their comfort and profit.

Birds are attracted to the wood lot, and from this shelter make sallies out upon the harmful insects that prey on crops or gardens. From the friendly tree-tops they also pour out their tribute of song.

The location and size of the wood lot.—It may not always be desirable to plant a large wood lot near the buildings. When such is the case, low wet places, steep hillsides, or small irregular pieces of ground not suitable for cultivation can often be utilized.

From one-half an acre to several acres of ground can

Using the wood lot for social center work, school picnics and club festivals, near Dows, Iowa.

profitably be set to trees on a fair-sized farm. While the returns are not immediate as with other crops, yet the profit is reasonably sure in the end. Many far-sighted farmers are now providing for the fence posts and timbers they will need ten or twenty years hence by setting out and caring for trees in a wood lot. It is estimated that Minnesota farmers set out a million trees in one year and in many other regions the movement is quite as marked.

Varieties of trees for the wood lot.—It is impossible to recommend definite varieties of trees for the wood lot, since this depends on the region and the use to be made of the timber. Some prefer to plant the rapid-growing soft wood trees, while others are willing to wait longer for the harder woods to grow. An excellent plan is to plant a number of varieties. Not only will this allow a mixture of the slow and the fast growing trees, but provide a variety of timber suitable for different purposes of utility and comfort for the farm.

From the eastern to the middle western states the favorite trees seem to be the different varieties of maple, elm, oak, locust, ash, fir, basswood, hickory, walnut, boxelder, cottonwood, yellow poplar, catalpa, chestnut, sycamore, etc.

In the drier regions such as western Kansas and Nebraska, Oklahoma, Texas and Colorado, it is difficult to start successfully some of these varieties. Among the best drought resisting trees are the black locust, green ash, Osage orange and Russian mulberry. In the southern and far western states practically all varieties suitable to the North and East can be grown and many others besides.

Starting the wood lot.—The wood lot may be started, in the case of most trees, either by planting the seed, or by setting out young trees. A common method of starting a grove of hardy catalpa, for example, is to prepare the seed bed as if for corn. Catalpa seed is then planted, and the field cultivated for several years. The young trees are sometimes cut back to the ground after two years of growth for the purpose of producing straighter and more sturdy trees. The growth of the tree is not retarded by this process.

A seed bed for trees can easily be started, and the trees transplanted to the desired positions when the seedlings are from one to three years old. A small seed bed will supply trees for a large wood lot.

3. *Tree Enemies*

While most of the common trees are not subject to a large number of enemies, yet they must have reasonable care and protection if they are to thrive.

Farm animals.—One of the most common mistakes in starting young trees is to allow them to be exposed to stock. Cattle, sheep or hogs are sure to injure the trees by grazing upon the leaves and branches, by trampling them, or by rubbing against them. The wood lot should be fenced, and all stock excluded until the trees are well grown. Horses should never be tied to trees.

Weeds and sod.—Young trees are as easily injured as any other plant by weeds or grass. Many people seem to think that because large trees can take care of themselves against these enemies young trees can do the same. But trees once checked in their growth by the choking of weeds or sod will never fully recover.

Insect and fungous enemies.—Shade and timber trees are, on the whole, less subject to insect and fungous attacks than fruit trees. Yet occasionally even the most hardy trees succumb to such enemies. The elm, one of the healthiest of our trees, has recently suffered greatly in certain regions. The chestnut has also been seriously afflicted with a bark disease. Whole forests of fir have died in southern localities. Even the catalpa is subject to a fungous trouble at certain stages of its growth. Whenever a considerable number of trees in a locality show signs of disease, an expert should be consulted and his directions followed.

Topics for Investigation

1. Join with the teacher and class in making a collection of all the woods in your locality. Use seasoned woods for specimens when possible, selecting sticks two or three inches in diameter, and sawing them about four inches

long. Split each specimen, then smooth and sandpaper the flat side and ends and spread a coat of shellac over the finished parts. Learn to identify each specimen both by the bark and by the texture and grain.

Power spraying of trees.

2. Gather and preserve in wide-mouthed bottles samples of the seeds of all the trees in your vicinity. Learn to identify these seeds. Plant some of each, and learn to iden-

tify the young plant of each variety. Consider the possibility of starting a tree nursery or seed bed on the school ground, where the seeds of the different trees can be planted and seedlings raised for study and replanting, either on the school grounds or at the homes.

3. How can you tell the age of a tree after it is cut down? Find some freshly cut tree and discover its age. Can you tell from the annual rings any years when the tree did not make a good growth?

4. Make a collection of the leaves of all the different trees available, and learn to identify them.

5. What is the difference between plain-sawn and quarter-sawn lumber? Look at different pieces of oak furniture, and decide whether the lumber was plain or quarter-sawn. Why does some hard pine flooring have a tendency to splinter up, while others do not?

6. Locate on the map of the United States the forest reserves of our country; the lumber producing sections.

7. Estimate the cost of producing a ten-acre wood lot of some prevailing trees of your section.

8. Write down the names of all the different trees you can think of common to your state, in the order of their importance to the farm.

4. *Demonstrations on Home Grounds and Wood Lot*

1. Demonstrate how properly to remove and transplant a shrub or bush.

2. Demonstrate how to make a tree graft; how to make a bud graft.

3. Demonstrate how to prune and thin the different kinds of trees.

4. Show the proper method of spraying for different insects, diseases and blights.

5. Show how to treat the tree-trunk to prevent insects from passing from the ground into the tree.

6. Demonstrate different methods of tree surgery, such as repairing injured limbs and diseased and decayed spots.

How does this compare with dental work, medical and surgical treatment of human beings?

7. Demonstrate how to lay off a lawn with a view to artistic arrangements for the lawn itself and as related to the home, buildings, pathway and roadway.

8. Demonstrate how to sharpen and set a fence post.

9. Show how to set a corner post and brace it.

10. Demonstrate how to make bird houses, bird baths, watering troughs, feeding platforms, etc., on the lawn or in the shrubbery, trees, and out in the wood lot, to encourage and help the conservation of the farmers' bird friends.

5. *Play Contests for Home Grounds and Wood Lot*

There can be no better way to arouse interest in the improving of home grounds and the planting and care of wood lots than to inaugurate a large number of play contests, related to this work. Practically all of the demonstrations outlined above can be so organized as to become very interesting play contests. Illustrations:

1. Tree naming contest.

2. Spelling contest from a list of names of trees, shrubs, plants and flowers.

3. Drawing contest, showing the plan and arrangement of lawns, wood lots and farm home grounds.

4. Wood collection and exhibit contest.

5. Manual-training contests, in which the pupils are to contest in making articles from wood, leaves, bark, buds and flowers.

6. Tree judging contest.

7. Lawn management contest, the same to cover a season and to involve not only the mowing of the lawn but its proper up-keep, repair and improvement.

8. Essay writing contest on the home grounds and wood lot.

CHAPTER XXXII

THE COUNTY AGRICULTURAL AGENT

SEVERAL new agencies have recently entered the field of agricultural extension education and rural development: some of these are (1) the *county agricultural agent,* and (2) the *county farm bureau.* The latter consists of an organization of the business men and farmers of a county for the purpose of furnishing a kind of clearing house for agricultural information and an organization through which a county agent may work. The county agent is an agricultural leader whose business is to organize, lead, instruct and give agricultural direction and advice to the farmers or to pupils and teachers of agriculture in the schools of the county.

1. *The Work of the County Agent*

First work in the South.—The advent of the Mexican boll weevil in the cotton fields of Texas was responsible for the beginning of this work. So great were its ravages that in 1905 and 1906 the United States Department of Agriculture employed Doctor Seaman A. Knapp to investigate what could be done to exterminate the boll weevil and to demonstrate to the southern farmer that cotton could be grown in spite of the pest.

Doctor Knapp soon discovered that printed circulars of instruction, public lectures and other former means of agricultural instruction would not accomplish what was needed to be done. So he determined upon a plan of field and farm demonstration work for the purpose of showing upon the man's own farm not only how to exterminate the boll weevil, but how to grow an earlier variety of cotton and, if possible, a weevil-resistant strain. From this beginning there has been a very rapid growth of this type of extension work, until at the present time county agricultural agents are employed in every state in the Union.

The county workers.—Men employed as county agricultural agents are required to be possessed of scientific information and successful experience on the problems of agriculture. They are expected also to have had practical experience in the general management of a farm. Plans have already been made by which the county agent is assisted by a woman agent who must be thoroughly trained and fitted to advise and direct the girls and women in all matters relating to the making of better homes. Several hundred women agents are now at work in as many counties.

Organization of the county work.—The county agents live in the county and are supplied with an office where they may be consulted. They usually are furnished with some means of transportation so that they may travel about the county, from farm to farm and from home to home. In this way the county agents carry to the very door of the farm home and the public school the services of specialists. They are able to bring to those who can not go to college the help, advice and leadership of the best scientific investigators, and really make the farms a part of the campus, class rooms and laboratories of the agricultural college and demonstration centers of the United States Department of Agriculture.

Character of help rendered.—The work of the county agents is calculated to increase the profits of farming, and the comforts and efficiency of the farm home; to aid in conserving and building up the soil; and to encourage the advancement of community education and social interests.

Like the physician or surgeon, the county agents are to be called when advice, treatment or preventive measures are needed. They plan for a system of demonstrations to show the best methods of managing the soil, preparing the seed bed, selecting and caring for seed, management and care of farm animals, organization and care of gardens and

The county agricultural agent is discussing grain problems with the farmers at thrashing time.

orchards, and the handling and conservation of farm buildings and machinery.

If a herd is stricken with tuberculosis, the hogs with cholera, the cotton-field with the boll weevil, or the corn-field with cutworms, the county agent should be notified and his help secured. If he is not able directly to give information and aid he will know where to secure assistance on short notice. In like manner the county agent will be of special assistance in planning the proper management of soils and crops when the seasons are too dry or too wet; in the best organization of farm enterprises; and in the management of all of the efficiency factors important to the success of American agriculture.

2. *Financial Support*

The county agent work was first supported by the United States Department of Agriculture by the use of funds directly appropriated by Congress to the Department. This was liberally supplemented by a fund from the General Education Board, having in trust a large fund donated by John D. Rockefeller. The work under Doctor Knapp's direction made definite progress toward the extermination of the boll weevil and the development of resistant types of cotton. The best part of his work was the fact that through the county agent movement he succeeded in getting the southern farmers to appreciate that they needed to grow their own pork, beef, poultry and dairy products and that crop rotation was quite as possible in the South as in the central and northern states. He also demonstrated through these men that growing cotton as a single crop enterprise from year to year meant certain destruction agriculturally to the South.

This work called for a more liberal appropriation of funds from year to year from four different sources: (1) The United States Department of Agriculture; (2) the state legislatures; (3) the General Education Board; (4) the local or county government.

The United States Congress in the year 1912 appropriated an additional amount of money to be expended for the development of farm demonstration and county agent work in the northern, central and western states for the first time. This fund was supplemented by one hundred thousand dollars donated by a Chicago business man. In

1914 the Smith-Lever Bill was enacted into law and this made federal aid available for every state in the Union, beginning July 1, 1914. The entire amount appropriated for the first year was four hundred and eighty thousand dollars, to be divided equally among the forty-eight states. The appropriation is gradually to increase until the federal government is contributing some four and one-half million dollars annually for the encouragement of demonstration extension work in agriculture.

The Smith-Lever Law contemplates that the greater part of this immense fund shall be spent in supporting county agricultural agents, state and district leaders of boys' and girls' club work, demonstration work in home economics, and specialists who will help in shaping and building up agricultural interests throughout the nation. The agricultural colleges through their extension divisions and the United States Department of Agriculture through the States' Relations Service are to cooperate in carrying out fully the provisions of the act.

Steps to be taken in securing a county agent.—The matter of securing an agent for a county should first be taken up with the state leaders, whose headquarters are with the agricultural college of each state. He is in a position to assist in planning and conducting the campaign for an agent and can give information in regard to available sources of county, state and federal funds, and the amount of funds necessary properly to finance the movement. When the county is ready for the appointment of an agent, the state leader may be able to recommend a man qualified for the work.

3. *The County Agent and the School*

The county agents seek not only to help the farmers in their immediate problems, but also to advance agricultural education in every possible way.

Help for the school.—Every agent desires to assist the work in agriculture in the schools of his county. In many instances the county agents and the county superintendents plan and carry on their work together. Teachers and pupils can always feel free to call on the agent for help or advice in connection with any agricultural club or individual project.

Apple Club boys pruning orchard under direction of county agent, Cortland County, New York.

When it is impossible to reach the agent for a personal interview, the telephone or mail can be employed. Pupils and teachers should become acquainted with the agent personally, attend the demonstrations and public meetings, and study the experiments and investigations he makes. Think over carefully the work of the farm and if either you or your parents have problems that are annoying—troubles of any kind with soil, crops, or stock—seek the advice and help of the agent at once.

Advice on club projects.—Club projects should be selected with great care. The county agent should be consulted as to the best project for the boys to undertake, and the woman county agent should be consulted as to the best one for the interest of the girls and the home. All of the club projects outlined in this book will be of especial interest to the county agricultural agents and they will be glad to give encouragement and assistance to the work. They will help plan also the work of the manual training classes in the rural and village schools so that it will fit into the needs of the farm, the garden and the home.

Special programs.—The county agent should be invited to the school, and especially in connection with the special programs of an industrial and agricultural nature. His help can be secured in the conducting of agricultural demonstrations, the judging of grains, fruits, vegetables and stock, and the organization of rural games and contests. His advice will be valuable in determining the basis of award and the methods of judging a contest. He should also be consulted with reference to suitable circulars and *Farmers' Bulletins* for correlation reading in connection with the agricultural and home economics studies of the school.

Topics for Investigation

1. Have you a county agricultural agent in your county? If so, who, and how long has he served the county? Where is his office located? Who pays his salary? Has the county a lady agent? Who is she? Tell something about the character of her work.

2. It was estimated that in one county the work of the various leaders increased the yield of corn by five bushels an acre in a certain year. The county is twenty-four miles square and eighty per cent. of the area is under cultivation. Of that under cultivation forty-five per cent. was in corn. What was the leaders' help on the corn crop worth to the county, figuring corn at fifty cents a bushel?

3. If your county has no agent, has the matter of securing one been discussed? Do you know what steps would have to be taken to secure an agent? How would the expenses have to be met? If you are not certain on these questions inquire of your state agricultural college or the United States Department of Agriculture.

4. What farm projects in your community need the advice of a county agent? Do you know of land that is foul or run down? Pastures that are weedy or dying out? Swamps that need drainage? Orchards that do not bear profitably? Flocks or herds that are not profitable? Ravages of insects or disease that cause severe loss? Hogs dying from cholera?

5. On what farm or garden project would you especially like advice from an agricultural agent in order to make sure of success the first year?

6. How much money is available this year from the Smith-Lever Act for the club work, county agent and farm demonstration movement? Upon what conditions is this secured and how is it administered? What part of this does your county get?

7. Does your state college of agriculture have an extension department? If so, name the officers and leaders, such as director of extension, state agent in charge of club work, state agent in charge of county agents and demonstration work. (Write for its literature on club activities extension work.)

8. To what extent do the Department of Education and the normal schools of your state encourage agricultural and home economic education? Do they have officials who give direction in this type of work? Name them.

CHAPTER XXXIII

FARM IMPLEMENTS AND MECHANICS

1. *Importance of Implements and Tools*

ONE of the most important and interesting phases of agriculture is the study of farm implements, their origin, history, utility, value, proper care and up-keep.

Tillage and tools.—Good crops and large profits usually depend upon wise management and proper tillage; and good tillage requires the use of tools adapted to the soil, the particular crops, and the condition under which the farming is done. It is poor economy to farm with unfit tools, or implements in poor repair. On the other hand it is possible to have too large an amount of money invested in farm implements and machinery. A number of the larger farm machines, such as corn harvesters, thrashing machines or shredders, can be owned cooperatively in a community and made to do the work of four to ten farmers instead of one. This will reduce both the first cost and the up-keep.

The care of machinery.—It is generally considered that a machine kept in good repair, and well housed when not in use, will last as long doing the work of five farmers as a machine owned by a single farmer and doing but one-fifth of the work, if neglected and allowed to stand out-of-doors in rain, snow and all kinds of weather when idle. There is no better test of the progressiveness and good management of a farm than the way the farm tools and machinery are treated.

A young farmer mechanic with a well-equipped shop.

Practical farm mechanics. Omega club farmers, Elmira, N. Y.

2. *The Farmer as a Mechanic*

Every farmer should, at least to a degree, be a mechanic. This is not with a view to manufacturing implements, or even to the building of his own barns and houses, but to enable him to keep the implements, barns and houses constantly in good repair.

The farm work-shop.—A great many dollars can be saved on the average farm if the farmer has equipped himself with a little work-shop and a number of the necessary repair tools. A loose bolt, a broken rivet, a loosened board, or a brace out of position can easily be repaired by a practical farmer, while if it is neglected it may result in greater breakage, with the consequent loss of time and money. A large number of minor pieces of farm equipment, such as watering and feeding troughs, feed racks, seed trays, test boxes, fireless cookers, bins, shelving, wagon boxes and hog racks can profitably be made in the farm shop.

There are always plenty of rainy days and occasionally periods of time when the rush and heavy work of the fields have been completed and an opportunity given for repair work and the making of practical necessities belonging to the farm.

Manual training and the farm boy.—A farmer boy's education has no more important part than training in the use of farm tools and the application of the ordinary mechanical work needed about barns, fences and machines. This phase of training should be correlated with the manual-training courses in the public school. The manual training learned by the farmer boy should relate to farm needs. Every farmer boy should master the practical principles of painting, the mixing and use of paint, and the relation of color schemes. For the use of paint not only beautifies, but conserves buildings, fences and machinery.

The use of cement.—Cement has come to be one of

A modern type of cow pen.

A deep tilling plow, with two disks.

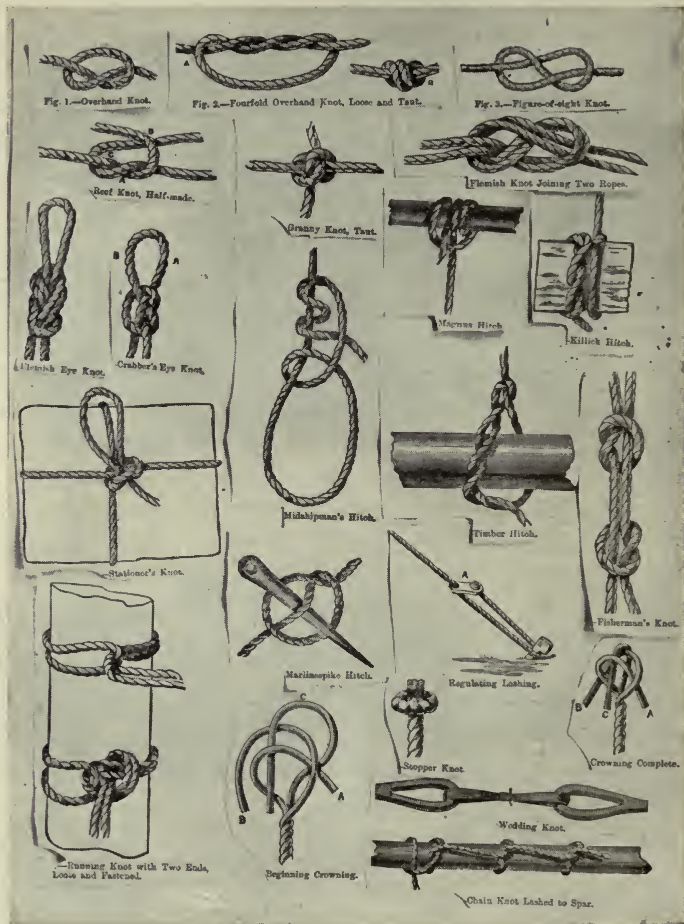
the most important economies of a farm homestead. Every boy will want to know something about the making of concrete, and the proper methods of mixing and surfacing. He should understand the making of molds, the laying of foundations for cement structure, and the application of cement to the construction of silos, water-tanks, fence posts, bridges, feeding floors, etc.

3. *Rope Tying and Splicing*

One of the elementary yet most interesting divisions of farm mechanics is rope tying and splicing. The place of the rope in farm management is very much the same as the relation of the nail to the builder. Ropes are also widely used in other occupations, and the lives of many workmen often depend on the strength of a rope or the security of a knot.

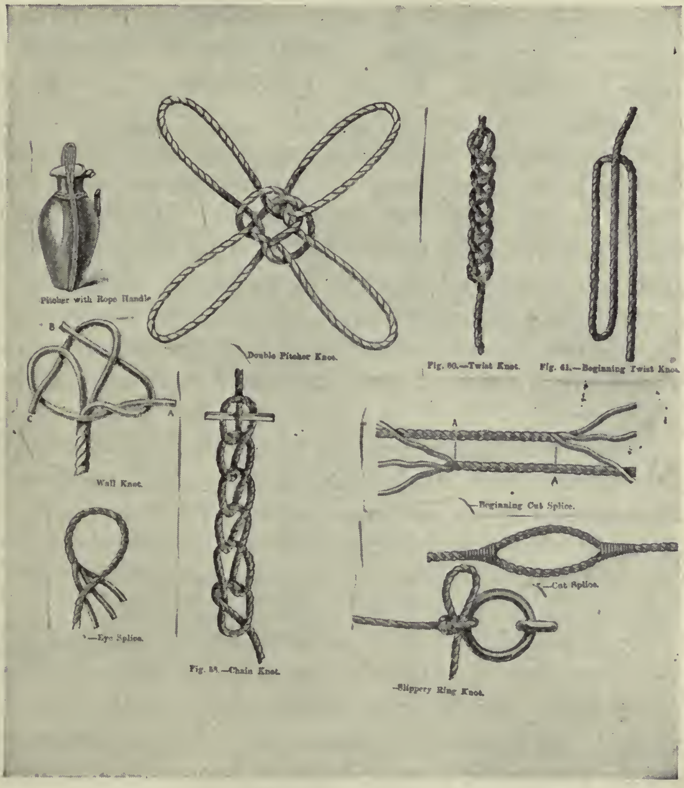
The uses of ropes.—Long before farm machinery was invented or useful implements invented, rope tying and splicing bore a very important relation to the work of agriculture. The first harness was made of rope. Joints and splicings were made with rope long before the day of bolts, rivets and other metal devices for the joining of parts in farm machinery. In spite of the fact that we have to-day all manner of improved farm machinery we still need the convenience and economy made possible by the use of the rope in knot tying and splicing.

Some knots useful on the farm.—Some of the practical rope knots are as follows: the clove-hitch; bowline; never-slip noose; slipknot; Beckett hitch; reef-knot, or square knot, which never slips but is always easily untied; the two half-hitches often used for the halter-hitch; weaver's knot for the joining of small cords; fixed knot; anchor bend; timber-hitch, which can be easily untied but never slips; and the carrick-bend for joining ropes.



Some useful knots. Learn to identify and tie.

Making the right knot.—Different knots are required for different purposes. A simple knot that will serve in one use is not adapted to another; knots that will untie



Learn to "do" these knots and rope splicings.

under certain conditions may be impossible to untie under other conditions.[1]

1. A most interesting little book on rope knotting and splicing is one published by David McKay, Philadelphia. 50 cents. A number of the drawings here shown are taken by permission of the company from this set.

Principles of knot tying.—Certain principles apply to the tying of all knots. The efficiency of the knot does not depend on the number of turns or hitches, but on the position of the "nip." The bend or hitch must be so formed that the part of the rope under strain *nips* securely some portion of the knot, either against itself or the object to which it is attached. The nip of each different knot should be studied.

Rope materials.—While a large part of our rope and cordage is made of hemp, many other materials are now coming to enter into their manufacture. The coil rope is made from cocoanut fiber, which is used because it is so light and pliable. This rope is useful for warps, rocket lines, life-buoy lines, nets, etc. Manila grass is adapted to the construction of coarse ropes and hawsers requiring great strength and hard wear, and where tar can not be used on the rope.

Strips of hides are used for ropes where great strength and pliability with small diameter are needed. Cotton is employed for ropes and cordage used for fancy work of all kinds. Wire is used for rope making whenever very great strength is needed, as in connection with dredging machinery, suspension bridge cables and the like.

Rope making.—*Yarns* are formed by twisting the hemp right-handed, while the *"strands"* are made by twisting or laying up the yarns left-handed, and the *rope* by laying it up in strands right-handed. Three small ropes laid up left-handed form a *cable-laid rope*. Four-stranded ropes are laid round a heart. In using hemp for rope making, great care should be exercised not to twist the hemp more than necessary, as this weakens the rope. A three-stranded rope will bear a greater strain in comparison to its size than any other rope of the same material. This accounts for the fact that most of our rope is made of three strands. Cable-laid and four-stranded ropes are as a rule about one-fifth weaker.

Topics for Investigation

1. Make a list of all your farm machinery and estimate the value. Talk with your father and determine the annual expense of the farm machinery in deterioration and interest on the investment. How is your machinery housed? Is it kept in good repair?

2. Make a similar list of all your shop tools. Have you all that are needed for the up-keep of your farm buildings and machinery?

3. Make a list of all the knots you have ever seen used on the farm. Tie all these knots. What other knots would be serviceable? Learn to tie other useful knots from the pictures shown in this chapter.

4. If you wanted to draw a plank from the ground up to the gable window of a barn by use of a rope, what knot would you use? Think of several other such uses for knots and show the knots to be employed.

5. Make a rope halter for a horse or calf. Show how they are made and for what purpose they are used.

6. Locate on a map of the world the places where the different rope materials are produced. Make a collection of all the different kinds of rope available, and tell of what they are made.

4. *Rope Play Contests*

1. Knot naming contest.

2. Rope judging contest.

3. Knot tying and splicing contest, to see who can tie and name accurately the largest number of rope knots in a period of five minutes. Contest to be judged on skill, accuracy and number of knots tied.

4. Rope spelling contest, to be conducted from the list

of words used in connection with rope, cordage and splicing work, the object being to make pupils familiar with the terms.

5. Knot drawing contest.

5. *Rope Club Projects*

It is possible to organize a group of boys into a rope club with a view to the mastery of rope tying, splicing,

A rope tying contest, Wright County, Iowa. Record by one boy, thirty-eight knots tied, named and untied, in six minutes.

cordage work, etc. The requirements should be to study in connection with geography the various fibers used, such as hemp, cotton and cocoanut. The method of production of the plants, a study of uses of rope, and their practical application to farm and home mechanics should be taken up. The basis of award of a club project of this sort may be as follows:

1.	Knowledge of origin, development and methods of manufacture of the rope industry	20
2.	Ability to name and tell the use of knots and splicings	20
3.	Exhibit of knots and splicings named and mounted on board. (Use quarter-inch rope.)	20
4.	Skill shown by actual test in the tying and naming of rope knots	20
5.	Written story of "Rope Tying and Splicing as Related to Farm Mechanics"	20
	Total score	100

CHAPTER XXXIV

ROAD BUILDING AND MAINTENANCE

GOOD public roads are a prime necessity to successful agriculture and rural development. They add to the pleasure, profit and convenience of the farm.

1. *Importance of Public Roads*

There are in the United States about two million two hundred thousand miles of roads. Of this immense stretch of public highway, two million miles are classed as *earth* roads. This is to say that we have enough earth roads to circle the globe eighty times at the equator.

Good roads and prosperity.—A study of history shows that every great and prosperous nation has built a good system of public roads, while primitive and unprogressive peoples are satisfied with poor roads. In our own country we find the most prosperous and progressive communities are those that are giving attention to their roads.

Need for good roads.—Because good roads allow the farmer to haul his produce to market at a minimum of expense in time and energy, he can make more profit out of his crops and stock. And the prosperity of the farmer tends to increase the prosperity of all business men and lower the cost of living to consumers. The success of the rural schools also depends much on improved roads. Especially is this true where the schools are being consolidated and the pupils transported to the school by the district. Rural mail delivery and the extension of the parcel-

An earth road that needs improving.

The same road improved.

post system further demand the improvement of country roads. And, not least important, the making of country life interesting and attractive rests in no small degree on good roads, for they allow rural people easily to travel about the community for social as well as for business purposes.

Growing movement for good roads.—In nearly every part of the United States there is at present a growing interest in good roads. New laws have been passed and millions of money appropriated to improve our roads. Commercial clubs, business concerns and other organizations are working together to encourage road building. And farmers are coming to demand improved roads for both teaming and the use of automobiles.

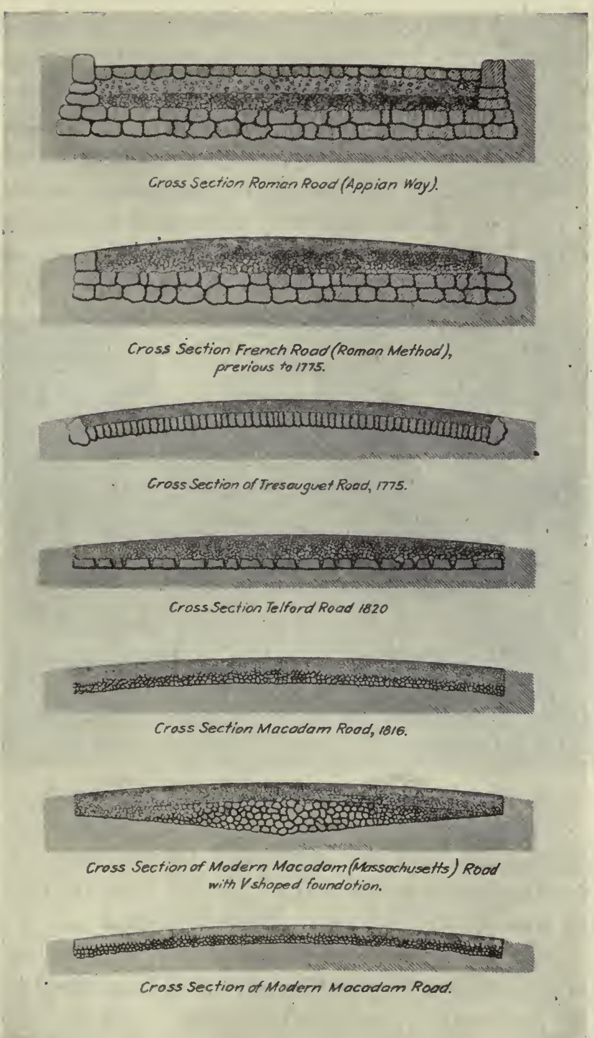
2. *Types of Roads*

Roads are generally considered under the following types: (1) earth roads, (2) sand clay roads, (3) gravel roads, (4) macadam roads, (5) bituminous macadam roads, (6) brick roads, and (7) concrete roads. The discussion in this chapter will be confined to the earth roads, since these are the most necessary and practical study for the public schools.

Earth roads.—A chain is no stronger than its weakest link; so, also, a road is no better than its poorest part. This means that the heaviest load that can be drawn over a public highway is the load that can be drawn up the steepest hill, through the worst ruts or mud-holes, or over the deepest stretch of sand. Hence the importance of lowering or going around the hill, and eliminating the mud-holes, ruts and stretches of sand.

3. *The Location of a Road*

Public roads should, as far as possible, be located in straight lines. In hilly or mountainous regions, however,



Cross-sections of different types of roads.

this rule must often give way to avoid the climbing of too heavy grades.

Straightness and grade.—To lift a ton one foot high requires two thousand *foot-tons* of energy. On a road surface requiring one hundred pounds traction per ton, the same energy would roll the ton a horizontal distance of twenty feet. As far as the actual amount of energy used is concerned, therefore, to save one foot of grade, or up-hill

Earth road in Kansas.

climb, the road may be lengthened twenty feet. Public road grades should avoid a rise of more than six feet in a distance of one hundred feet. The hills should be cut down and the material used to fill in the hollows or else the road relocated to go around the hill and to avoid the steep grades.

The necessity of sunlight.—Every road bed should have at least six hours of sunlight each day. Brush, trees or hedges that interfere with this requirement should be cleared away or sufficiently thinned out. On the other hand, suitable trees, shrubbery, grass, vines and flowers should be encouraged along the roadway, as they add both to the beauty of the road and the value of farms.

Drainage.—As a rule the only ditches needed for the proper drainage of the road can be made by the road grader. Deeper ditches are necessary where the adjoining land is low and level. In the building of culverts care should be taken to make them large enough to handle the overflow. They must also be sufficiently durable to resist the spring

Concrete road near Detroit.

freshets and not be injured by the maximum flow caused by storm water. They should have sufficient slope so that the wash will keep them clean. All the spillways should be paved, if necessary, and the outlet and inlet protected by suitable head and wing walls.

4. *The Construction of Earth Roads*

Shaping the road bed.—Earth roads should not be made too wide. Twenty-four to thirty feet is sufficient unless the road is to be macadamized or otherwise permanently improved. All roads should be properly crowned or rounded in order to aid them in disposing quickly of surface water. An earth road twenty-four feet wide should not be less than six inches nor more than twelve inches higher at the center than at each of the borders. The total fall from center to side should be about an inch to the foot.

The work of construction.—The earth roads can best be crowned and ditched by a reversible road grader. The use of picks, shovels, scoops and plows should be avoided. One road machine with sufficient power and a good operator will do the work of a large number of men and do it much better. Graders as a rule should be used when the soil is damp. This will make the soil pack well while drying. If it is worked when dry and hard it takes more power to draw the machine and in addition the dry earth and dust will absorb and retain moisture and soon develop ruts. All clods, sod, weeds and vegetable matter should be removed.

5. *Maintenance of Earth Roads*

Necessity of constant care.—The greatest problem of earth road building is that of maintenance, and any earth road which carries a great deal of traffic requires almost constant attention. Repairs should be made when needed. A few days spent upon the road at different times throughout the year will accomplish a great deal. It is a serious mistake to devote all of the time in road building to a particular season, leaving the road without care the remainder of the year. Most communities need a few men and teams spending their entire time in keeping roads in repair.

Dragging earth roads.—One of the most useful devices for the maintenance of public earth roads is the *split-log drag*. This works with great efficiency on both earth and gravel roads. To obtain the best results the roads should be dragged once each way after every heavy rain. This must be done while the soil is moist but not sticky.

It is not necessary to employ the direct supervision of skilled engineers for the maintenance and repair of earth and gravel roads, providing the directions and suggestions they lay down are carefully and intelligently followed. A

The split-log drag at work on an Iowa road.

difficult piece of construction or fixing of grades should, however, always be carried out under the supervision of an expert.

Topics for Investigation

1. What is the prevailing type of road in your locality? How many miles of public roads in your school district? In your county?

2. What roads do you know which climb steep hills? Can you devise a method by which you can measure the

grade of the incline, and find how many feet rise to each one hundred feet?

3. How many split-log drags in your school district? What road machinery is owned by the township or road district?

4. Under what management is the care of roads in your locality? Name the road officials of your district and county. Give a statement of the road laws of your state.

5. What different materials are used in constructing bridges, culverts and road drainage systems in your locality? Which seems to be the most satisfactory?

6. Do any transcontinental or state highways pass through your state? If so, locate them on a state map and name them.

7. For whom was the macadam road named? Describe how such a road is built.

8. Look up the story of each of the following men and learn what he did to help the cause of good roads: Pierre-Marie Fresaguet, J. L. MacAdam, Thomas Tilford, Eli Whitney Blake.

6. *Demonstrations*

Many of the demonstrations should be conducted out on the public highway and when possible under the supervision or direction of the road supervisor, commissioner, or expert.

1. Demonstrate how to make a split-log drag, either full size or miniature.

2. Demonstrate by means of drawing, paper or wood construction, the various types of drainage used in road building.

3. Show how properly to crown a road.

4. Demonstrate how to repair a rut in a permanent roadway.

5. Demonstrate by drawing a roadway showing correct perspective, crowning, drainage, etc.

A good macadam road.

Bituminous macadam road in New Jersey.

7. *Road Play Contests*

1. Road dragging contest.
2. Split-log drag making contest.
3. Road drawing contest.
4. Essay writing contest on subjects relating to roads.
5. Spelling and drawing contests, as related to the words and interests of road work.

A concrete bridge. This type of structure should replace the old wooden bridge.

8. *Road Club Projects*

Permanent road building is not, as a rule, the work of boys and girls. But the building, maintenance and repair of common earth and gravel roads is quite within the reach of the boys ranging in age from twelve to nineteen. Two different road projects are suited to club work.

One project is known as the "School Road Dragging Club," in which the pupils, under the leadership of the teacher and with the advice of the road officer, take charge of one mile of public highway near the schoolhouse, keeping it well dragged and in repair for the season. A second project permits individual pupils to take charge of one mile of road in front of the homestead, keeping it carefully dragged and in good repair during the summer.

Awards.—The basis of award in either of these club projects may be as follows:

1.	General improvement in road during period of club project, based upon trueness, alignment, regularity and clearness of ditches, amount and shape of crown, betterment of surface and drainage	15
2.	General condition of improved section at end of club project period with reference to clearness of ditches, waterways, trueness, and shape of borders, freedom from ruts and depressions, smoothness, compactness, regularity of width	15
3.	Economy of methods used, based on ten cents per hour for time of horse, and ten to twenty cents per hour for member	15
4.	Complete records and story of "The Road Work of the Season"	15
5.	Faithfulness of maintenance during club project period with reference to freedom of flow in ditches and waterways, repair of borders and washes, rapidity of drying out and hardening after rains, and the regularity and systematic use of the split-log drag	40
	Total score	100

The authors are indebted to Mr. Maurice O. Eldridge, of the office of Good Roads, Washington, D. C., for able assistance in the preparation of this chapter, and to the office of Public Roads for photographs used.

CHAPTER XXXV

BIRDS AND OTHER INSECT DESTROYERS

THE farmer is greatly assisted in his war against the insects that prey on crops, orchards and gardens by birds and other creatures that use these pests for food. Every farm boy and girl should learn the most useful of these small friends and protect them in every way.

1. *Birds and Their Food*

Whether certain birds are helpful or harmful to the farmer depends almost wholly on what the bird eats. If its diet consists chiefly of farm grains and domestic fruits, or if the bird kills other useful birds, it is an enemy; if, on the other hand, its food is made up mainly of harmful bugs, beetles, grasshoppers, caterpillars and worms, it should be counted as a friend. It is also to be remembered that many birds that eat grain or fruit as a part of their diet may kill enough noxious insects in return to pay far more than for the damage they do. Besides devouring insects, many species of birds eat immense quantities of weed seed, thus reducing the weed crop of the next season.

Food of some common birds.—Scientists of the United States Department of Agriculture have examined the stomachs of many birds to determine the nature of their food, and thus discover their relation to agriculture:

The *quail* or bobwhite eats weed seed, potato beetles, squash beetles, the boll weevil, chinch-bug, grasshoppers, cutworms, etc.

A favorite food of the birds.

Mourning doves live principally on weed seed, with a small proportion of waste grain.

Cuckoos live chiefly on caterpillars, grasshoppers, beetles, moths and other harmful insects.

The *red-headed woodpecker* makes three-quarters of his diet consist of harmful insects, and most of the rest of weed seed and wild fruit.

The *night hawk* is especially fond of flying ants, but also eats grasshoppers, beetles and bugs.

Bank swallows and *barn swallows* live almost entirely on flies, various species of flying beetles, ants and weevils.

The *grosbeaks* are among the most useful of our birds. They are particularly fond of potato beetles, and have done much to rid the farmers of this pest. They also eat other harmful insects.

The *barn owl* lives principally on mice, rats and rabbits. While he captures an occasional chicken, he does far more good than harm and should be protected.

The *crow* is usually looked upon as a thief and a robber. There is no doubt that the crow does pull up young corn, rob birds' nests and occasionally kill young chickens. Yet the crow is so fond of beetles, grasshoppers, bugs and other crop enemies that his virtues exceed his vices and he should be counted as a friend.

Other useful birds.—It will not be necessary to extend this list, which might be made to include scores of birds that join with the farmer in his efforts to rid the crops of insect pests. Among the many species that should be encouraged and protected are: meadow lark, house wren, song sparrow, oriole, scissor-tail fly catcher, mocking-bird, blue jay, red-winged blackbird, cardinal, red-headed woodpecker, killdeer, screech owl, robin, bluebird, snow bird, warbler, kinglet. In general, the birds are the farmer's friends and deserve his good will.

The hairy and downy woodpeckers.

Harmful birds.—A few species of birds do much more harm than good and therefore do not merit protection.

The *English sparrow* has been declared a pest and should be exterminated. While in some regions it eats a certain proportion of weed seed and harmful insects, on the whole its diet consists of orchard fruits, young garden vegetables and field grains, especially wheat. It also eats the eggs and attacks the young of a score of useful birds, thus reducing their number. Campaigns of extermination have been waged against the English sparrow in various parts of the country.

The *house finch* and the *sapsucker* also do sufficient damage that they have no claim to the farmer's good will or protection.

2. *Other Enemies of Harmful Insects and Animals*

Besides birds a number of other creatures, most of them so lowly as all but to escape observation, are good friends of the farmer.

The toad.—The common ugly toad, which we often either avoid or kick out of our path, deserves better treatment. Its food consists of flies, caterpillars, cutworms, June-bugs and other harmful insects.

The *horned lizard* fancies almost the same bill of fare and joins with the toad to protect our gardens.

Snakes.—The small snakes common to most regions are entirely harmless, and live on our enemies, such as mice, various beetles and weevils. It is therefore a mistake to kill them.

3. *Protecting Our Friends*

Young people should make a study of the life and habits of the humble friends who do their best to rid our

The meadow lark.

fields and gardens of their enemies, and should always encourage and protect them.

Attracting the birds.—Bird houses consisting of small boxes roofed over, cans open at one end, or other suitable receptacles placed in trees or on posts in secluded places will do much to attract certain birds. When deep snow covers the ground in winter, hiding the seeds and other

English sparrows, male and female.

food, it will pay well to scatter a little grain each day where the non-migrating birds will find it.

How to treat a friend.—Bird hunting should not be with a gun, but with a camera, field glass or alert eyes for the purpose of becoming acquainted with our feathered friends. Birds' nests should never be disturbed, the eggs handled or the young worried during nesting time. The fashion which decorates hats with the plumage of birds, thus requiring their destruction, should be severely condemned. We should even come to look upon toads, lizards, snakes and frogs as our friends and treat them well.

Topics for Investigation

1. Make a list of the birds you are able to identify at sight. Do you know the nesting habits of each of these?
2. Make a list of all the birds' eggs you are able to identify. Do you know the hatching time of each?
3. Secure a copy of *Farmers' Bulletins* Nos. 54 and 506, and make a table of the food of each of the common birds of your locality.
4. What birds remain over winter in your region? What ones migrate and where do they go?
5. Watch for toads, lizards and snakes and observe their feeding habits.
6. Keep a lookout for birds you do not recognize, and find out their names and habits.

CHAPTER XXXVI

MISCELLANEOUS INFORMATION

1. *How to Remove Stains*

Iron rust.—Apply salt and lemon juice to the dampened spots. Place in the sun or near the fire. Then rinse or wash thoroughly.

Fruit stains.—Pour over stained cloth, boiling water, letting it fall a distance of four or five feet, or wring article out of cold water and leave out-of-doors over a cold night.

Blood stains.—All fresh blood stains can be easily rubbed out after soaking in cold or tepid water. After the blood has been dried, use javelle water or peroxide of hydrogen. Kerosene is sometimes used with success.

Paint spots.—Use equal parts of ammonia and turpentine. Wash or rub until clean.

Grass stains.—Remove grass stains by the use of alcohol, naphtha soap, or ammonia and water.

Ink.—The commercial ink eradicator will remove ink stains from all white goods. If used on colored goods it will probably bleach or remove color. Another practical recipe is to wet the spot with warm water and sapolio, rub or polish between the hands, wash in a solution of hydrochloric acid and rinse in ammonia water.

Mildew.—Mix equal parts of soap and starch, half as much common salt, and juice of half a lemon. Spread over the spots and lay garment upon the grass until the stain disappears.

Perspiration.—Soak in cold water, wash with borax and spread garment to dry in sunlight. Under-arm stains usually require an acid such as a weak solution of muriatic acid.

Burned cooking utensils.—To clean granite ware where mixtures have been burned on the surface, fill container half full of water, add good soap, washing powder, or baking soda. Bring water to a boiling point and scrub with a small brush.

Tea, coffee or cocoa.—Wash with cold water, pour glycerine over spots and let stand for a few hours. Then wash with cold water and hard soap. If stains are fresh, pour over the stains boiling water from a height of four or five feet, after soaking.

Tar or wagon grease.—Use cold soap-suds.

Pit stains.—Grease with lard before using soap and water. Turpentine will usually remove the stains if other remedies fail.

2. *Location of Colleges of Agriculture, Extension Departments and Experiment Stations*

Letters addressed to any of these institutions, requesting information on agriculture or home economics subjects will be answered with courtesy. Help will be rendered or farm bulletins supplied when possible.

STATE	College of Agriculture	Extension Department	Experiment Station
Alabama	Auburn	Auburn	Auburn
			Uniontown (Sub.)
			Tuskegee (negro)
Arizona	Tucson	Tucson	Tucson
Arkansas	Fayetteville	Fayetteville	Fayetteville
California	Berkeley	Berkeley	Berkeley
Colorado	Fort Collins	Fort Collins	Fort Collins
Connecticut	Storrs	Storrs	Storrs
			New Haven
Delaware	Newark	Newark	Newark
Florida	Gainesville	Gainesville	Gainesville
Georgia	Athens	Athens	Experiment
Hawaii	Honolulu	Honolulu	Honolulu
Idaho	Moscow	Boise	Moscow
Illinois	Urbana	Urbana	Urbana
Indiana	Lafayette	Lafayette	Lafayette
Iowa	Ames	Ames	Ames
Kansas	Manhattan	Manhattan	Manhattan
Kentucky	Lexington	Lexington	Lexington
Louisiana	Baton Rouge	Baton Rouge	Baton Rouge
	New Orleans	New Orleans	Auburn Park (brch.)
			Calhoun (branch)
			Crowley (branch)
Maine	Orono	Orono	Orono
Maryland	College Park	College Park	College Park
Massachusetts	Amherst	Amherst	Amherst
Michigan	East Lansing	East Lansing	East Lansing
Minnesota	St. Paul	St. Paul	St. Paul
Mississippi	Agric. College	Agric. College	Agric. College
Missouri	Columbia	Columbia	Columbia
Montana	Bozeman	Bozeman	Bozeman
Nebraska	Lincoln	Lincoln	Lincoln
Nevada	Reno	Reno	Reno
New Hampshire	Durham	Durham	Durham
New Jersey	New Brunswick	New Brunswick	New Brunswick
New Mexico	State College	State College	State College
New York	Ithaca	Ithaca	Ithaca
			Geneva
North Carolina	West Raleigh	West Raleigh	West Raleigh
North Dakota	Agric. College	Agric. College	Agric. College
Ohio	Columbus	Columbus	Wooster
Oklahoma	Stillwater	Stillwater	Stillwater
Oregon	Corvallis	Corvallis	Corvallis
Pennsylvania	State College	State College	State College
Porto Rico	Mayaguez	Mayaguez	Mayaguez
			Rio Piedras (Sub.)
South Carolina	Clemson College	Clemson College	Clemson College
South Dakota	Brookings	Brookings	Brookings
Tennessee	Knoxville	Knoxville	Knoxville
Texas	College Station	College Station	College Station
Utah	Logan	Logan	Logan
Vermont	Burlington	Burlington	Burlington
Virginia	Blacksburg	Blacksburg	Blacksburg
	Hampton	Hampton (negro)	Norfolk (branch)
Washington	Pullman	Pullman	Pullman
West Virginia	Morgantown	Morgantown	Morgantown
Wisconsin	Madison	Madison	Madison
Wyoming	Laramie	Laramie	Laramie

THE END

TO THE TEACHER

TO THE TEACHER

1. *The Point of View*

SUCCESSFUL teaching of agriculture, more than that of any other subject, depends on the spirit and methods of the teacher. Agriculture is so thoroughly concrete a subject that only a small part of it can be effectively taught by text-book and in class room without the assistance of field and farm. The teacher of agriculture must remember first of all that there is no *real agriculture* in the text-book.

The place of the text.—Real agriculture is out in the fields, gardens and pastures, and among the herds and flocks of the farm. The text-book can only serve as a guide to point the way, showing the pupil what to look for, and teaching him to understand what he finds as he meets the problems of preparing the soil, planting and tilling the crop, or feeding and caring for the stock. Agriculture can therefore not be taught from the text alone, no matter how complete or well arranged it may be, nor how generous the illustrations. The text-book is very important in class room and laboratory, but it must be supplemented by extension methods and agencies to the immediate interests of the farm.

2. *Public School Extension Work*

This point of view suggests a method for connecting the work of the school with the home. The children should actually *do* the things they study about. For a number of years the colleges of agriculture have been engaging in various forms of *extension* work, with a view to offering the services of the educational institution to those who can not go to college. The time has come when the public school should also offer some such form of extension service and by so doing reach all the homes of its patrons.

Plans for extension projects.—Agricultural extension work can be carried out by the public schools according to two different plans: (1) the setting of certain definite home or farm "projects," or specific pieces of work, to be carried out by the individual pupils as a part of the course in agriculture; or (2) the organization of agricultural clubs, which provide for group training for leadership and in principles of cooperation in addition to the work of specified nature with state or national club organizations. In either case a certain amount of school credit may be allowed for home and club work satisfactorily done.

Agricultural club projects.—The United States Department of Agriculture in cooperation with the state colleges of agriculture has undertaken the organization of boys' and girls' clubs in every state in the Union, and, wherever possible, works in connection with the public schools. Government experts, state club directors, county agricultural agents of the state agricultural colleges all stand ready to help organize, promote and direct these clubs.

The teacher of agriculture will find the club a great incentive to pupils, and an invaluable extension agency to text-book and class-room work. Through the club it is possible to translate book and laboratory information into real *action* in the field, with the herds, and in the home. Agricultural club work will also do much to bridge the gap that has so long existed between the home and the school.

The number of club projects.—The club idea must not, however, be overdone. It is possible to start so many projects that none of them can be well supervised or successfully carried out. Probably no school should encourage the formation of more than two different club projects for the same season. Club work is outlined with almost every chapter in this text, but not with the expectation that any school will organize at one time all the clubs suggested.

The teacher, with the cooperation of county, state or other agricultural club leaders, should select for boys the project of greatest agricultural significance and value to the community, and for the girls the project of greatest economic and social value to the community home life. Every rural school, especially, should have two such club projects. This plan will carry the benefits of the school to the homes, and offer the boys and girls real interests in agriculture and home economics not only for the school year, but for the summer vacation as well.

3. *Equipment for Teaching Agriculture*

The amount and nature of the equipment required for the teaching of agriculture will depend largely on the time allotted to the study, the age and grade of the pupils, and the scope of the work undertaken. But every school, no matter how small or elementary, must have certain necessary equipment if the work is to be most successful. Much of this material can be made by the pupils in the school, if they are properly directed.

Tables and cabinets.—It is essential to have suitable table space so as to permit study or demonstration in a group. This will be much more satisfactory than undertaking to do the work from the individual desks of the pupils. For successful class work the pupils should always be seated together for observation and instruction, and there must be room for the display and distribution of material to be used by the entire class. Adequate cupboard or cabinet space for the storing of material and specimens is important. These may be separate pieces, or built permanently in or against the wall. They should be mouse- and insect-proof, otherwise the specimens are likely to be destroyed. The upper section of the cabinet may be of glass and the lower doors of wood. The doors should be locked throughout night and vacation periods.

4. *Individual Equipment*

A few pieces of litmus paper.

Small glass vials for the selection of weed seeds and samples of soil.

Two pieces of quarter-inch hemp rope for use in the study of the relation of the rope to agriculture.

A few blotter testers, a rag-doll tester, and at home, a box seed-corn tester.

Seed racks and seed trays used for drying and exhibiting purposes.

A small thermometer for the testing of temperatures of water, soil, testers and incubators.

A few simple garden tools like hoes, rakes, small hand spades, potato fork, etc. Most of the garden tools can, of course, be supplied from the home to be used both at home and at school.

Some simple carpenter tools for use in the making of model hen houses, trap nests, feed and watering troughs, single-trees, seed boxes, cold-frames, etc.

5. *General Equipment for the School*

Seed trays, seed-testing equipment, soil capillarity tubes, a set of large-mouthed bottles for exhibits of types of soil, a similar set for exhibits of seeds, a Babcock milk tester, canning equipment, a few miniature models of farm machinery. When room has been provided and funds are available regular farm machinery, cream separators, fanning mills, can sealers and washing machines will be of great value in the teaching of the various subjects of agriculture.

6. *Laboratory Material*

A great deal of the material for instruction can be obtained as needed from the homes, and adjoining farms and fields. It is not possible, however, to make the course in agriculture follow the seasons exactly, and some material therefore needs to be stored for class use. Other material may not be easily found when required. Samples of still other products may not be available in the region, and should be kept for comparison.

Samples of soils.—Samples of all the different varieties of soils to be found in the region should be collected and kept in laboratory bottles, jars or common fruit jars. These samples should include soils rich in humus, clays, sands, lava, and soils in which organic matter is lacking. Each sample should be labeled, telling the type represented and where obtained.

Specimens of cereal plants and grains.—Samples of all the common cereal grains, including the different local varieties, should be collected and stored in wide-mouthed bottles. These will serve for comparison with samples brought by the pupils from their farm crops. Specimens of the cereal plants should also be collected and stored when the crop is ripening. This will allow the class to study the different types and varieties of wheat, oats, etc., and to identify each from the plant, even if the study can not be taken up when the crops are available in the fields. It is also desirable to make a collection of types or varieties not common to the region and use them for comparison. The state agricultural college can usually help in securing such a collection.

Specimens of grasses and legumes.—A complete collection of the native grasses and legumes should be made in every school. The pupils will delight in helping in this work, which may be made one of the most valuable parts of their instruction. Wherever possible the roots should be saved with the stem, so that the entire plant will be represented. The specimens should be clearly labeled and tied in bunches or attached to pieces of cardboard. It is not intended that these dried samples shall be used for study instead of the growing plant, but they are often useful for occasional illustration during the winter and when there is no time to collect the new material. They also serve as a standard for identification of specimens brought by the pupils to the school. The list should include the chief varieties grown in other sections of the country.

Specimens of weeds.—A collection of the noxious weeds of the region should be made and labels attached. Here again the class may be used in making the collection of all specimens that are available at the time school is in session or even during vacation. A collection of weed seeds should be saved in bottles like those used for the cereals. Pupils should become able to identify at sight both the weed plant and its seed, and should know the habits of growth, the injury done crops and the method of eradication.

Specimens of injurious insects and worms.—The insect pests common to the region should be collected and preserved for study by attaching them to cardboard by means of laboratory pins or other device. The school should have a cyanide insect bottle for killing specimens, and insect cases for preserving them. Each specimen should be clearly labeled and the time of its appearance and disappearance given. These specimens will then serve as a guide for the class in making their own collection, or identifying the insects at work. The proper place to study insects is, of course, in the field in connection with the soil and plant life whenever they are available.

Specimens of woods.—A collection of native woods is one of the most interesting and easy to make. Every pupil will be glad to take part in the work. Samples of the leaves should also be collected and preserved. Such a collection will supply the basis for a study of trees, and should result in each pupil being able to identify native trees at sight, by their leaves, wood and habits of growth. Pupils should not be permitted, however, to destroy useful plants for the sake of school specimens. The best exhibit of woods and tree interests is a well managed, growing wood lot on the school or home grounds.

7. *Method of Instruction*

It is neither possible nor desirable in this place to give detailed discussion as to the methods of teaching agriculture. Certain broad and fundamental principals may, however, be stated.

Seeking knowledge at first hand.—From the very first day, the pupils should be made to feel that the study of agriculture is the study of the actual problems of the farm—crops, soils, animals, and all else that goes to make up the life of the farm. To "get a lesson," is therefore not to commit to memory what the text may say on a certain subject, but to use the text-book and all other available helps to master fully the problem at hand in the study of an ear of corn, the cotton plant, the preparation of the seed bed, the fertilizing of a field, or the feeding and management of a flock or herd.

Use of the text-book.—The text-book is arranged to give as natural and interesting an approach as possible to each chapter or topic. There is hardly a text-book lesson for a single day which does not provide for some practical home and field study in connection with the subject under consideration. The lesson assignment should usually first be studied from the text, the field laboratory or home project on the topic should then be carefully assigned and directed. *The topics for investigation and the questions throughout the text should always be worked out fully and thoroughly.* In many instances the teacher will desire to add questions or topics to supplement those of the book. Only in such practical ways can agriculture be made interesting and vital.

Use of note-books.—The pupils should be provided with note-books of uniform size. In these should be kept a record of all demonstrations, experiments, field trips, excursions and observations. Here should also be worked out all the exercises and problems required in the text, and those assigned by the teacher. Drawings, diagrams, tables or any other matter brought into the course should find their way into the note-book. Pictures of farm animals, crops, machines, farm buildings and the like, should be assembled and form a part of the record of the course. Every note-book should be neat and well kept, and arranged in a businesslike manner.

Correlation with other subjects.—Agriculture may well be made in many schools to serve as the basis of correlation with other subjects. Much of the arithmetic can be taught more efficiently and naturally from the lessons in agriculture than in any other way. Language work, including composition and letter-writing, can be related to much of the work of the agriculture course. Industrial geography is suggested by every chapter in the text. Freehand and mechanical drawing, manual training and domestic science all correlate easily and naturally with the lessons and problems of the course.

Connection with home work.—Constant reference is made in the text to the crops, gardens, stock, soil and other interests *found on the farm or in the home.* This is not by accident. The purpose is to make the study of agriculture interesting and helpful by connecting it immediately with the homes. The teacher who will faithfully carry out this concrete method of instruction will find growing in the pupils a firm and abiding enthusiasm in the subject never to be expected in mere text-book study. *The great purpose and the highest success is to get the lessons of the text translated into life and common practise.* The work on agricultural projects assigned in connection with the course should, as far as possible, be done under the guidance of the teacher and may receive school credit.

Demonstrations and experiments.—The difference between *demonstrations* and *experiments* should be clearly understood by the class. The idea in an experiment is to investigate, discover or verify some truth. In a demonstration some well-known truth is illustrated, shown or demonstrated to others, with the purpose of convincing them of its merits and leading them to adopt it in practise.

8. *Seasonal Order of Study*

Seasonal order impossible in text.—It is wholly impossible to arrange any text on agriculture so that the topics will follow the seasons throughout the year. If this could be done it would make the teacher's work much simpler and easier. But seasonal variations do not come at the same time in different regions, nor does the order of the crops and gardens follow the arrangement of the present school year. The summer vacation, however, must be used for definite extension work in agriculture by means of club work or home projects.

Order to be based on crop sequence.—Because of these facts, it must be left to the teacher to select such an order from the text as best fits the crops and seasons of his region. It is not necessary that the chapters be taken in succession as they occur. For northern schools opening in the late summer, the corn chapter undoubtedly will be best for a beginning. The potato chapter should be taken up before the crop is harvested if possible. It may be referred to again at planting time in the spring. The garden chapters should be studied during the late winter or early spring, and again referred to as the planting, spraying or tillage is under consideration. The teacher need not be afraid even to divide a chapter, using a part at two or more different seasons if this seems best. For example, the field study of corn should be started in the fall with the ripening crop, but the testing and grading of seed corn should be reserved for winter and early spring study.

The greater part of the study of farm animals can be successfully carried on during the winter, though certain of the features should be taken up in the fall or spring. Some of the work on soils can also be utilized for winter study. Actual field study and demonstrations will, of course, be carried on when the ground is not frozen. The great point is to base the lessons on the immediate activities of the farm during just as much of the year as possible, making the assignments from the text conform to the seasonal order of the locality.

9. *Reference Material*

Every school where agriculture is taught should be stocked with a number of standard texts on each of the divisions of the subject. The library should contain a standard cyclopedia of agriculture. It is also desirable to have the *Agricultural Year Book* of the United States Department of Agriculture, a complete classified file of farmers' and station bulletins, and the Census Reports that deal with the subject of agriculture. Arrangements can also be made for the receipt of the current crop reports.

Government publications.—The United States Department of Agriculture, Washington, D. C., is in position to give help to all citizens on the subject of agriculture. A large number of *Farmers' Bulletins,* circulars, reports and special series of instructions on almost every conceivable agricultural or home economics subject, can be secured by addressing the States' Relations Service, United States Department of Agriculture, Washington, D. C. Most of the publications are free and are intended for the use of the public. This material makes a very necessary and helpful supplement to the text-book, and should be constantly referred to. It is well to provide some library or filing arrangement to contain such material, so that it can be properly classified and available for ready reference.

State agricultural colleges and experiment stations.—Every state has its agricultural institution and experiment station. These institutions publish a great deal of valuable material on the agricultural problems of their respective states. In most cases the material is free to all citizens of the state, and should be freely drawn upon for school use. A list of the agricultural colleges and experiment stations will be found in the chapter on "Miscellaneous Information."

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