ONE HUNDRED LESSON
IN
AGRICULTURE

ARETAS W. NOLAN

ROW, PETERSON & COMPANY

Courtesy of Farmer and Breeder *Photo by Hildebrand*

A FINE DAIRY HERD

One Hundred Lessons in Agriculture

with

Practical Problems

By

Aretas W. Nolan, A. M.
Associate Professor of Agricultural Education,
West Virginia University

Chicago

Row, Peterson & Company

TO
MY FATHER AND MOTHER,
WHO ALL THEIR LIVES
HAVE DWELT AMONG THE FIELDS,
IS THIS BOOK DEDICATED.

PREFACE.

The preparation of this book is an effort to combine in convenient form the discussions, directions for laboratory and field exercises, note-book work, and farm arithmetic, which the author has found most practical and helpful in teaching elementary agriculture in rural schools.

It has been the aim of the author to select from the vast field of agricultural knowledge and practice such subject-matter, materials, and methods as the teacher in the one-room country school, in the grammar grades of a graded school, or in the beginning years of a high school, may find easily practical, within the range of the pupil's understanding, and full of profitable interest and educational value. It is a text-book and manual combined for the purpose of leading away from the usual text-book method of teaching to the method of first-hand contact with the real things of agriculture. The fields, the pastures, the groves, the orchards, and the gardens, are the real text-books,—this book is only a "friendly guide-post." If the work is not conducted by means of real things, the educational value is lost, and the information given not permanently retained.

Many of the lessons are followed by a set of practical farm problems. These problems have a definite relation to the subject-matter which they follow, as well as a close relation to farm life. Most of these problems were prepared by Professor Hatch of the University of Wisconsin, to whom we make grateful acknowledgment.

The lessons are arranged in the order of actual farm operations and interests, during a year on the farm, and the teacher in the public schools may easily adapt them to local needs, beginning with any month of the year. The seasonal sequence of subject matter in school agriculture is both pedagogical and practical. Illustrative material is easily obtained, the interest of the pupils is at once awakened, and coöperation with the farm activities of the community is natural and inevitable.

THE AUTHOR.

SUGGESTIONS TO TEACHERS.

1. Read from other texts the subject-matter treated in these lessons.

2. Collect beforehand the materials needed for the practical exercises, and have everything ready for the recitation.

3. Ask the pupils to assist in collecting the materials, and have them perform the experiments whenever possible.

4. Make many excursions for observations of farming methods. Bring the class to the material when the material cannot be brought to the class. But always obtain permission from the owner of the farm upon which excursions are made.

5. Have a school garden if possible.

6. Write to your State Agricultural Experiment Station, the State College of Agriculture, and to the Department of Agriculture at Washington, D. C., for information, bulletins, and seeds.

7. Require each pupil to keep a permanent agricultural note-book in which to write a neat pen-and-ink record of each lesson. The work of recording the results of the practical exercises gives the pupil something definite to do.

8. Have the lesson in agriculture the last period of

the day, and there will be better opportunity for practical work. Some of the lessons of the text may serve for several school lessons.

9. Relate the work in agriculture to the home farms whenever possible. Make "home projects" the basis of many recitations.

10. Make the "Year on the Farm" the work of the school year in agriculture.

TABLE OF CONTENTS

September

October

November

December

January

February

March

April

LESSONS IN AGRICULTURE

A YEAR ON THE FARM

SEPTEMBER

LESSON I

SELECTING AND LAYING OUT THE FARM

A forty-acre farm.—Let us suppose that it is the first day of September, and that we have moved into a new home upon a forty-acre farm. Our farm is square —80 rods by 80 rods—and the buildings are located at one corner of it. We shall do general farming. Our market is five miles away, and we have good roads. The farm is level, with the exception of a V-shaped valley extending across it from north to south, dividing the farm into two nearly equal parts. This valley furnishes excellent drainage facilities and an abundance of good spring water throughout the year. The soil of our farm is a rich, sandy loam for the most part, above a clay subsoil, and is in good physical condition. The fields are free from stumps, stones and waste places.

There is an orchard of five acres, a wood-lot of five acres, and the rest of the farm, with the exception of the valley running through it, is tillable.

The climate is temperate, ranging from zero to 90 degrees above zero. The climatic conditions do not interfere with stock raising, and the general healthfulness of the place is assured. The local markets, the school and church facilities, the character of the neighbors, are all excellent factors in helping us to decide upon this farm.

We shall be very busy all the year, but we shall find great pleasure in our work. The planning, the building, the sowing and reaping, and the beautifying of our home will furnish us interesting work for many years; in fact, the work will never be finished, and therein is the joy of it all.

The month's work.—September is the month for school to begin, and the interests of the farm will enter largely into the activities and lessons of the school. Busy days are ahead of us. Very little planting is to be done at this season, aside from wheat sowing, but we are in the midst of harvest, when we reap the rewards of the year's labor, and begin to plan for the coming winter. The great work of this month is the sowing of the wheat, and we shall learn of this great crop during the month. The second crop of clover is to be cut for seed. Perhaps the wheat from the July harvest has been stacked and is to be thrashed. During this month we shall find many weeds on the farm going to seed, and these should be cut down. The hungry insects will continue their ravages and demand our attention

Practical Exercises

1. Report on the Home Farm

Make a report in class upon the home farm, using the following topics:

1. Kind of farming done.
2. Size and shape of farm.

Courtesy of O. J. Kern.

FIG. 2. AT THE GROVE SCHOOL

3. Surface condition—level or hilly.
4. General fertility condition.
5. Drainage.
6. Water supply.
7. Advantages or disadvantages of the location—market, schools, neighbors, etc.

8. Improvements—house, farm buildings, etc.
9. Trees and landscape features.
10. Climate and healthfulness.

2. Map of Home Farm

Each pupil in the class should draw a map of the home farm, showing fields, woodlot, orchards, gardens and buildings. Draw to a scale of inches. Write the report and draw the map as the first exercises in your agricultural note-book.

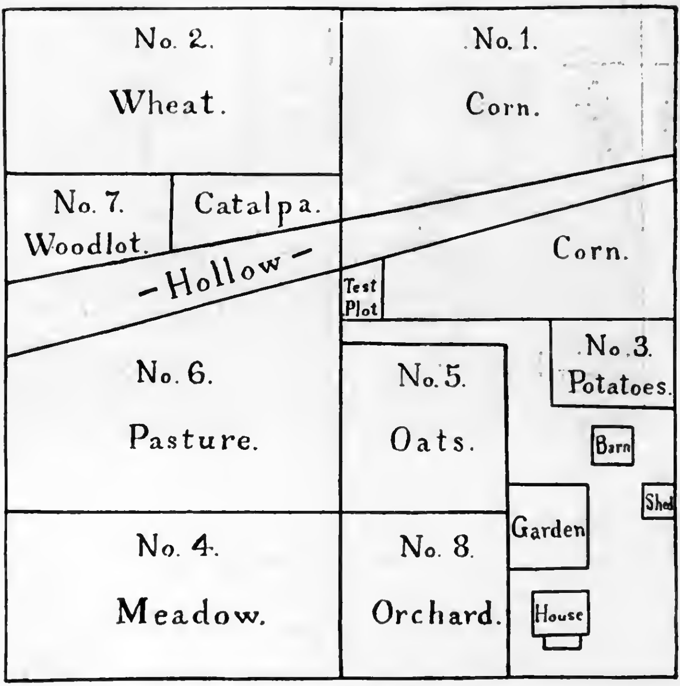


FIG. 3. DIAGRAM OF 40-ACRE FARM

LESSON II

FARM BUILDINGS

Location.—On our farm we have a good house, barn, granary, silo, carriage house, poultry house, and farm laboratory. Attention has been given to the proper arrangement of these buildings, within themselves and in relation to each other. The barn and other farm houses are located back of the dwelling house, and the vegetable garden is convenient to the kitchen, yet well hidden from the front view of the house. The dwelling house is situated upon an elevation sufficient to afford good drainage, several rods back from the road, leaving room for a pretty lawn in front. A drive leads from the road to the barn, passing through the barn-lot, convenient to the side of the house. A clean, dry gravel walk leads from the house to the barn. A silo is attached to the barn, and the granary is near by. One of the most important out-buildings on our farm is the silo. The importance of silage as a feeding stuff is growing more apparent, but silage will not keep well in a poorly constructed silo. The silo must be air-tight, strong, perfectly smooth on the inside, and placed on a strong, solid foundation.

The farm workshop.—Every farmer should have a building, or a room in some building, in which he can do experimental work with plants, soils, etc., and in which he can do wood-working, forging in iron, and general shop work. A shop well equipped with carpenter's tools, a forge and anvil, a work-bench and its equipments, would save the farmer many dollars and much time in the repairing of his implements and buildings. This same workshop might be provided with apparatus for seed-testing, fruit-tree pruning and grafting, soil testing and analyzing, and with various chemicals and apparatus used in experimental work with plants and animals.

A room so equipped on every farm would furnish interesting and profitable work during the winter months, and the results of the experiments in these laboratories might be profitably applied on the farm.

The following is a list of materials and furnishings that might be useful in the farm laboratory:

1. Work-bench and carpenter's tools.
2. Forge and anvil, with necessary tools accompanying.
3. Medicine case with drugs for animals; and chemicals, such as formalin, sulphuric acid, ammonia, copper sulphate, lime, sulphur, lead arsenate, paris green, hellebore, phosphoric acid, potash, sodium nitrate, etc., etc.
4. Tight case for various seeds.
5. Boxes of clay, sand and humus soils.
6. Table for general experimental work.
7. Water supply and means of heating the room.

The pupils and teacher may add other materials to the above list, and, as a part of the work of this lesson, the pupils should draw the ground floor plan of such a room as described above, and indicate in their plan where they would place the different furnishings of the shop.

Free Bulletins, U. S. Dept. of Agriculture

No. 32.—Silos and Silage.
No. 126.—Practical Suggestions for Farm Buildings.

Measurements

Rules.

1. To find the area of a triangle multiply the base by one-half the height.
2. To find the circumference of a circle multiply the diameter by 3 1-7.
3. To find the area of a circle multiply the square of the radius by 3 1-7.
4. The square of the hypotenuse of a right triangle is equal to the sum of the squares of the other sides.

NOTE: Make a drawing before attempting to solve any of the following problems.

FIG. 4. MODEL FARM BUILDINGS

Problems

1. How many feet of inch lumber will be required to build a pig pen six feet wide, four feet from peak to ground, and eight feet long? (See rules 1 and 4.)

2. How many feet of inch lumber will be needed to board up the gables of a barn thirty feet wide, the peaks being twelve feet above the eaves?

3. How much lumber will it take to cover a corn crib with four-inch slats, placed one inch apart, the crib being twenty-four feet long, six feet wide at the bottom, eight feet at the top, eight feet to the eaves, and the peak three feet above the eaves?

4. How long will the rafters need to be for this crib if they are to project one foot? How many feet of 2x4 rafters will be required if they are placed two feet apart?

5. How many feet of 2x4 studding will be needed if they are placed the same distance apart? How many feet of roof boards will be required if they are allowed to project one foot at each end?

6. How many cubic feet must a bin contain in order to hold a thousand bushels? Make a list of convenient dimensions for such a bin.

7. How many feet of two-inch plank will be required to build a cylindrical tank fourteen feet across and two feet deep? What will be the cost of the lumber at $30 per thousand?

8. How many feet of band iron will it require to make three hoops for this tank?

9. How many feet of inch lumber will be required to cover the inner wall of a "round" silo twenty-one feet across and eighteen feet high? How many feet of two-inch plank will be needed for a cover? What will be the cost of all this lumber at $25 per thousand.

10. What will it cost to put a cement floor in this silo at 10 cents per square foot?

11. How many 2x4 studdings eighteen feet long and placed one foot apart will be required, and what will be their cost at $24 per thousand?

12. What will it cost for the lumber to floor a barn forty by sixty feet with two and one-half inch plank at $18 per thousand?

FIG. 5. BARN AND SILOS

13. The peak of this barn is twelve feet higher than the eaves. What will inch lumber for sheeting the gables cost at $24 per thousand.

14. The rafters are made of 2x4, and twenty-seven inches long, placed eighteen inches apart. How much will they cost at $20 per thousand.

15. What will be the cost of the sheeting for the roof at $16 per thousand if the roof projects two feet at each end?

16. What will it cost to shingle this roof with shingles worth $3.25 per thousand, laying them five inches to the weather and allowing for a double course at the eaves?

17. This building is placed on a wall twelve inches thick and eight feet high. What is the cost of the stone for same at $5 per cord?

18. What will it cost to fence a field sixty rods long and forty-five rods wide with a five wire fence, posts one rod apart, worth 5 cents each, staples 6 cents per pound (200 to the pound), wire weighing one pound to the rod, worth $4.50 per cwt., and labor amounting to $6.

19. What will it cost to build a five board fence around the same field, using twelve-foot boards, six inches wide, and worth $16 per thousand, posts 5 cents each, nails and labor, $15.

LESSON III

MAP STUDIES OF LIFE A-FIELD

School out-of-doors.—Boys and girls who have enjoyed the free life out of doors all summer may not relish the prospect of sitting indoors during the pleasant September days studying from books, while all is life and activity on the farms without. Hence let us begin by bringing some of the life of the farm into the schoolroom, and carrying some of our school problems out to the farm for answer. The fields, the woods, the roadsides, the brooks and the skies shall be our books when we are out of school, and we shall enjoy our hours in school, telling each other what we have seen and learned in the big books of nature. In all

FIG. 6. A BOY'S COLLECTION

our study of agriculture let us learn from real things, and not depend altogether upon books.

Practical Exercises

1. Make measurement of a tract of land containing five or ten acres, and draw a map of the same to an

accurate scale. Place in this map the creeks, springs, buildings, etc.

2. Collect bottles of the different kinds of soil found on the tract, and bring to school.

3. Make a list of all the useful plants growing on the plot.

4. Make a list of all the weeds or useless plants known on the plot.

5. Make a list of all the domestic and wild animals seen.

6. Make a list of all the birds and insects observed from time to time.

This work may continue through many weeks, and the pupils should keep a neat and accurate record in their permanent note-books of the observations on their tracts of land.

LESSON IV

INSECTS THAT INJURE THE CROPS

"The farmer may prepare the soil ever so well, he may fertilize with the greatest of care, he may cultivate thoroughly, the weather conditions may be favorable, and yet he may lose all or a portion of his crop through the attacks of insects and the ravages of plant diseases." (Hatch.)

Extent of injury.—Insects destroy our crops to the value of millions of dollars. The farmer has learned to fight some of these pests successfully, and yet too little attention is paid by the average farmer to methods of combating insects as well as plant diseases. There is much to learn about insects before we can hope to control them successfully. We must learn when and where the insects lay their eggs, when the eggs hatch, and into what forms they develop, and what they feed upon. Some people make fun of boys and girls when they see them hunting and studying "bugs," but if somebody did not hunt and study bugs, they would eat and drive us all out of house and home.

Life history of an insect.—There are usually four stages in the life history of an insect—the egg stage, the grub or caterpillar stage, the resting or pupa stage, and the full-grown insect. The egg is laid by the full-grown insect in the ground or in any part of the plant. The eggs hatch into what we usually call a grub or worm. The grub of most insects is a great eater, and it is in this stage that much damage is done to our plants. After it has eaten and grown fat, it hides itself and goes into a pupa or resting stage. From this pod-like affair it emerges as a full-grown insect, ready to lay eggs and repeat the life cycle. Some insects, such as grasshoppers, do not go into the resting

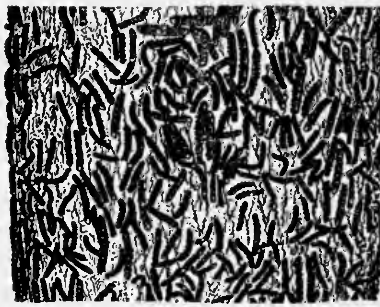


FIG. 7. SECTION OF A TREE-TRUNK SHOWING GYPSY MOTH LARVAE ASCENDING

stage, but grow their wings as they hop about in search of food.

Feeding habits of insects.—Insects may be divided into two classes, according to their habits of injury to plants: the leaf-eating insects and the sap-sucking insects. These habits of the insects furnish the farmer a clue to methods of destroying them. If he finds that a certain insect is eating the leaves of his plants, he can spray them with a poison, such as lead arsenate, and the insects will eat the poison and die. If the insect that is injuring the plants has a beak which it uses to suck the sap from the tree or plant, without eating the leaves, then the farmer can spray with lime-sulphur or a mixture of kerosene and soapsuds, which will stop the insect's breathing pores or destroy its body. Directions for making these mixtures are given elsewhere in this book.

The body of insects.—Insects are so called because they are "in sections." There are three main sections of an insect's body—the head, thorax, and abdomen. The head is provided with a pair of feelers, a pair of strong jaws (or a sucking tube), and two compound or two simple eyes. Three pairs of legs and usually two pairs of wings are attached to the thorax. The abdomen is the back part of the body, made up of segments. Insects breathe through little holes in their sides. In the practical exercises which follow you will note all these points of structures in various insects.

NOTE. The practical exercises on insects will be given as separate lessons and so numbered.

LESSON V

1. THE GRASSHOPPER

General directions.—In making these practical studies of insects, an example of each of the common orders of insects will be taken up. The pupils should provide their own material, and bring the insects to the class for study. The insect net illustrated below will facilitate the catching of winged insects like the grasshopper, butterfly, bee, etc. Bottles and cans may be used to catch such insects as the beetles and bugs.

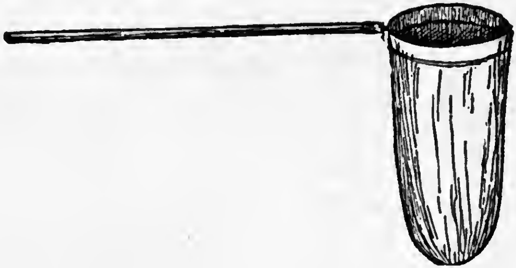


FIG. 8. INSECT NET

A hand lens to magnify the insect body will be found helpful. A sharp penknife, a pair of sharp-pointed scissors, two large needles mounted in wooden holders, and a pair of sharp eyes are essentials in the study of insects.

Field and laboratory studies.—In making this study of the insects, the pupils should first draw a whole body view of the insect, and then make such notes and answer such questions as are asked in the lesson outlines. Determine all answers from observation.

1. Observe in the field:

Its method of locomotion.

Its protective coloration.

Its enemies. Its sounds. Its haunts. Its food.

2. With the living insect, try to find the breathing spiracle, just above the base of the middle legs. Watch the opening and closing of the lips of this breathing pore. Put a grasshopper under a glass and see if it

FIG. 9. DIFFERENTIAL LOCUST—AFTER SANDERSON

will eat grass or leaves. Perhaps it has spit "tobacco juice" on you. Why does it do this? How many times the length of its body can it jump?

3. In what ways do the hind pair of legs differ from the others?

Of what advantage are the hooks and spines on the legs?

Count the number of joints on each leg.

4. Study the wings. How does the front pair compare with the hind pair? How are the hind wings folded? By rubbing the upper and lower wings together, the grasshopper sounds are made. Make a drawing of the wings.

5. Study the mouth parts. These are the most difficult of all the external parts to see. Find the following parts:

(a) The upper lip, a two-lobed labrum.

(b) A pair of blackish horny mandibles, covered by the upper lip.

(c) A pair of jointed maxillæ below the mandibles.

(d) A two-lobed lower lip, the labium.

6. The female has at the end of the abdomen, four points called the ovipositor. These are used for making an opening into the ground to receive the eggs. Young grasshoppers are called nymphs, and resemble the adults in every way except that their wings are undeveloped.

7. Count the segments of the abdomen. Observe on each side of the abdomen a groove, and just above it a row of breathing spiracles. Observe the thin membraneous depression on the first segment of the abdomen. This is supposed to be the ear.

8. Observe the eye. Perhaps you can see that it is made up of many divisions. The grasshopper has two compound eyes and three simple eyes. Try to find these.

9. What other insects belong to the grasshopper family? Are they injurious on the farm? How?

Note.—For killing insects, prepare a cyanide bottle as follows: Break potassium cyanide into small pieces and put into the bottom of a wide-mouthed bottle. Avoid the deadly poisonous fumes. Pour over the pieces just enough water to cover them. Add plaster of paris until the water is absorbed. Leave unstoppered until the contents are dried; then cork tightly. Insects dropped into the bottle will die. *Keep the bottle from children.*

LESSON VI

2. THE BUTTERFLY

Every country boy or girl knows the white cabbage butterfly, and its associate, the sulphur butterfly. With a freshly killed specimen, take up the study as follows:

1. Make a drawing of the whole body, showing the characteristic markings.

2. How many segments to the body? What are the appendages from these segments?

3. How do the legs compare with those of the grasshopper?

4. Write a descriptive sentence about each of the following points of the wings: Action, shape, overlapping, scale-covering, and vein-structure.

5. How many segments to the abdomen? Are they like those of the grasshopper?

6. Examine the mouth of the butterfly. Find the coiled tube which it uses to obtain the nectar from the flower. With a pin uncoil it and note its length.

7. Answer the following points on the observation of a live butterfly:

(a) Its manner of flight.

(b) The kind of food, and the manner of feeding.

(c) The natural enemies of the butterfly.

(d) The position of the wings when at rest.

8. What is the damage done by the cabbage butterfly?

It should be remembered that the common toad is the best friend we have in the garden to rid the cabbage of this pest.

9. What is the life-history of the butterfly? This question will be asked in connection with all the insects we shall study; therefore a general answer should probably be given to make this point clear. The cabbage butterfly lays its eggs usually on the lower surface of cabbage leaves. They are small and are pale-yellowish in color. These hatch into larva, the so-called cabbage worms. After the worms have fed upon the cabbage leaves for some time, they spin from their mouths a silken pod around themselves; this pod is called the pupa. The pupa is usually found on old fences or posts. In a short time the pupa ruptures, and a full-grown cabbage butterfly crawls out, dries its wings and flies away to begin the life history of a new generation.

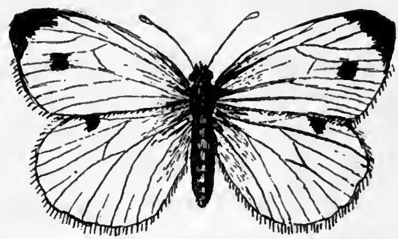


FIG. 10. CABBAGE BUTTERFLY

10. If you can get a moth compare it with the butterfly as follows:

(a) Difference in the feelers (antennæ).

(b) Manner of folding the wings when at rest.

(c) Time of flying, day or night.

(d) Comparative size of bodies.

NOTE.—Butterflies and moths belong to this order of insects.

LESSON VII

3. THE FLY

1. Make a drawing of the common house-fly.

2. Write a sentence on each of the following points, based upon your own observation of a live fly:

(a) The rapidity of the wing motion.

(b) Its manner of eating.

(c) Its favorite haunts.

3. How many wings has the fly? Look under the wings and try to find the little white knobs, called the balancers.

4. Note how rough and hairy the legs and feet of the fly are. Would they hold filth and dirt so that it could be carried?

5. How does the abdomen of the fly compare with other insects we have studied? Count the segments of the abdomen.

6. The life history of the fly family may be studied

easily in the schoolroom. Expose out of doors a bit of lean meat, so that the eggs may be laid upon it. The blue-bottle fly will lay eggs upon meat. Fill a tin can or box with sand, and on a chip in the center of it place the bit of meat with the eggs on it. Invert a glass tumbler over it, and push the rim of the tumbler down onto the sand to prevent the escape of offensive odors. In a few hours the eggs will hatch, and in a few days the larva will be fully grown. They will probably crawl under the chip to change into pupæ. They may come out soon as adult flies, or they may remain over winter in this stage. The house fly lays its eggs in manure and filth and is transformed through the same stages of life history.

FIG. 11. THE FLY

Rules Against Flies

1. Flies are very dangerous in the spread of disease, therefore we should not allow any decaying organic matter in which they can breed to accumulate.

2. If the cellar is damp clean out the dark and damp corners and apply lime.

3. Pour kerosene into the drains and also treat with kerosene all waste materials not intended for fertilizers.

4. If the kitchen waste is deposited in large cans it

should be removed at least once a week. The cans should have covers.

5. Kitchen waste intended as food for hogs should be removed and used daily.

6. Haul out the manure and spread it on the soil every day, or put it in a screened box to be emptied over the fields or gardens at least once a week.

7. If inconvenient to haul the manure at short intervals, treat it with kerosene or gypsum.

8. Keep up the work of destroying adult flies by the usual methods, and judiciously screen against them. Flies breed in filth; they are among the worst agencies in the spread of typhoid fever, and every means possible should be used to banish them from our homes.

LESSON VIII

4. THE BUG

If it is possible to catch a two-year cicada, sometimes called "dog-day harvest fly," or improperly, the locust, this will make the best specimen for the study of the true bug. If none of these can be got, a squash bug will illustrate the characteristics of all bugs.

1. Draw the view of the whole body.

2. How many wings are there? Note in the squash bug that the front half of the wing is horny and that the back half is membranous.

3. Note the triangular prominence of the thorax on the back.

4. Observe the mouth parts. What does the bug's mouth show as to its manner of eating?

5. For what kind of locomotion are the legs adapted?

6. Find the eyes and feelers. Write a sentence describing each.

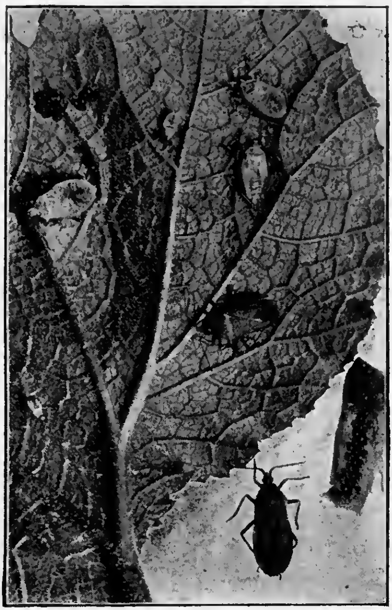


FIG. 12. THE SQUASH BUG—THREE STAGES OF INSECT GROWTH

7. What is the life history of the squash bug and cicada? How can they know?

8. All the bugs belong in this order, together with plant lice, tree hoppers, scales, etc.

— What is a "bug"

This is an injurious order of insects, and the kerosene emulsion spray is the means of combating in most cases.

LESSON IX

5. THE DRAGON FLY

Both dragon and damsel flies will have to be caught with a net. They are usually seen flying about ponds or streams of water.

1. Answer the following questions from the observation of a living specimen:

(a) What is their habit of flight?

(b) What is their food?

they know (c) How do the dragon fly and damsel fly differ in habits?

msel flies? (d) What is the position of the wings at rest?

2. After killing the dragon fly in the cyanide bottle, straighten its wings and legs and draw the whole body view. not copy picture?

3. How do the legs compare with those of the grasshopper?

4. How many wings are there? Write a descriptive sentence about them.

5. Note the enormous development of the eyes. hat? What would this indicate as to their habit of life? Find the three simple eyes, and tell where they are located.

6. Write a descriptive sentence about the abdomen. How many segments?

7. Does the dragon fly have a sting? Most children will say yes.

8. The life history.—The eggs are laid in the water. They hatch into a nymph, a form resembling the adult without wings. In this stage they live in the water, and feed greedily upon small water insects. At this stage they are beneficial in eating mosquito larva. When the nymph is fully grown it crawls out of the water upon some convenient rock or reed, fastens its feet firmly, splits down the back, and the adult dragon fly crawls out, dries itself, and is soon ready to fly. The dragon fly is a beneficial insect, because it preys upon other insects that are pests to us.

FIG. 13. THE DRAGON-FLY

LESSON X

6. THE BEE

1. Answer the following questions on the honey, or bumble bee, based upon field observation:

(a) What kind of flowers does it feed upon?

(b) Is it shy while feeding? Will it sting then? Not while eating.

(c) Does it stay long at each flower?

(d) What does it gather from the flower?

(e) Explain how it helps the flower.

(f) How does its manner of flight compare with that of the butterfly?

2. Kill the bee in the cyanide bottle, and make a drawing of the body.

3. Note the large body in comparison to the wings. Do you think that the wings wear out easily? How many wings are there?

4. Are the legs of the bee all alike? Explain.

5. Try to find the mouth parts and the tongue. Write a descriptive sentence about them.

6. Can you see any value in the hairy covering of the bee's body?

Worker. Drone. Queen.

FIG. 14. THE BEE

7. Find the sting of the bee and remove it. There is a poison gland at the root of the sting, which pours a fluid into the wound made by the sting, causing the painful sensation with which every boy is familiar.

8. Where does the bumble bee make its nest? What is it made of?

9. Life history.—The eggs are laid in the cells. The second stage is the worm-like creature, the larva, lying inactive in the cell. It must be fed, and it is a big eater. When it is fully grown it spins a silken cocoon about itself and enters the next stage. The third stage is the pupa. Here it remains quietly concealed within

its cocoon, over which the workers spread a thin layer of wax, making a cell of it. After a time it cuts its way through the top of the cell and comes forth a fully developed bumble bee.

10. To this order belong the wasps, hornets, sawflies, gallflies, ants, and honey bees.

NOTE.—If it is desired to make an extended study of the honey bee as an insect for farm use, write to Mr. Frank Benton, of the Division of Entomology, Department of Agriculture, Washington, D. C., for his Bee Book and other circulars.

LESSON XI

7. THE BEETLE

1. Make a drawing of the beetle.

2. How many wings has the beetle? With a freshly killed specimen in hand, extend the two horny, sheath wing-covers, which meet by smooth edges along the middle of the back, completely covering the thin membraneous wings beneath. Spread out all four of these wings and make a drawing to show the wing arrangement.

3. Write a descriptive sentence about the mouth parts. Are they made for sucking or biting and chewing?

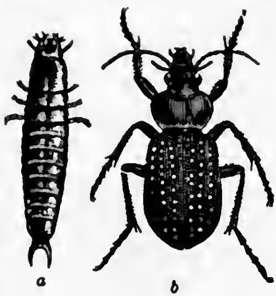
4. Write a sentence telling of the size and position of the eyes.

5. How many joints in the beetle's leg? Describe the claws.

6. How many segments in the abdomen? Compare the upper and lower surfaces.

7. How do beetles live? Find as many different kinds as you can.

8. Life history.—The beetle has all the four stages: egg, larva, pupa, and adult. The eggs of the beetle hatch into grubs, wire worms, borers, etc. In this stage they do great damage to the crops, trees, and other vegetation. From the grub stage they pass into a pupa stage similar to all other insects. The pupas are usually in the ground, from which emerge adult beetles.



a. Larva. b. Adult.
FIG. 15. GROUND BEETLE

Most of the beetles are very injurious insects, the tiger beetles and lady beetles excepted, and, since they are usually chewing insects, the treatment is a lead arsenate or paris green spray.

Free Bulletins, U. S. Dept. of Agriculture

No. 38.—Spraying for Fruit Diseases.
No. 45.—Some Insects Injurious to Stored Grain.
No. 75.—The Grain Smuts: Cause and Prevention.
No. 91.—Potato Diseases and Their Treatment.
No. 99.—Three Insects Enemies of Shade Trees.
No. 127.—Important Insecticides.
No. 132.—The Principal Insect Enemies of Wheat.
No. 146.—Insecticides and Fungicides.
No. 171.—The Control of the Codling Moth.
No. 172.—Scale Insects and Mites on Citrus Trees.
No. 196.—The Usefulness of the Toad.
No. 212.—The Cotton Bollworm.

Spraying Mixtures for Plant Diseases

(Bordeaux Mixture.)

5 lbs. unslacked lime	$0.04
3 lbs. copper sulphate at 10c	.30
Total	$0.34

Dissolve each thoroughly in 25 gallons of water. When both are thoroughly dissolved, mix. Use wooden vessels. Strain carefully into spray-pump, barrel, or tank.

Lime-Sulphur

1¼ gallons lime-sulphur	$0.20
50 gallons water.	

For Leaf-Eating Insects

½ lb. Paris green to 50 gallons water. Spray. Cost	$0.15
3 lbs. arsenate of lead to 50 gallons water. Cost	$0.45

Asenate of lead sticks to the plant much better than Paris green, and is therefore more useful, especially in rainy seasons.

For Sap-Sucking Insects

2 gallons kerosene	$0.25
1 lb. hard soap (1 qt. soft soap)	.10
1 gallon water	
Total cost	$0.35

Problems

1. Suppose it takes two applications of two pounds of lead arsenate each, and two days' time at $1.00 per day to destroy the bugs on an acre of potatoes, how many bushels of potatoes at 50c per bushel will it take to pay for the treatment?

2. If one house fly lays 80 eggs four different times during the summer, and half of these eggs hatch female flies, each one laying the same number of eggs as the first fly, and so on to four generations, how many flies would come from the first fly during the summer?

3. Find out the average yield of honey from hives in your community, and calculate the income from a hive of bees at the prevailing price paid for honey.

LESSON XII

PLANT DISEASES

Injury and control.—Perhaps we have noticed during the summer that some of the plants we were interested in grew sickly and died, in spite of all the care and attention we gave them. We are told by the botanists that plants have diseases, just as people do. Rust, blight, smut, rot, and the like, are the common names of diseases which afflict the plant. They spread from plant to plant by means of little dust-like particles called spores. These spores float around in the air and settle on healthy plants. Here the spores may grow and injure the plant by living upon its sap. They must be destroyed or they may kill the plant upon which they feed. The various diseases caused by the spores are called fungous diseases. Some of the most common forms are the fire blight of the pear and apple, the smut of corn and oats, the rust of wheat, the potato scab, potato blight, peach leaf curl, apple scab, club root, black knot of plum, brown and bitter rot, and many other kindred varieties.

As soon as the diseases make their appearance in the orchards or on the crops, the farmer should begin his fight. If the leaves of the trees begin to dry up and blacken with the blight, the affected parts should be immediately cut off, at some distance below the blight, and burned. The lime-sulphur, or Bordeaux mixture, spray described in Lessons 11 and 64, are the spray remedies to use on most plant diseases.

Practical Exercises

1. Observation of Some Plant Diseases

Bring samples of diseased plants to the school and fill out the following outline as you study the specimens:

Common Names of the Diseases.	Plants Affected.	Remedy.

2. Treating Oats for Smut

Bring a half bushel of oats to school in a "gunny-sack." Soak the oats, sack and all, for about ten minutes in a vessel holding ten gallons of water, to which has been added one-fourth pint of formaldehyde (40 per cent). Then spread the oats out to dry. The formaldehyde kills the spores of the smut that are on the oats, and the crop coming from this treated seed will be free from the disease. It would be a good service to the farmers if the school would treat all the seed oats in the community.

Problems

1. Suppose it takes 200 gallons of Bordeaux mixture to spray an acre of potatoes. What is the cost of the mixture? (See Lesson 11.)

2. Suppose it takes two applications to cure the blight and each application requires a day's time, worth $1.00. What is the cost of the cure?

3. How many bushels of potatoes, at 50 cents a bushel, will it take to pay the cost of this spray?

4. Suppose two fields of potatoes of an acre each, owned by different farmers. One farmer sprays to cure the blight, and gets 188 bushels of potatoes, worth 50 cents per bushel. The other neglects his field and gets but 75 bushels. What is the difference in the value of the two crops?

5. What did it cost the first farmer to apply the spray? What is his actual gain over the other farmer? Did it pay to spray?

6. If formaldehyde costs 50 cents per pint, and a pint will treat 40 bushels of oats, how much will it cost per acre to treat the seed oats, sowing three bushels to the acre?

7. Suppose it takes a day's work, worth $1, to treat the seed for 12 acres, what is the total cost of the treatment?

8. How many bushels of oats, at 30 cents per bushel, will it take to pay for the treatment? Suppose the treatment increased the yield 20 bushels per acre, how much does the farmer gain on his crop?

LESSON XIII

THE WHEAT CROP

General cultural requirements.—Wheat has been cultivated from the earliest times. The crop ranks third in value in the United States. It grows in cool, temperate, and warm climates, and in many kinds of soil. It does best in clay loam, and poorest in sandy loam.

The soil must be well drained, and in a good physical condition—that is, it must be open, crumbly, and mellow. Hard clay soils can be made valuable for wheat by manuring, by good tillage, and by crop rotation. Cow peas or red clover make a valuable crop to precede wheat; for they add nitrogen to the soil, loosen it, allow free circulation of air, and add humus to the soil when plowed under.

FIG. 16.—WHEAT FIELD IN SHENANDOAH VALLEY

Soil preparation.—The method of preparing the soil for wheat will depend on the previous crop and the nature of the soil. Where wheat is to be sown in standing corn, the most practical soil preparation consists in thorough cultivation of the corn crop, keeping the soil mellow and free of weeds throughout the summer. It is much better to cut off the corn and thoroughly disk and harrow the ground before drilling the wheat. Wheat requires an ideal seed bed and a firm sub-soil.

Seeding the wheat.—The time to sow wheat in the central states varies from the second week in September to the first week in October. On account of the Hessian fly it is advisable to sow wheat as late as possible. The seed drill is the best implement for sowing wheat. The amount of seed per acre required to get the best results depends upon a number of conditions, such as the fertility of the soil, the condition of the seed bed as to fineness and moisture, and the size and quality of the seed used. With medium-sized seed of good quality on a well prepared fertile soil, six pecks per acre will usually be sufficient.

The selection of good seed is an important means of increasing the yield of wheat. Seed should be selected from the best portions of the crop, graded and cleaned in such a way as to get the largest and plumpest grains for sowing. In Indiana, the highest yielding varieties of wheat are the Ruby, Pearl's Prolific, Michigan Amber, Farmer's Friend, and Abundance.

Feeding the wheat crop.—Wheat responds to the use of fertilizers more readily than most of the ordinary crops. A study of the crop will show what sort of fertilizer is needed. If the straw is inferior and short, the soil may be deficient in nitrogen; but if the straw be luxuriant and the heads small and poorly filled, the soil may contain too little phosphoric acid and potash.

Purdue Experiment Station recommends for wheat the application at seeding time of about 300 pounds per acre of a fertilizer containing two per cent nitrogen, eight available phosphoric acid, and two to four per cent potash. If the farmer wishes to mix his own fertilizer and thus save several dollars per ton, 200 pounds per acre of the following mixture is advised: 900 pounds steamed bone meal, 300 pounds high grade acid phosphate, and 200 pounds muriate of potash. These may be purchased from fertilizer companies and can be easily mixed with a shovel on the barn floor.

The average yield for wheat in the United States is but little over thirteen bushels per acre. In view of the fact that the acreage of wheat is decreasing, and the population of the country increasing, there is occasion for alarm over the future bread supply. The future wheat supply must come, not so much from increased acreage, as from increased production per acre.

Practical Exercises

1. Study of the Wheat Plant.

Take a walk into a wheat field. Note whether the stand is good. Is there a luxuriant growth of stem? Have the heads filled out well? Pull up a single wheat plant, root and stem. Take several wheat plants and a handful of wheat into the schoolroom. Make a drawing of the wheat and its root system. Separate your handful of wheat grains into two piles—one containing the plump, large seeds, and the other, the smaller, inferior seeds.

2. The Stooling Habit of Wheat

Plant a few wheat seeds in pots in the schoolroom, and after they have grown into stems and begun to fall over, dig out a few of the plants without breaking off many of the roots. Volunteer wheat may be found growing in the fields. Try to find the grain from which the plant started. Find the first joint.

Do you find more than one plant starting from this joint?

All but the central one of these are *stools.*

Do the stools seem to be as strong as the central plant?

Does the thickness of the stand seem to have anything to do with the amount of stooling?

Is the stooling greater in rich soil or in poor soil?

Is a large amount of stooling desirable? Why?

3. A Visit to the Mill

If practicable, visit some mill to see how the flour is made. Write a paragraph describing your visit.

Problems

1. How much wheat will we have on our farm at 30 bushels per acre? What will it be worth at the prevailing price?

2. Calculate what it will cost to raise this crop at the present price of labor and seed and fertilizer. What will be our profit?

3. At the price of flour, will it pay the forty-acre farmer to raise wheat, or buy the flour?

References: The Cereals in America.—Thos. Hunt. How the World is Fed.—Industrial Reader, Carpenter. Circular 23, Purdue Experiment Station, Lafayette, Ind.

OCTOBER

On the Farm.—While the trees are preparing for winter, shedding their beautifully colored leaves, we too must prepare for the winter, by filling our barns, cellars, and granaries with the grains and fruits of our fields. After the silo is filled, we shall cut and shock a part of our corn, but the greater part we shall husk and leave the fodder in the field for "stalk pasture." Our apples will be piled in cool places until time to store in the cellar. We shall have pumpkins to gather, potatoes to dig, sauerkraut and cider to make, and fall vegetables to store away. If there are any more shrubs and trees to plant on the farm, October is a good month for this work. Of course, we shall set some hyacinth, tulip, daffodil, and crocus bulbs for early spring flowers.

LESSON XIV

SELECTING AND STORING SEED CORN

The good farmer in husking his corn will have by him a special box or basket into which he can throw ears of corn selected from the stalk for next year's seed corn.

Position of ear on stalk.—The first point to notice in selecting an ear for seed is its position on the stalk. The ear should be set about midway up the stalk, not too near the bottom nor too near the top. The shank that holds the ear should not to be too long, so that it holds the ear far from the stalk. On the other hand, it should not be so short that it causes the ear to stand upright against the stalk. The stalk should be of medium size, strong and tapering with strong brace roots and plenty of leaves.

Shape of ear.—The next point to observe is the general shape and development of each ear selected. For the first selection of the corn in the field be governed by the following points:

1. Length of ear, between eight and ten inches.

2. Circumference of the ear, about three-fourths the length.

3. Rows of kernels, straight and running well out to the tip and butt of the ear. Kernels well shaped. firmly set in place, deeply dented and all of the same purity of color.

Governed by these points in the field selection of ears, the farmer may select more corn than is really needed for his seed, so that a closer selection and grading may be made in the spring before planting.

Storing seed corn.—In storing the corn, it should either be hung by the husks torn back from the ear, or be placed in racks made of narrow strips with spaces between. Whatever the device used to store the corn may be, it should provide for free circulation of air about the ears, and a dry, cool place, protected from mice, rats and poultry.

The scoring, judging, and final testing and selection of seed corn are treated in the lessons for March, but if desired may be taken up in the schools at this time; in which case it would be advisable to repeat them in the spring.

Practical Exercises

1. Observational Study of Stalks of Corn

Bring a half dozen stalks of corn into the schoolroom. Let each stalk have its roots, leaves, ears and all

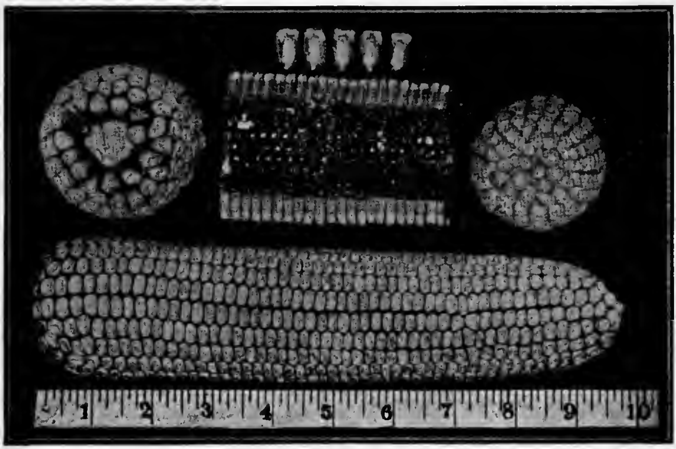


FIG. 17. REID'S YELLOW DENT

complete. Make notes of your observations of each stalk on the following points:

1. Leaf growth.
2. Size and vigor of stalk.
3. Brace roots.

4. Height of ear.
5. Length of shank.
6. Ear—good or poor type.

Reference: Farmers' Bulletin, No. 229.

2. Selecting the Seed Corn in the Field

Go to a corn field in the vicinity of the school and select at least fifty desirable stalks of corn bearing the ears as explained in the discussion above. First select the strong, medium-sized, stocky stalks having the ears properly located and bending from the stalk. Husk enough of the ear to see whether the other points of selection mentioned as (1), (2), (3) above, are up to a good standard. Husk ten or twelve ears and take them to the schoolroom for further study.

If it is not practical to go to a corn field, a dozen or more stalks of corn should be brought into the schoolroom for a study of the points in field selection of seed corn. Make notes criticizing the stalks.

3. Storing Seed Corn

Construct a swinging shelf in the attic of the schoolroom by means of four wires and a board about six feet long by one foot wide. Lay the corn you have selected for seed on this shelf, cording it up like wood several layers deep. Such a swinging shelf may be made in the barn or crib at the farm, and several bushels of seed corn stored upon it.

4. Selecting Exhibition Corn

Arrange for an exhibit day as a practical lesson under this topic. Each pupil should bring ten of the best ears of corn he can select from the home crop. One very important thing in choosing corn for an exhibit is the principle of *uniformity.* In order to get a high rating on an exhibit, all the ears in the set must *look alike* as nearly as possible. Pick out the best ten ears you can find, which by careful measurement and comparison

FIG. 18. DRYING RACK FOR SEED CORN

are nearest alike. Arrange all the exhibits which are brought to school, so as to show them to the best advantage. See the lesson on corn judging and scoring. Have some outside person judge the corn, invite the parents in, award prizes, talk corn, and make a great day of the corn exhibit. Save the ten ears that won first prize and bring them to the county and state corn shows.

5. *Field Studies of the Corn*

With note-book, pencil, and rule, go to the corn field, and answer from observations the following points:

1. Name of the variety of corn.
2. Date the corn matures.
3. Average height of corn.
4. Average number of leaves on a corn stalk; the number of joints.
5. Length of ear shank on an average of ten plants.
6. Husks; abundant or scarce; close or loose.
7. Number of corn plants on an acre (10 rods x 16 rods).
8. Average height of ears from the ground.
9. The number of ears of corn on the acre measured; the number of bushels on the acre.

6. *Study of an Ear of Corn*

With an ear of corn on the desk before you, describe it, using the following outline:

1. Name of the variety.
2. Color of grain and cob.
3. Surface, smooth or rough.
4. Rows of kernels; number, straightness, spacing, and completeness.
5. Grains, firm or loose.
6. Shape of the ear.
7. Butt; even, shallow or deep.
8. Tip; exposed or covered, nature of kernel at tip.
9. Kernels; square or rounded at top, shoe-peg or rounded form.

10. Length and circumference of the ear.

11. Weight of ear, of kernels, and of cob; per cent of grain.

12. Number of kernels on the ear.

Problems

1. The corn crop for the last five years in the United States has been over 2,500,000,000 bushels a year. How much is that for each person in the United States?

2. What is the value of this corn at the prevailing price?

3. How much corn was grown in your state last year? What was the yield per acre? (See Year Book of the Department of Agriculture. If the school does not have the latest copy, apply to your member of Congress.)

LESSON XV

THE BEST CORN IN THE COMMUNITY

Practical Exercises

Let each pupil weigh out one bushel of corn in the ear at home, and bring the weights to school. Then each one copy the weights and data of all the others, and tabulate the results as follows:

Pupils' Names.	Weight of Bushel.	No. of lbs. Overweight.	Per cent Overweight.	Lbs. of Underweight.	Variety.

Problems

1. How much should we expect to gather from our ten-acre lot of corn as shown in Lesson I, and what is it worth at the present price?

2. How many ears of corn will it take to make a bushel?

3. How many bushels of corn in a wagon box 10 feet long, 3 feet wide, and 27 inches deep, filled to rounding and gauged by bushel measure 12x12x27 inches?

4. How many bushels of corn in a bin 10 feet long, 10 feet wide, and 10 feet high, using the same gauge?

LESSON XVI

COLLECTION OF FARM PRODUCTS

Practical Exercises

Try to get small bundles of each of the grains raised in the community, viz., wheat, oats, rye, corn, cowpeas, clover, and any other crop raised for its seed. Pupils should each bring a few culms of these and a collection will soon be made. Each bundle should be labeled as follows:

Name of plant. Date of collection. Name of collector. The collection should be accompanied by samples of the mature seed, put up in bottles of uniform size, and labeled as above.

All the grasses and clovers used as hay may be collected in the same way. Arrange the exhibit on the wall or in a frame in as artistic a manner as possible.

A day could be set apart when the fruits and vege-

PREPARING A FRUIT EXHIBIT

tables, as well as the farm products of the neighborhood, can be exhibited. Awards and prizes might be offered, thus making the school a new center of interest in the community.

As much of the collection as can be made permanent should be made so and kept at the school during the term.

The collection and arrangement of this material

FIG. 19. A WEST VIRGINIA CORN EXHIBIT

will furnish a valuable lesson, and give opportunity to develop skillful exhibitors.

A farm product show would be an excellent activity for the boys and girls of the agricultural society mentioned in a later lesson.

LESSON XVII

FRUIT GROWING

Interest in fruit.—During October it is easy to be interested in fruit, both in the planting and the harvesting. It is easy to resolve, when one sees the splendid harvest of apples, peaches, and other fruits ripening in the autumn in our neighbors' orchards, to share in this bounty by planting fruit trees on our own farms. And this is a commendable resolution, for fruit is a most wholesome food, and the demands for it in the markets of the world are annually increasing.

Extension of orchards.—Many hillsides and rolling fields, poorly adapted to grain culture would produce profitable orchards of apples, peach, cherry, or smaller

Fig. 20. Modern Methods in Orchard Cultivation

fruits. It would be better for the soils of many farms, and for the purses of many farmers, were their hillsides planted to fruit trees rather than to grain, for in the former case the harvest will be barrels of fruit, while in the latter it is too often scattered grain and weeds in a badly washed and gullied field.

Setting and caring for the orchard.—For various reasons which we shall not discuss here, the young orchard should be set on high, rolling land. After a site has been chosen, the land should be prepared as thoroughly as for a corn crop. If it is not practical to plow the ground, large holes, about four feet in diameter and two feet deep, should be dug for places in which to set the little trees. It is best to buy trees at least one or two years old for planting. During this month the fruit trees may be set. Follow the principles of planting discussed in Lesson 72, and mulch the trees well with strawy manure as they go into the winter.

Apple trees should be set about forty feet apart each way, and peach trees from eighteen to twenty feet apart. They may be set in squares or in triangles. The triangular arrangement will give more trees to the acre.

Just as the young forest described in Lesson 72 is plowed in the spring, so should the young fruit orchard be cultivated, if possible. After cultivating the fruit orchard until the middle of June, it should then be sown to a clover or cow pea crop, which would act as a winter mulch for that season. Such care, together with the pruning and spraying that is discussed later, will start the young orchard well on the way to fruitfulness.

The fruits.—The trees may be divided into pome and stone fruits. The apple, pear, and quince are called *pomes,* because they contain a core in which are the seeds. The cherry, plum, peach, prune, and apricot are called *stone* or *drupe* fruits, because the seed is enclosed in a hard stony shell. The grape is our only vine fruit.

Of the small fruits the currant, gooseberry, raspberry, blackberry, and dewberry, are commonly called the bush fruits from their habit of growth. The strawberry is a small fruit in a class by itself.

Picking, marketing, and storing the fruit.—Whether

Fig. 21. Harvesting Apples

the apples and peaches are to be gathered for home use or to be sold on the market, it is always best to carefully pick them from the trees rather than to shake them down and allow them to become bruised or injured. Fruit with bruised or broken skin will rot much sooner, and sell for less in the market. Apples and peaches should be picked by hand and placed in baskets by the pickers. Apples should be kept in a cool, well ventilated place until freezing weather before storing in the winter cellar. Winter apples will keep much longer and in better condition if each fruit is wrapped in thin paper of some sort. Apples for the market are carefully graded and packed in attractive packages, either in barrels or bushel boxes, and shipped to all parts of the country and to foreign lands.

Practical Exercises

1. Types of Fruit

1. Let each pupil take an apple and a pear and observe the blossom end, opposite the stem. Here is a depression called the *basin.* This was the base of the apple and pear blossom. Compare with the blossom end of the peach or plum. Explain the difference.

2. Let each pupil cut the fruits through the center in a plane perpendicular to the main stem. Examine the core, the cells and the seeds. How many cells are there? How are they arranged? Observe the parchment-like walls of the cells. How many seeds in each cell? Make a drawing of the cross section of the pear or apple.

3. Compare the structure of the plum or peach pits with the apple seeds. Note the hard shell-like covering of the pits. Crack the shell and observe the seed. In this meaty portion lies the embyro, which will grow into a new plant under proper conditions of air, heat, and moisture. Draw cross section of the peach.

Answer the following questions:

1. What fruits have a depression at the blossom end?
2. What fruits are more or less round at the blossom end?
3. What common fruits have seeds?
4. What three common fruits have pits?
5. How much space does the core take up in the apple?
6. How many cells in the core of the apple?
7. How do pits and seeds differ in structure?
8. What are the general differences between a pome fruit and a drupe fruit?

References: U. S. Dept. Bulletin, No. 178.

2. Judging and Scoring Apples

Each pupil should bring four or five apples of the same variety to exhibit and use for scoring. The apples should be of standard size, all alike in shape, size, and color. Each apple should be free from insect, or fungous blemish, and as nearly perfect in every respect as it is possible to find. If only one plate of apples can be obtained, set it before the class and let each pupil mark the score for the apples, using the following score card:

Score Card for Judging Apples

Owner of the exhibit...................... Date............

Points Noted.	Perfect Score.	Pupil's Score.	Teacher's Score.
Size of the exhibit........	20		
Color	15		
Form	15		
Quality	15		
Freedom from blemishes..	20		
Total	100		

When single plates or apples are scored, the first point may be graded the full 20 points.

2. Decay in Apples

Select three ripe apples of the same variety and of equal degree of ripeness, and bring them before the class.

1. Strike against the side of one so as to bruise the surface but not break the skin.
2. Bruise the second apple so that the skin is broken.
3. Leave the third apple uninjured.

Place the three apples away somewhere in the room where they will not be disturbed, and observe the results from day to day.

1. Which apple decays first?
2. Of what use is the skin of the apple?
3. Take two apples of nearly the same size, and weigh both. Peel one and leave the other untouched. Weigh both apples again in twenty-four hours. Which has lost the most in weight? Explain the cause.

NOTE. If there are no scales in the school, ask some pupil to bring his instrument from his home.

Problems

1. On our farm is an apple orchard of three acres. If the trees are 40 feet apart, and are about 15 years old, what cash return should we expect from the sale of apples at $3.00 per barrel?
2. What will it cost per acre to set out a young apple orchard, if we have to pay 25c a tree? Plant trees in squares, 36 feet apart.
3. Deduct from the price received above for apples, the expenses of spraying, determined in Lesson 73, and

give the net profit we shall have on our three-acre orchard.

References: Bailey's Principles of Fruit Growing.
Farmers' Bulletin, No. 178.
Waugh's American Apple Orchard.
Farmers' Bulletins, Nos. 113 and 33.
Farmers' Bulletin, No. 154.

LESSON XVIII

NUT CROPS

Value of the nut crop.—Nuts are not usually thought of as a farm crop, yet every country boy and girl knows that the autumn time without nuts would lose much of its charm. Nuts are valuable food. They are rich and nutritious, and should always be counted as a part of our winter's store. There are several kinds of nut trees which are highly esteemed as ornamental shade trees, as well as for the valuable fruit they yield.

Some of the leading kinds of nuts are English walnut, almond, white walnut or butternut, black walnut, hickory nut, pecan, chinquapin, chestnut, hazel nut, cocoanut, and Brazil nut.

Nuts to plant.—The planting of nut orchards is to be encouraged on the farm. Several varieties of valuable nuts, such as the pecan, English walnut, and hickory nut, are widely adapted to temperate as well as sub-tropical regions, and should be planted on more of our farms. The pecan, especially such varieties as Mantura and Appomatox, the English walnut, and the little shell-bark or shag-bark hickory, have been successfully grown as far north as latitude 40°. If the boys and girls who read this lesson would plant a few nut trees this month, they would be rewarded, even before they were full grown men and women, by profitable and gratifying returns of a most delicious food.

Practical Exercises

1. Tabular Study of Nuts

Bring to the school samples of as many different kinds of nuts as you can find this month. Fill out the following table from your observation and study of these nuts:

Kind of Nut.	Nature of Shells.	Kind of Kernel.	Price in the Markets.

Reference: Farmers' Bulletin, No. 332.

LESSON XIX

CLASSIFICATION OF FARM CROPS

Outline Review

By the end of October all the farm crops for the year have been planted and most of them harvested. It will be well for us to classify these crops into a few groups by which they are commonly mentioned.

The following outline should be copied into the pupils' note-books, and filled out as indicated:

I. Cereals. Those crops which belong to the grass family, and whose seeds are made into flour which is used for bread.

1. .... 4. ....
2. .... 5. ....
3. .... 6. ....

II. Legumes. Plants with blossoms similar to the sweet pea and garden pea.

1.	4. ....
2.	5. ....
3.	6. ....

III. Roots. Crops having a slender or fleshy root which is used for food both for live stock and man.

1.	3. ....
2.	4. ....

IV. Tubers. An enlarged underground stem, used for food.

1.	2. ....

V. Bulbs. An enlarged and thickened leaf-stock or petiole, on which are thickened scale leaves.

1.	2. ....

VI. Fibre Crops. Any plant that furnishes material out of which cloth or rope is made is called a fibre plant.

1.	3. ....
2.	

VII. Forage Crops. The term forage crops is used for a good many crops. It usually means those crops that are used for coarse feed for live stock.

1.	4. ....
2.	5. ....
3.	6. ....

VIII. Miscellaneous Crops. Various other crops that cannot be classified with the above.

1.	4. ....
2.	5. ....
3.	6. ....

NOVEMBER

On the farm.—When the harvest is over and the winter stores are properly put away, we shall look to the stock on our farm. We must decide what stock we shall keep over winter and what we should sell. The barns and sheds must be in good repair, the mows and silos full of feed, and all conveniences possible provided for the care and feeding of the live stock. The most important work on the farm during the winter months is the care and feeding of the farm animals.

LESSON XX

THE STOCK ON THE FARM

The good farmer in most cases avoids "scrub" stock. He has learned that it pays to take good care of his stock, and that it costs no more in care and feed to raise a good animal than to raise a poor one. The successful farmer has also learned that it pays to keep plenty of live stock on the farm. Farm animals are kept primarily to supply the demand for meat, milk, eggs, wool, and to furnish motive power for certain kinds of labor, but they also make possible a larger production of grain year after year, and a complete utilization of everything grown on the farm, besides returning to the farm a large percentage of the feed in the form of valuable fertilizers.

Feeding farm animals.—Animals must be fed to make them grow, to keep them warm and active, and to furnish special products, such as milk, eggs, wool, etc. Animals must be fed regularly and with the proper food in sufficient quantities. Shelter against the heat and storms of summer and the cold of winter must go along

FIG. 22. HIGH GRADE BEEF CATTLE

with the proper feeding of farm animals. If the stables are cold or the animals are allowed to stand out during the winter days, then the additional heat required to keep them warm must be supplied by additional food. Animals, like people, suffer in extremes of temperature. It is not right to allow stock to suffer, either for food or shelter. Animals that are poorly fed, left unsheltered, or allowed to become filthy and dirty, grow unhealthy, sicken, and die. No one can doubt that it pays to take good care of stock.

Value of good stock.—It takes no more room and costs no more in food and care to raise a good farm animal than it does to raise a "scrub." A scrub cow eats as much hay, takes as much stable room, and requires as much work to care for as a cow of good breeding, and

FIG. 23. A HERD OF JERSEYS

it has been shown that the scrub cow does not pay for her keep. A scrub colt or a scrub sheep is no better than a scrub cow; it eats as much or more, and will not sell for as much as a good animal. And a "hazel-splitter" hog certainly requires as much food and care as a genuine "porker." If the pupils who read this lesson are convinced that it pays to keep good stock instead of scrubs, the purpose of the lesson is already attained.

Free Bulletins, U. S. Dept. of Agriculture

No. 41.—Fowls: Care and Feeding.
No. 51.—Standard Varieties of Chickens.
No. 64.—Ducks and Geese: Breeds and Management.
No. 100.—Hog Raising in the South.

No. 141.—Poultry Raising on the Farm.
No. 179.—Horseshoeing.
No. 200.—Turkeys: Breeds and Management.
No. 205.—Pig Management.

Extracts.

No. 15.—Some Practical Suggestions for the Suppression and Prevention of Bovine Tuberculosis.

Table showing value of manure, per head, produced annually by farm animals:

Horse	$27.00
Cow	19.00
Hog	12.00
Sheep	2.00

Table showing value of manure, per animal, saved annually from animals by the average farmer:

Horse	$10.00
Cow	6.00
Hog	4.00
Sheep	.75

Practical Exercises

NOTE. The practical lessons on farm animals will be given and numbered as separate lessons in this series.

LESSON XXI

THE DRIVING HORSE

By comparing the horses we see on the road, we can observe that there are different forms or types. Some have a form that enables them to draw a heavy load at a slow pace, while others have a form adapted to drawing light loads at a rapid pace. These represent two distinct types, and are called *draft horses* and *driving horses.*

In this lesson we are to study the driving horse. You will observe that the driving horse has a long graceful neck, a narrow chest, long body and legs. In this horse weight is not so important as in the draft horse. Speed and endurance seem to be the principal points sought in the roadster. The driving horse varies widely in height and weight.

The following points any school boy should recognize in a good driving horse:

FIG. 24. A GENERAL PURPOSE HORSE

1. The color is not so important in this type of horses. The dark colors are generally preferred.

2. Geldings are to be preferred.

3. The horse should be fifteen to sixteen hands high at the withers.

4. Conformation. The horse should be harmoni-

ous, unblemished, withers rather low, and loins slightly weak, but powerful croup, thighs, buttocks, legs and hocks are essential.

5. The neck should be long, chest large and deep, limbs clean and long, and muscles and joints showing graceful prominence.

6. The animal should have good life, and not be afraid of ordinary objects.

The teacher should study the following score card for light horses, and if the proper explanations be made, pupils of the eighth grade will be able to mark the card and score the horse fairly well:

Have a horse before the class for this lesson.

The class should gather about the horse, with this book in hand, and opened at the score card. Each pupil should read each point of the score card, then look at the horse to see how it measures up to the description given. Mark lightly with lead pencil the grade you would give on each point, opposite the perfect grade given on the score card.

Score Card for Light Horse

Description.	Perfect Score.	Students' Score.
Frame—Smooth, evenly proportioned	4	
Quality—Bone clean and hard, tendons well defined, veins prominent, skin and hair fine	5	
Temperament—Active but kind	3	
Head—Lean and symetrical	1	
Forehead—Full and broad	1	
Eyes—Large, clear, open, and bright	1	
Ears—Close together, medium in size, pointed to carry well forward	1	
Muzzle—Clean and fine, nostrils large, lips thin and even	1	
Neck—Muscular, crest high, windpipe prominent.	1	
Shoulders—Long, oblique, well muscled	2	
Arms—Short, thrown forward	1	
Fore-arms—Long, wide	2	
Knees—Wide, straight, and clean	2	
Cannons—Short, wide, sinews large	2	
Fetlock—Wide, straight	1	
Pasterns—Strong, angle with ground 45 degrees.	3	
Feet—Medium and even in size, horn dense, frog large, elastic, bars strong, sole concave, heel wide	6	
Legs—Viewed in front, a perpendicular from point of shoulder should cut the center of knee cannon, pastern and foot viewed from side, a perpendicular from center of elbow should cut the center of knee and pastern joint and the back of hoof	4	
Withers—Well finished and muscled at top	1	
Chest—Deep, low, large	2	
Ribs—Long, sprung, close	2	
Back—Straight, short, broad, well muscled	2	
Loin—Wide, short and thick	2	
Underline—Short, straight	1	
Hips—Wide, level	2	
Croup—Long, wide, muscular	2	
Tail—Attached high, well carried	1	
Thighs—Muscular, long, and spread	2	
Quarters—Deep and heavily muscled	2	
Gaskin—Muscular, long and wide	2	
Hocks—Clean, wide, straight	5	
Cannons—Short, wide, and clean	2	
Fetlocks—Wide, straight	1	
Pastern—Strong, sloping	2	
Feet—Same as fore feet	4	
Legs—From behind, perpendicular from point of buttock cuts center of hock, cannon, pastern and foot; from side, perpendicular from point of hip should fall on center of foot and divide gaskin in the middle and perpendicular from buttock should be parallel with cannon..	4	
Action—Walk quick, elastic, trot rapid, straight, regular and high	20	
Total	100	

LESSON XXII

THE DRAFT HORSE

Have a draft horse in the school yard for this lesson. Note the short legs, heavy body, short, thick neck, broad, deep chest and shoulders, strong hocks and rather large joints and feet. With the draft type weight is one of the most important considerations. A draft horse may weigh from 1,500 to 2,000 pounds. The heavy horse in harness brings greater power into the collar than does the light one.

There are several different breeds of draft horses. The Percherons, Belgians, Clydesdale, and English Shires are the common breeds.

The following points any school boy should recognize in a good draft horse:

1. The best selling colors are: bay, chestnut, brown, roan, black, and iron gray.

2. Body conformation, massive, low-set, ample, very muscular, short-flanked, cylindrical, large and broad limbs, good feet, good face, ardor, and endurance.

3. The horse should be at least sixteen hands high at the withers.

4. The animal should be sound, and the following blemishes should always be in mind in examining a horse: Spavin, curb, thorough-pin, sidebones, splints, sweeney, sprung knees, faulty hoofs, poor eyesight, string halt, poor wind, parrot mouth, blindness, etc.

5. The horse should have good life but be gentle.

While the horse is present for this lesson, some interesting and profitable measurements may be made.

which should teach the pupils to recognize good proportions in the horse.

Three important points for measurements are, length of the head, total length of the body, and the total height of the body.

FIG. 25. A PERCHERON TEAM

Use an ordinary tape measure in this part of the exercise.

1. The height of the horse, from the top of the withers to the ground.

2. The height of the horse from the hips to the ground.

3. Length of the body from the point of the elbow to the back of the buttock.

4. The length of the head.

It will be found in a horse of good proportions that the first three measurements each equal about two and one-half times the length of the head.

If we take the total length of the horse's head, and compare it with the body of a well formed horse, we will find that there are four other measurements almost exactly equal to it as follows:

1. The length of the neck from the top of the withers to the poll. If there is much difference between these measurements, we say that the head is too long or the neck is too short.

2. The height of the shoulder from the top of the withers to the point of the elbow.

3. The thickness of the body from the middle of the abdomen to the middle of the back. If there is a great variation in these measurements, we say the horse has poor form.

4. The width of the body from one side to the other.

A better instrument for taking the measurements of a horse, as suggested by Mr. Harper in the Cornell Rural School Leaflets, is as follows: A piece of soft white pine two inches wide, one-half inch thick, and four feet long; to one end of this, and at right angles to it, tack a similar piece of pine 18 inches long; to the other end strap loosely an ordinary carpenter's square so that it may slide back and forth. Now mark off the long piece into inches, beginning at the inside of the right angle.

"Ay! gather your reins and crack your thong,
And bid your steed go faster;
He does not know as he scrambles along,
That he has a fool for a master." —Holmes.

The Horses' Plea

Please give us water often.

Please give us a moment's rest on the way up the hill.

Please do not overload us. We are doing our best.

Please do not use the whip. It is seldom necessary.

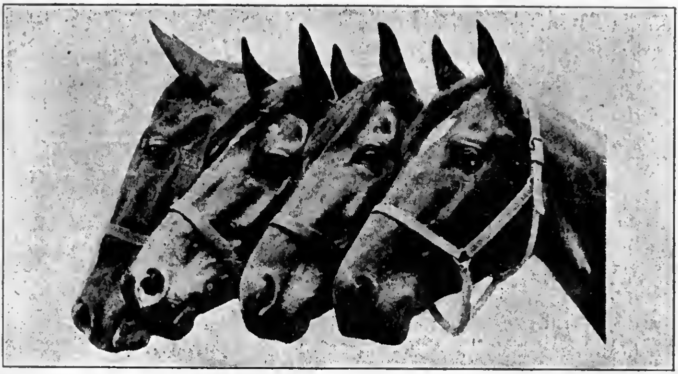


Fig. 26. Four Faithful Friends

Please remember that we will respond to a word as quickly as to a blow.

Please look out for our health, and don't work us when we are sick.

Please see that we are properly shod.

Please be sure that we have enough to eat, and that we are fed regularly.

Please see that the harness fits, and does not chafe sore or tender spots.

Please remember that two weeks' vacation each year will make us more serviceable and valuable.

Remember, we work hard for you.

LESSON XXIII

THE DAIRY COW

For this lesson bring a dairy cow into the school yard, and as the class observes the cow the teacher should speak briefly upon the following points.

Cattle are kept for two main purposes; for the production of milk and for the production of beef. These two purposes make different demands upon the energies

FIG. 27. A TYPICAL JERSEY COW

of the animal, and thus through many generations of selection and development, there have arisen two types of cattle, the beef form or type, and the milk form or type. These two forms are not entirely distinct or separate, but they tend to merge into intermediate forms.

The chief differences that distinguish the beef and dairy types are:

1. Outline of body.

2. Depth and smoothness of flesh.
3. Size of udders.

In the dairy type the general outline of body is wedge-shaped from before backward. This is due to a large development of the hind quarters, and sometimes to low thin shoulders. The height of the animal at the hip is from one-half to one inch greater than at the shoulders. The wedge-shaped appearance is increased

FIG. 28. A TYPICAL HOLSTEIN COW

by a large and pendulous abdomen, and by a large and well developed udder. In the dairy type there is less muscular development and more spare, angular appearance. The animal may be fat enough and still present this spare appearance. In the dairy type the udder is much larger and fuller than in the beef type, and the so-called "milk-veins" stand out prominently.

The dairy breeds are the Jersey, Guernsey, Ayrshire, Holstein, etc.

While the cow is before the class the pupils should each score the animal, using the following score-card, which explains how the points should be marked:

Score Card for Dairy Cows

Student's Name .... Date..................

Breed.................. Age................ Weight...............

Description.	Perfect Score.	Students' Score.	
General—			
Form—Wedge shaped, viewed from front, side and top	10		
Quality—Hair and skin fine and mellow, skin loose and thin	8		
Temperament—Nervous	6		
Head and Neck—			
Muzzle—Large and clean, nostrils large	1		
Eyes—Large, brilliant full and mild	1		
Face—Dishing and lean	1		
Forehead—Broad	1		
Ears—Medium in size, fine in texture, with no long, coarse hair	1		
Horns—Waxy, small, and fine in texture	1		
Neck—Fine, clean, with little or no dewlap	1		
Forequarters—			
Withers—Short, lean and thin	2		
Shoulders—Light, lean and oblique	2		
Legs—Short, straight and fine	1		
Body—			
Chest—Deep, wide, girth large	12		
Bowel—Ribs arched, long, and wide apart; stomach large and roomy	12		
Back—Straight, lean; spines prominent and wide apart	2		
Loin—Broad	2		
Navel—Large	2		
Hindquarters—			
Hips—Far apart, level	2		
Rump—Long level	2		
Pinbones and Thurlls—High, wide apart, and prominent	3		
Tail—Reaching to hocks, fine	1		
Thighs—Thin, long	4		
Escutcheon—High and spreading	2		
Udder—High behind, extending well forward in front; quarters even; teats evenly placed; udder not fleshy	20		

LESSON XXIV

THE BEEF COW

This lesson should follow Lesson 23, so that the comparison of the two types may be brought out more clearly. The chief characteristics of the beef cow are as follows:

In the beef form the outline of the body approaches the rectangular. The general contour of the top and bottom line is straight and parallel, and the general di-

FIG. 29. BEEF TYPE

mensions of the body approximate those of a brick. In the best beef animal the whole body is thickly and smoothly covered with flesh, so that the angles of the bones are not prominent. The neck is short, and the whole body has a rounded appearance. In the beef type, not only is the udder small, but the veins leading from it are small and more or less embedded in the surrounding muscular and fatty tissue.

The principal breeds are: Aberdeen-Angus, Galloways, Shorthorn or Durham, Hereford, Sussex, etc.

Use the following score card and judge the points in the animal before the class:

Score Card for Beef Cattle

Student's Name .... Date ....

Description.	Perfect Score.	Students' Score.
General—		
Weight—Score according to age	10	
Form—Broad, deep and massive; top line and under line straight; legs short	15	
Quality—Hair fine, skin pliable, evenly fleshed, deep meated, especially in the valuable cuts	15	
Head and Neck—		
Forehead—Broad and full	1	
Eyes—Bright, clear and large	1	
Face—Short, quiet expression	1	
Muzzle—Mouth large, jaw wide, nostril large	1	
Ears—Fine texture, medium in size	1	
Horns—Medium in size, fine in texture, waxy	1	
Neck—Short and thick, with no loose skin	1	
Forequarters—		
Shoulder—Well covered with compact flesh on top and bottom, and smooth; shoulder vein filled out so as to make a smooth connection with the neck	5	
Brisket—Prominent, showing well forward of the legs viewed from the side	1	
Dewlap—Should not have a surplus of loose skin	1	
Legs—Short and straight, arms full and smooth	2	
Body—		
Chest—Full, wide, deep, girth large	5	
Ribs—Arched, long, and thickly fleshed	6	
Back—Straight, broad, smooth, evenly and deeply meated	10	
Loin—Broad and thick	7	
Flank—Deep and full, making a straight underline	3	
Hindquarters—		
Rump—Long, wide and smooth, no bunches of flesh at tail	2	
Hips—Smooth and well covered with meat	2	
Pinbones—Far apart but not prominent	1	
Thighs—Deep, wide and full	2	
Twist—Deep and full	2	
Purse—Full, fleshy	2	
Legs—Short, straight and smooth	2	
Total	100	

LESSON XXV

THE SHEEP

Sheep raising is especially profitable, and it would be well to emphasize the study of this farm animal. Discuss the following points about sheep:

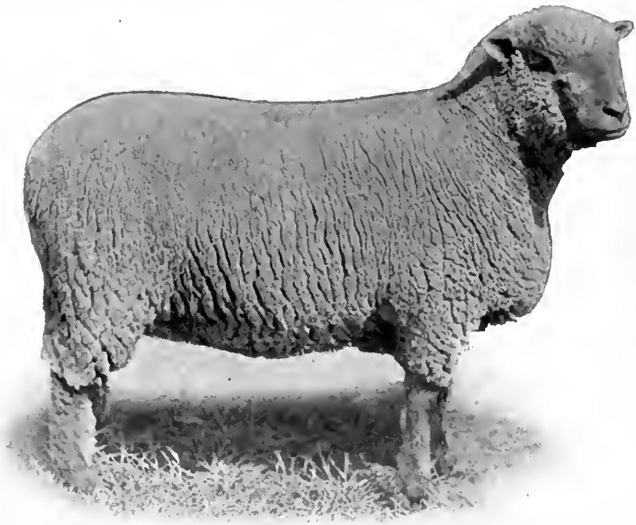


FIG. 30. A SOUTHDOWN EWE

1. Sheep are found in almost every latitude, and they can find sustenance and thrive where other animals can scarcely live.

2. Sheep provide man with meat and clothing, and are among the most profitable of animals.

3. Sheep increase rapidly, mature early, furnish wholesome food, and improve the land on which they are pastured.

4. Sheep are docile, rather easily handled, live on a great diversity of food, and require less grain than any other kind of live stock.

5. Enough food is wasted on the ordinary farm to maintain a small flock of sheep.

6. Sheep may be divided into two classes, wool breeds and mutton breeds. Of the wool breeds, American

Fig. 31. A Cotswold Ewe

Merino, Delaine Merino, and Rambouillets are the standard types.

Of the mutton breeds, Southdown, Shropshire, Horned Dorset, and Cheviot are the standard types.

Open the fleece of the sheep and observe the clean skin in which the fibres grow. These fibres are so rough that they keep the dirt to the outside.

Wool is valuable in proportion to the length and evenness of the fibre and the density of the fleece.

Answer the following questions:

1. How many pounds ought a fleece of wool to weigh?

2. Which makes the better clothing, coarse or fine wool?

3. Why are sheep washed before shearing?

4. Does cold weather trouble sheep. Wet weather?

Use the following score card and mark the score for each sheep before the class:

Score Card—Sheep

Scale of Points.	Mutton Sheep. Standard.	Mutton Sheep. Students' Score.	Fine Wool Sheep. Standard.	Fine Wool Sheep. Students' Score.
A. Age .... Teeth				
B. General Appearance				
Weight—Estimated .... lbs. Actual .... lbs. according to age	6	....	4	....
Form, low, compact, symmetrical	6	....	5	....
Quality, bone and wool fine.....	7	....	9	....
Constitution, as seen in girth, skin, and fleece	10	....	10	....
C. Head and Neck.				
Muzzle, fine; mouth and nostrils of good size; lips thin........	1	....	1	....
Eyes, bright, full, whites clear.	1	....	1	....
Face, short	1	....	1	....
Forehead, broad	1	....	1	....
Ears, fine, erect	1	....	1	....
Neck, thick, short	1	....	1	....
D. Forequarters.				
Shoulders, smooth, well covered.	6	....	4	....
Chest, wide, deep	6	....	5	....
Brisket, thick and carried well forward	4	....	3	....
Legs, straight, short, strong, well set, arm full, shank smooth..	3	....	3	....
E. Body.				
Back and Loin straight and wide.	8	....	6	....
Ribs well sprung, deep..........	4	....	3	....
Flanks low, making straight underline	3	....	2	....
F. Hindquarters.				
Hips well apart, smooth.........	4	....	2	....
Rump long, level, wide.........	5	....	3	....
Thighs full	5	....	3	....
Twist plump, deep	4	....	3	....
Legs straight, short, strong; shank smooth	3	....	3	....
G. Wool.				
Quality fine, soft, clean, even....	3	....	11	....
Density great	3	....	6	....
Length good	3	....	5	....
Yolk	1	....	4	....
Total	100		100	

Animal........................ Breed.........................

Owner.......................... Student.......................

Date.......................... Grade of Student..............

LESSON XXVI

THE HOG

For this lesson go to see some good breed of hogs, or have a good specimen brought to the school yard.

The first point to mention is the hog's structural adaptation to the life he leads. The skeleton is heavy and low, allowing great accumulation of weight in flesh and fat. The snout is strong and tough for rooting, and the eyes are set below the ears, indicating his ground-feeding habits.

The chief value of the hog is its production of meat, and if properly cared for, it will bring the farmer more money than any animal on the farm.

The most desirable type of hog has short legs, heavy shoulders, small dished head, straight back and straight under-lines, and heavy hams. The "razor back" hogs are very unprofitable, and will not gain so rapidly under feeding.

The following are some standard breeds of hogs:

1. Chester White	5. Poland-China
2. Yorkshire	6. Duroc-Jersey
3. Tamworth	7. Cheshire
4. Berkshire	8. Victoria.

Hogs will do better when kept as little as possible in pens. But when they are kept in pens, cleanliness is most important to reduce the danger of disease.

Score the hog, using the following score-card and marking the points:

Score Card—Hog

Scale of Points.	Standard	Students' Score
GENERAL APPEARANCE—30 Points:		
1. Weight, score according to age	4	....
2. Form deep, broad, low, long, symmetrical, compact, standing squarely on legs	8	....
3. Quality, hair silky; skin fine; bone fine; mellow covering of flesh, free from lumps and wrinkles	8	....
4. Condition, deep, even covering of flesh, especially in region of valuable cuts	8	....
5. Temperament mild, quiet	2	....
HEAD AND NECK—8 Points:		
6. Snout, medium length, not coarse	1	....
7. Eyes full, mild, bright	1	....
8. Face short, cheeks full	1	....
9. Ears fine, medium size, attached neatly	1	....
10. Jowl strong, nest broad, firm	2	....
11. Neck thick, medium length, smooth to shoulder	2	....
FOREQUARTERS—12 Points:		
12. Shoulder broad, deep, full, compact on top	8	....
13. Breast advanced, wide	2	....
14. Legs straight, short, strong; bones clean; pasterns upright; feet medium size	2	....
BODY—32 Points:		
15. Chest deep, broad, large girth	4	....
16. Sides deep, lengthy, full; ribs close and well sprung	8	....
17. Back broad, straight, thickly and evenly fleshed	9	....
18. Loin wide, thick, straight	9	....
19. Belly straight, even	2	....
HINDQUARTERS—18 Points:		
20. Hips wide apart, smooth	3	....
21. Rump long, level, wide, evenly fleshed, straight	3	....
22. Ham heavily fleshed, plump, full, deep, wide	10	....
23. Legs straight, short, strong; bone clean, pasterns upright; feet medium size	2	....
Total	100	....

Animals .... Date..................

Student ....

Answer the following questions:

1. At what age marketed?
2. Average weight then?
3. Average price?
4. Symptoms of hog cholera?
5. Good preventives?
6. At the present price of corn and hogs, would it pay better to feed corn to hogs or sell it by the bushel?

7. How many and what breeds in your community?

8. Do hogs like pasture?

9. What do hog raisers generally feed the hogs? How expensive is this feed as compared with feed for cattle or horses?

Problems

1. A cow requires about 4 feet by 9 feet floor space for a stall, with 4 feet by 3 feet additional for a manger. How much floor space will be required for 20 cows?

FIG. 32. A POLAND-CHINA PRIZE WINNER

2. Will it be better to stand the cattle in one long row, or in two rows of 10 each?

3. If in two rows, would you have them face each other with the manger between, or face the wall? Why?

4. What will be the dimensions of a barn for 20 cows in two rows of 10 each, using the floor space given in the first problem?

5. Draw a plan of this barn with cows facing each

other. With the cows facing the wall. What are the advantages and disadvantages of each plan?

6. How many feet of 2-inch plank will it take to lay the floor in this barn? Find cost of same at $25 per thousand.

7. What will be the cost of a cement floor for same at 10 cents per square foot?

8. Will "scrub" cattle require the same room?

NOTE. In the following examples do not forget to add the value of the manure produced to the values of the product:

9. If a cow eats 3 tons of hay worth $6 per ton, 1,000 lbs. of ground feed worth 80 cents per cwt., and pasture amounting to $5 in a year, what does it cost a farmer to keep a cow? Will a "scrub" cow cost as much?

10. A "scrub" cow will give 15 lbs. of milk, worth 80 cents per cwt., daily for 300 days in the year, and raise a calf worth $3. What is the farmer's profit on her?

11. A Jersey cow will give 25 lbs. of milk daily for the same time and raise a calf worth $5. What is the farmer's profit on her?

12. How much more does he make on the Jersey than on the "scrub"?

13. If it costs 2 tons of hay, 40 bu. of oats and $6 worth of pasture annually to raise a colt, what does it cost to raise a horse 4 years old with hay at $5 per ton and oats at 30 cents per bu.?

14. A "scrub" colt will bring about $80. Has the farmer lost or gained, and how much?

15. A coach horse will bring $150 instead. What has the farmer gained or lost on this colt? Which is the more profitable animal?

16. If it takes 3 tons of hay worth $6 per ton, 50 bu. oats worth 25 cents per bu., and $10 worth of pasture to keep 10 sheep for a year, what is the cost per head?

17. If one "scrub" sheep will shear about 4 lbs. of wool worth 20 cents per lb., and raise a lamb that will weight about 50 lbs. and bring about $3.50 per cwt., what will the entire flock return to the farmer? What will each sheep return? Will he gain or lose, and how much?

18. If of a good breed, each sheep will shear about 8 lbs. of wool and raise a lamb weighing about 70 lbs., worth $5 per cwt., what will this flock return? What will each sheep return?

19. How much per head will be the farmer's gain on a well-bred flock?

20. If it takes 12 bu. of corn worth 35 cents per bu. and $3 worth of other feed to raise a pig until it is six months old, what is the cost of the pig to the farmer?

21. If a "scrub," it will weigh about 125 lbs. at six months and bring $4 per cwt. Will the farmer gain or lose?

22. If a Poland-China, it will weigh about 200 lbs. and be worth $4.75 per cwt. What is the pig worth? Will the farmer gain or lose, and how much?

23. How much more will the blooded pig bring on the market than the scrub?

LESSON XXVII

FEEDS AND FEEDING

Purposes of feeding.—We have learned that we feed live stock to repair the waste in their bodies, to make them grow, to keep their bodies warm, to furnish energy for work, and to make special products—milk, eggs, wool, and the like. All animals wear out their muscles by work and exercise, and must have food to repair this waste or they will grow thin and poor. The harder the horses work, the more they must be fed. Young animals that are growing must not only eat to repair the waste, but they must have food to make them grow larger. The bodies of animals are kept warm by the food they eat. The strength of the horse and its power to do work must come from the food it eats. The food builds up the muscles, and strong muscles are necessary for work. Just as the fuel and water make the engine go, so food furnishes the heat and energy to "make the mare go." In addition to all these reasons for food, the dairy cow must have food out of which to make milk. When the pasture gets "short" in the summer, we notice the milk supply runs low. So, too, the sheep must have an extra supply of food out of which to make wool, and the hen requires special food from which to make eggs.

Kinds of food needed.—Farm animals are a sort of factory, producing materials that we need. The horse is a power house; the cow is a milk factory; the sheep, a wool factory; the hen, an egg factory, and the hog, a meat factory. In order to get these products from our animal factories, we must feed them the raw materials from which they can make these products. Herein lies the problem of the whole system of stock feeding. The farmer must determine the best and most economical food to be used in order to produce the desired results.

Foods are divided into three classes: fats, protein, and carbohydrates. The following are examples of these foods:

Fat meats, butter, lard, and all kinds of oils, come under the class of *fats.* The white of an egg is the best example of *protein.* The sticky part of flour, the principal part of cheese, lean meat, glue, hides, hair, wool, and feathers, are largely *protein.* Starch, sugar, and vegetable fibre are the carbohydrates. The fats are usually included under carbohydrates also, and may thus be considered in these lessons. Carbohydrates are foods containing carbon, hydrogen, and oxygen in combination. The protein foods differ from the carbohydrates in that they contain nitrogen in addition to other elements.

Balanced rations.—All the common stock foods have more or less of the three kinds of materials mentioned above—fats, protein, and carbohydrates. A balanced ration is one that has the proper amount of protein and carbohydrates to secure the animal product desired. The balanced ration usually given for a dairy cow and a work horse is one in which there is about six times as much carbohydrates as protein. A "wide" ration contains a larger proportion of carbohydrates, and a "narrow" ration, less. The table at the end of the lesson shows how much dry matter, fats, protein, and carbohydrates are in the different feeding stuffs.

Special uses of the different foods.—The protein foods make bone, blood, and muscles. The carbohydrates are the fat producing foods. Carbohydrates make heat for the body. If muscle is to be built up, then protein foods must be fed. If the horses are fed only upon corn and timothy hay in the summer, they are getting too much fat and heat producing food, and not enough muscle forming food. Corn and timothy are rich in carbohydrates. Oats and clover hay are rich in protein food material. In the spring it is muscle and energy that is wanted and not heat and fat. Protein foods are also required to produce wool, milk, and eggs. Young growing animals should be fed plenty of protein food, with mineral matter in it, to form bone and muscle. In most foods there is plenty of carbohydrates; the difficulty is to get the protein food in the proper balanced ration. To find the total amount of carbohydrate in any feeding stuff, multiply the fats given by 2¼, and add to the carbohydrates. One pound of fat will produce 2¼ times as much heat as one pound of carbohydrates. The "nutritive ratio" is the proportion of protein to carbohydrates. To find the nutritive ratio of any ration, divide the total amount of carbohydrates in the ration by the total amount of protein.

Practical Exercises

NOTE. The practical exercises on this subject follow as separate lessons.

LESSON XVIII

TEST FOR FOOD COMPOUNDS

(a) To test for the presence of starch in such carbohydrates as corn, oats, wheat, or rye, pulverize a few seeds, pour over them a little boiling water, let stand a short time, and add a drop of iodine. If the seeds contain starch the water will turn blue or black in a short time. If the seeds contain sugar it may be detected by chewing them slowly and thoroughly. A sweet taste will indicate the presence of sugar.

(b) To test for protein, remove the germ from a kernel of corn and scorch it on the stove. If it gives off the odor like that of burning feathers, it contains protein. All seeds contain protein. Test other seeds for protein.

(c) To test for fats or oil, crush seeds or nuts on a piece of clean white paper. Heat the paper gently, being careful not to scorch it. The grease spot that appears will indicate the presence of oil.

It might be a profitable exercise to make collections of feeding stuffs, and classify them into fats, protein, and carbohydrates.

LESSON XXIX

DETERMINING RATIONS FOR FARM ANIMALS

The following formula illustrates the method of finding the nutritive ratio:

$$\frac{\text{Carbohydrates}+(\text{fat}\times 2.25)}{\text{protein}}=\text{nutritive ratio.}$$

For example, suppose we wish to find the nutritive ratio of the following ration: (Horse weighing 1,000 pounds, doing medium work.)

Timothy hay ....15 pounds
Corn ....10 pounds
Cotton-seed meal .... 3 pounds

Solution:

In 100 pounds of timothy hay there is 86.8 lbs. dry matter, 2.8 protein, 43.4 carbohydrates, and 1.4 fat. (See table below.)

In 15 pounds hay there are:

15-100 of 86.8 dry matter, 13.02 pounds.
15-100 of 2.8 protein, .42 pounds.
15-100 of 43.4 carbohydrates, 6.51 pounds.
15-100 of 1.4 fat, .21 pounds.

In 10 pounds corn there are:

10-100 of 89.1 dry matter, 8.91 pounds.
10-100 of 7.9 protein, 7.9 pounds.
10-100 of 66.7 carbohydrate, 6.67 pounds.
10-100 4.3 fat, .43 pounds.

In 3 pounds cotton-seed meal there are:

3-100 of 91.5 dry matter, 2.74 pounds.
3-100 of 38.1 protein, 1.14 pounds.

3-100 of 16.0 carbohydrate, .48 pounds.

3-100 of 12.6 fat, .378 pounds.

	Dry matter	Protein	Carbo-hydrate	Fat
Timothy, 15 lbs.	13.02	.42	6.51	.21
Corn, 10 lbs.	8.91	.79	6.67	.43
Cottonseed meal, 3 lbs.	2.74	1.14	.48	.378
Total	24.67	2.35	13.66	1.018

Substituting in the formula given above,

$$\frac{13.66+(1.018\times 2.25)}{2.35}=6+.$$ Nutritive ratio is 1 to 6.

This is a proper ratio for the horse referred to above. One-fourth for breakfast, one-fourth for dinner and one-half for supper would be the proper division of his ration.

Problem.—Find the nutritive ratio for 15 lbs. of clover hay and 5 pounds of oat straw, and 10 pounds of oats.

Stock Foods—Average of Digestible Nutrients

NAME OF FOOD Digestive nutrients in 100 pounds	Dry matter in 100 pounds	Protein	Fat	Carbo-hydrates
Green food and ensilage—				
Corn fodder	20.7	1.0	0.4	11.6
Rye fodder	23.4	2.1	0.4	14.1
Kentucky bluegrass	34.9	3.0	0.8	19.8
Red clover	29.2	2.9	0.7	14.8
Cowpea vines	16.4	1.8	0.2	8.7
Corn ensilage	20.9	0.9	0.7	11.3
Hay and dry fodders—				
Corn stover	59.5	1.7	0.7	32.4
Timothy hay	86.8	2.8	1.4	43.4
Red clover	84.7	7.6	2.0	38.4
Cowpea vine hay	89.3	10.8	1.1	39.0
Oat straw	90.8	1.2	0.8	38.6
Wheat straw	90.4	0.4	0.4	36.3
Grain and other seed—				
Corn	89.1	7.9	4.6	66.7
Oats	89.0	9.2	4.2	47.3
Cowpeas	87.8	20.0	0.8	53.2
Mill products—				
Corn meal	85.0	5.5	3.5	63.8
Wheat bran	88.1	12.2	2.7	39.2
Cottonseed meal	91.5	38.1	12.6	16.0

Free Bulletins, U. S. Dept. of Agriculture

Farmers' Bulletins.

No. 22.—The Feeding of Farm Animals.
No. 36.—Cotton Seed and Its Products.
No. 49.—Sheep Feeding.
No. 58.—The Soy Bean as a Forage Crop.
No. 170.—The principles of Horse Feeding.

Protein and Carbohydrates in Feed

	Pounds per Bushel.	
Kind of Food.	Protein.	Carbohydrates.
Dry peas	10	32
Rye	5	39
Barley	4	32
Corn	3½	40
Oats	3	19

Table showing approximate amounts of protein and carbohydrates required daily by farm animals of average size:

Animal.	Protein.	Carbohydrates.
Dairy cow	2 lbs.	12 lbs.
Work horse	2 lbs.	12 lbs.
Calves under 1 year	1 lb.	6 lbs.
Pigs, growing	½ lb.	2½ lbs.
Lambs, growing	1-5 lb.	1 lb.

NOTE: This amount varies with the size and age of the animal. Fattening stock can be profitably fed a greater allowance of carbohydrates in the form of grain, like corn and barley.

Problems

1. How many pounds of protein in a bushel of oats? With oats at 30 cents per bushel, what does this protein cost per pound, disregarding the carbohydrates?

2. How many pounds protein in a bushel of barley?

With barley at 44 cents per bushel, what does protein in this form cost per pound?

3. Which is the cheaper feed at these prices? How much?

4. What is the cost per pound of protein in rye at 60 cents per bushel?

5. What is the cost per pound of protein in corn at 35 cents per bushel?

6. At the above prices which is the cheapest feed?

7. Which is probably the best feed for fattening purposes? Why?

8. Suppose all kinds of hay sell at the uniform price of $8 per ton. What is the price of protein per pound in each of the four kinds of hay given above?

9. Which is the cheapest feed?

10. What is the best kind of straw to feed, and why? How do we find the "nutritive ratio"? What is the nutritive ratio of clover hay? Is it a balanced ration?

11. Find the nutritive value of all the feeds given in the tables.

12. Which are most nearly "perfect" feeds—i. e., which have a ratio of about 6 to 1?

13. Which are the poorest feeds—i. e., which have the lowest ratio of protein?

14. Which are the feeds having the largest proportion of proteins?

15. Are any of the feeds given in the table so poor that, in themselves, they are practically worthless? If so, name them.

Illustration.—One ton of mixed hay contains 88 lbs. protein and 880 lbs. carbohydrates. Its ratio is 1 to 10. Let us mix it with some other feed to bring the ratio up to about 1 to 6. We shall try peas. We shall feed 1 bu. of ground peas with every hundred lbs. of hay.

Feed.	Protein.	Carbohydrates.
100 lbs. hay contain.....	4.4	44
60 lbs. peas contain....	10.	32
160 lbs. mixed contain...	14.4	76

Dividing weight of carbohydrates by that of protein (76 by 14.4) we get a ratio of about 1 to 5. We have more protein than we need. Let us try again with ½ bu. of peas instead.

Feed.	Protein.	Carbohydrates.
100 lbs. hay contain.....	4.4	44
30 lbs. peas contain....	5.	16
130 lbs. mixed contain...	9.4	60

Again dividing (60 by 9.4) we get 6.3, about right, and a much cheaper feed. Now, how much of this ration shall we feed to a dairy cow? The table shows us that a cow needs about 2 lbs. protein daily, so this will be about enough for five days. One-fifth of each feed will give us as a result 20 lbs. of hay and 6 lbs. of peas for the daily ration.

16. With the ration given in the illustration, how long will a ton of hay last a cow?

17. How many bushels of ground peas will be required in the same time?

18. What will it cost to feed the cow for this time with hay at $7 per ton and peas at $1 per bushel?

19. Suppose she gives 25 pounds of milk daily on this ration. With milk at $1.20 per cwt., what is gained?

20. Make a ration of clover hay and corn in the same way and figure its cost.

LESSON XXX

THE DAIRY

Dairy products.—The products of the dairy are milk, butter, and cheese. There is scarcely a man, woman, or child in the civilized world who does not use every day in some form the products of the dairy. The farmer who has only one cow, and uses her milk for butter or for drinking, has a dairy, but we usually think of dairies as places where cows are kept in stables and fed all their feed in mangers and milked to supply a city population. However, most of the milk is produced on farms, and a large part of the butter is made there also. The use of the cream separator is increasing on the farm. By this machine the cream is separated from the milk soon after it is brought from the cow, and only the cream need be hauled to the factory, if the farmer is selling it. The cream separator enables the farmer to get more butter than by any other method.

Cleanliness.—In the dairy the most important item is cleanliness. There is probably no other item of food more difficult to keep clean than milk. The dirt which we eat in milk and butter would astonish us, if we could see it separated. Good, pure, sweet milk is essential both for health and for profit on the market. Bad flavors and bad odors in milk are caused by the cows eating improper food and drinking impure water, and by uncleanliness on the part of the dairyman in handling the milk.

Essentials in caring for milk.—In another lesson we shall speak of little plants called bacteria, which live at the roots of the legumes and take nitrogen from the air to help make the plant food. In this lesson we are to learn of another kind of bacteria living in milk and causing it to sour. In the first place, milk sours because bacteria from the air fall into it, begin to grow, and soon change the sugar of the milk to an acid.

FIG. 33. A CREAM SEPARATOR

These bacteria are in the air, in water, in barn dust, on bits of hay, and on the cow. They are most plentiful in sour milk, and if we should pour a little sour milk into the fresh milk the latter would sour more quickly. The same thing happens when people put fresh milk into poorly cleaned pails. It follows that all utensils used in the dairy should be thoroughly scalded so as to kill all the germs that cause the milk to sour quickly.

Not only do these germs, which cause the souring of the milk, get into it, but the germs of consumption and typhoid fever will also live in milk, and thus endanger the health and lives of all who drink it. The following precautions in the care of milk should be known to all who supply us with this valuable food:

1. Avoid pitching hay or making beddings or sweeping in the barn soon before milking time, if the cows are to be milked in the barn, for more germs fall into the milk if the air is full of dust.

2. The milker should wear clean clothes, should have clean hands, and should never wet his hands with the milk.

3. For greater cleanliness and safety the milkman should curry the sides of the cow, and moisten the parts nearest him to prevent dust from falling from the cow into the milk.

4. The first few streams of milk from each teat should be thrown away, because the milk at the mouth of the teat has been exposed to the air, is full of germs, and will cause the rest of the milk to sour sooner.

5. Every vessel used in the handling of the milk should be scrupulously clean.

6. The surface of the milk should not be left exposed to the air of the cellar, living rooms, or any place where dust and germs may fall into it.

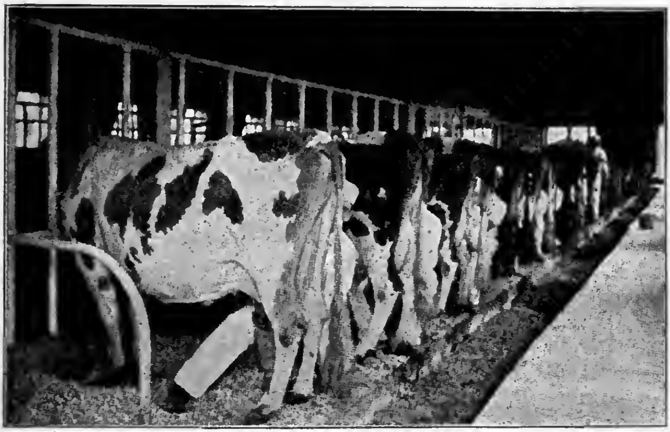
7. To test for formalin in milk, add a few drops of ferric chloride, then pour sulphuric acid into the milk, letting it run down the side of the glass. A purple

color at the junction of the milk and acid, indicates the presence of formalin.

8. Promptly cool and aerate the milk to prevent development of bacteria.

9. The cows should be healthy, especially as related to tuberculosis.

10. The stables should be well lighted and ventilated.



Courtesy Edgewood Farm.
FIG. 34. A MODEL COW BARN

Testing and selecting the cows.—The butter that milk will produce comes from the butter-fat that it contains. It is, therefore, important that the milk from each cow of a herd test well in butter fat, as well as be abundant in quantity. In general, no cow is paying her board bill whose milk tests much less than 3 per cent of butter-fat; neither is one which is giving less than twelve pounds daily. Every farmer should own a good cream separator, in order to get the maximum amount of cream and butter-fat that the herd produces, and also a Babcock tester, to ascertain whether his cows are yielding the highest percentage of butter-fat. A discussion of the Babock tester will follow in the practical exercises.

Practical Exercises

NOTE. The practical exercises for this lesson follow as separate lessons in the series.

LESSON XXXI

COMPOSITION OF MILK

Learn the following facts about milk:

Milk consists of about seven-eighths water and one-eighth substances in solution in the water, or floating in it in very small particles. You may be surprised to learn that so large a proportion of milk is water. This is true not only of milk but of many of our most important foods.

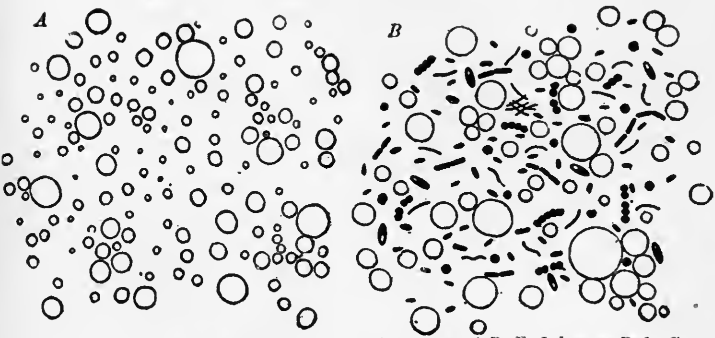
The constituents of milk are often referred to as water and total solids; fat, casein, albumen, sugar, and ash. A chemist can separate these substances with great accuracy, but by the following methods we can make a gross analysis:

1. Leave a little milk in a saucer for a short time in a warm place. The water will evaporate and leave the solids in dry form.

2. Separation of fat. Let a quart of fresh milk quietly stand in a shallow pan, in a cool place, until a layer of cream gathers at the top. This cream is

formed by the rising of tiny globules of butter-fat, which were distributed evenly through the fresh milk. The fat is so much lighter than the liquid in which it floats that it will rise in the cream layer in about twelve hours. This fat is a constituent of butter and of some forms of cheese.

3. Separation of casein. Add a few drops of acid,

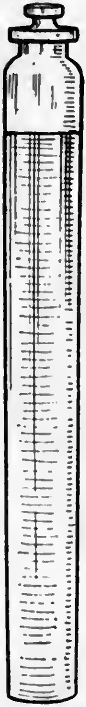


Courtesy of B. F. Johnson Pub. Co.

a. Pure. b. Bacteria.
FIG. 35. PURE AND IMPURE MILK

vinegar will do, to the skimmed milk. Soon it will thicken. Gently warm it now to about one hundred degrees and carefully break the thickened surface with a knife, and the skimmed milk will be seen to separate into curd and whey. Now strain through a cloth, and the casein will remain in the cloth, while the whey passes through. This casein is one of the principal parts of cheese.

4. Separation of albumen. Slowly heat the whey to 160 degrees Fahrenheit. It will become cloudy and soon a soft jelly-like substance will collect on the sur-



face. This is the albumen. This can now be separated by straining.

5. Separation of sugar. Take a small quantity of the whey from which the albumen has been separated, place in a saucer and warm gently until the water has been evaporated. A dry substance remains. This is about seven-eighths milk-sugar and one-eighth ash.

6. Separation of ash. It will not be possible to separate the ash and sugar in pure form. Heat the mixture in a dish or on the stove cover, and allow to burn as

Fig. 36. The Constituents of a Quart of Milk

Water	Fat	Casein	Albumen	Sugar	Ash
87 per cent	4 per cent	2.6 per cent	.7 per cent	5 per cent	.7 per cent
29.93 oz.	1.38 oz.	.89 oz.	.24 oz.	1.72 oz.	.24 oz.

long as it will. The small residue left is the milk ash.

(Adapted from Cornell Rural School Leaflet.)

LESSON XXXII

THE BABCOCK TEST

If the school can not be provided with a Babcock tester, this lesson will have to be omitted. The lesson is such an important one, and the ownership of a Babcock tester by the school would be such a valuable thing for the whole community, that the teacher should make every effort to get the material for this lesson.

Open.

Closed.

FIG. 37. A BABCOCK TESTER

Because of its simplicity, accuracy, and ease of operation, the Babcock test has become the standard test for determining the value of milk and cream as delivered to the cheese factories, creameries, and all milk stations over this country.

Complete directions for using come with every machine, and it will not be necessary to give them here. Observe great care for accuracy. Have some pupil bring a sample of milk from one of the cows at home. The sample should be taken after the milking is done, and the milk has been poured two or three times from one vessel to another so as to be thoroughly mixed. Take about a half cupful as a sample and put it into a clean bottle. From this bottle the sample is drawn for testing, after mixing the contents of the bottle thoroughly.

Having determined the per cent of butter-fat in the sample, an estimate can be made of the total amount of butter-fat in a gallon of milk. (A gallon weighs $8\frac{1}{4}$ pounds.)

Make many tests of the same cow's milk to determine its richness. A pound of butter-fat should make, in ordinary practice, about 1.1 pounds of butter, and the pupils can compare the price paid for butter and for the butter-fat, if sold at the creameries, and determine which method of sale is better.

If the school is in a dairy district, this lesson will furnish work for several weeks, and be profitable to patrons as well as to pupils.

Free Bulletins, U. S. Dept. of Agriculture

Farmers' Bulletins.

No. 29.—Souring of Milk and Other Changes in Milk Products.
No. 42.—Facts about Milk.
No. 55.—The Dairy Herd: Its Formation and Management.
No. 57.—Butter Making on the Farm.
No. 63.—Care of Milk on the Farm.
No. 151.—Dairying in the South.
No. 166.—Cheese Making on the Farm.
No. 201.—The Cream Separator on Western Farms.

Problems

1. How many pounds of butter-fat in 5,000 pounds of milk that tests 4 per cent?

2. A farmer owns a herd of 15 cows that average 24 pounds of milk per head daily. How many pounds of milk does he get in six months (thirty days each)?

3. If this milk tests 3.5 per cent, and butter-fat is worth 25 cents per pound, what does he receive monthly for his milk? How much per head?

4. A farmer has a herd of 20 cows. The milk for the week weighs as follows: 420 lbs., 418 lbs., 408 lbs., 422 lbs., 417 lbs., 432 lbs. and 423 lbs., respectively. It tests 5 per cent of butter-fat, the price of which is 30 cents per pound. How much do the cows average per head in money for this week.

5. A farmer hauls 43,250 lbs. of milk that tests 3.8 per cent to a factory. The price of butter-fat is 26 cents per pound. How much money should be receive?

6. A farmer owns six cows: Bess, Spot, Brindle, Bos, Kate and Red.

Bess	gives 22 lbs. of milk daily, which tests 3.8%,
Spot	gives 15 lbs. of milk daily, which tests 4.2%,
Brindle	gives 30 lbs. of milk daily, which tests 3.0%,
Bos	gives 20 lbs. of milk daily, which tests 3.0%,
Kate	gives 14 lbs. of milk daily, which tests 3.2%,
Red	gives 24 lbs. of milk daily, which tests 5.2%.

Figure out the dairy value of each. Which is the best cow? The poorest one? Classify them in order of dairy value.

7. Figure out the number of pounds of milk given by each cow in a month, and the value of it in butter-fat at 25 cents per pound.

8. Three herds of ten cows each are compared: The Friesians average 30 lbs. of milk each daily; and the scrub herd averages 10 lbs. daily. The Jerseys test 5.4

per cent; the Holstein-Friesians test 3.2 per cent; and the scrubs test 3 per cent. Which is the more valuable herd?

9. With butter-fat at 30 cents per pound, what is the monthly average per cow of each herd?

LESSON XXXIII

POULTRY

Poultry-raising as a business.—Much is being written in the farm journals and popular magazines about poultry raising, and many "get-rich-quick" schemes are proposed through various systems. Much of this poultry interest comes to naught. Nevertheless, poultry, if properly handled, will yield large returns, both on the farm and in the city lot. Poultry raising has not been given sufficient attention on many American farms. Fresh eggs and well-fattened young fowls are always in demand, and bring a high price on the market. The proceeds from the sale of eggs and poultry are no small item of the farm income. Poultry raising is a profitable business when thoughtfully and intelligently pursued.

Care of poultry.—The care of poultry, as in the case of other farm animals, must include the proper feeding and shelter. When fowls are left to roam and seek their food at will, they will get a balanced ration among the seeds and insects, and need but little care along this line. If they are confined, however, the food must be studied and properly provided. They must be fed egg-producing foods. They must have access to grit, oyster shells, charcoal, sand, ground bone and the like, to be used in grinding their food, and out of which to make egg shells. They must have food rich enough in protein, such as meat scraps, skim-milk, alfalfa meal, scratch-food, and table-scraps. Green foods like beets, cabbage, turnips, and silage should be given them in the winter. They should have an abundance of fresh

FIG. 38. COLONY POULTRY HOUSES

water. Hens fed entirely on corn will not lay well, because corn is a fat and heat-producing food, and eggs are made mostly of protein food.

The poultry houses.—Two systems of housing fowls are in use by poultry men and farmers: (1) The colony house, and (2) the continuous apartment house. Each system has its advantages. Expensive poultry houses are not necessary for success with poultry. The chief requirements are: (1) A well-drained soil. (2) Houses should face the south or southeast, as the coldest winds are thus shut off and the most sunshine is secured. (3) Cleanliness is absolutely necessary. Houses should be constructed so that they can be sprayed or whitewashed easily. The best method is to have every thing removable so that scalding water and sunshine can be used as cleansing agents when necessary. Feed hoppers, nest racks and other appliances should hang on the wall or stand on blocks. (4) Ventilation should be secured either by open-front houses or by some ventilator of approved design. (5) There should be no draft on the fowls at night. Perches should be placed in the most protected parts of the house. (6) Since exercise is necessary, both for egg production and for health, a place for scratching should be provided—a place where they can get to dry dirt and wallow in it. Dust acts as a sort of insect powder, filling up the insects' breathing pores, and thus keeps the chickens free from lice. The chickens may be forced to exercise by scratching in chaff or straw for their food, or jumping for bites of cabbage or beets hanging over them.

Breeds of fowls.—The varieties of fowls selected for farm use will depend largely on the purposes for which they are grown. Breeds such as the Leghorns and Minorcas are desirable for their laying qualities; the Brahmas and Cochins, for their meat; and the Plymouth Rock, the Wyandottes, and the Orpingtons, for general purposes, giving good returns both as layers and for meat production. The bulletins named below will be of value to the student, and to the practical poultry raiser.

Free Bulletins, U. S. Dept. of Agriculture

Farmers' Bulletins.

No. 51.—Standard Varieties of Chickens.
No. 64.—Ducks and Geese, Breeds, and Management.
No. 141.—Poultry Raising on the Farm.
No. 177.—Squab Raising.
No. 200.—Turkeys, Varieties, and Management.

FIG. 39. HENS NEED SHADE DURING HOT SUMMER

Problems

1. A flock of 60 hens average 80 eggs a year each. With eggs worth 15 cents per dozen, what is the value of these eggs?

2. How many bushels of corn will this buy at 40 cents per bushel? Of oats at 25 cents?

3. Suppose it takes only 12 bushels of corn, 5 bushels of oats and $7 worth of other food to keep this flock for one year, besides what they pick up for themselves. What is the profit over and above the cost of the feed?

4. What would have been the profit if they had laid 120 eggs each, instead of 80?

5. Ask pupils to furnish data for at least twenty other similar problems.

LESSON XXXIV

1. A STUDY OF FEATHERS

Have a fowl in the schoolroom a few hours before the lesson is given. Encourage the children to find out as many facts as they can for themselves before the school opens for work. Direct the observations of the pupils by a few questions, as: the kind of feathers; the location of the different kinds; any part of the body not covered with feathers. Suggest a little competition by asking which boy or girl can give the greatest number of facts from his observation of the feathers of the fowl.

At class time, the teacher should remove the fowl from the coop and hold it firmly by the legs to prevent fright and injury. Allow the children to come near.

1. Have the pupils feel the difference between the heat of the fowl's body beneath the feathers and on the outside of the feathers. Explain. Bring out the point that the feathers are non-conducting. What purpose does this serve the fowl?

2. Spread the wings and tail so that the different feather sections may be seen. Note that in the wing and tail, one feather overlaps the other so that each feather braces the other in flight.

3. Observe the lighter wing feathers (the sec-

ondaries) tucked under the heavier feathers (the primaries). What kind of feathers are in the tail? Are

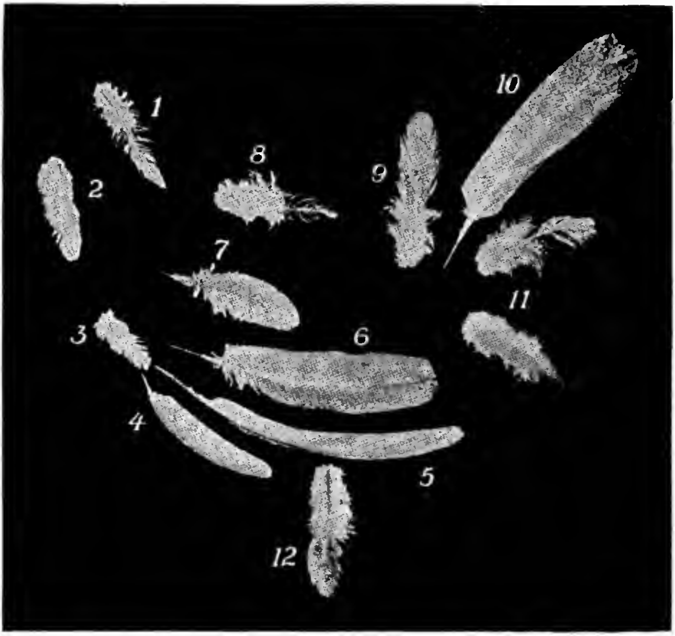


FIG 40. THE FEATHERS OF A CHICKEN

Showing their relative size, shape and position. 1. Neck hackle. 2. Breast. 3. Wing shoulder covert. 4. Wing flight covert. 5. Wing primary. 6. Wing secondary. 7. Wing covert. 8. Back. 9. Cushion. 10. Main tail. 11. Fluff. 12. Thigh.

they different from those of the wing? What use do the tail feathers serve?

4. Notice how the back feathers overlap each other. Why this arrangement? If the feathers shed easily without pain to the fowl, take out a feather from each

of the following places and fasten on a sheet of paper for comparison: 1. Neck feather; 2. Breast feather; 3. Wing shoulder covert; 4. Wing flight covert; 5. Wing primary; 6. Wing secondary; 7. Wing covert; 8. Back; 9. Cushion; 10. Main tail; 11. Fluff; and 12. Thigh. See figure for corresponding numbers.

4. Make drawing sketches of these feathers.

5. Make a drawing of a large primary feather, and name the parts: fluff, tip, quill, barb, and web.

LESSON XXXV

2. THE EGG

Each pupil in the class should bring a few eggs to form a collection for this lesson.

1. Tabulate in the note-book the record of the collection as follows:

(Number each egg with ink on the shell.)

The Breed	Size	Weight	Form	Pupil's Name	Date	No. of Egg

2. After this data has been recorded, a small hole might be broken in each end of the egg, the blow pipe or straw inserted, and the contents blown out, so that the egg shell may be preserved in a neat box as part of an interesting collection. From time to time, pupils might be encouraged to get the shells from the eggs

that are used at home to add to the collection. The contents of the eggs, blown, should be held in saucers, one to each pupil.

3. Observe the structure of the raw eggs in the saucers. Find the "germinal disc" which appears as a light colored spot, usually on the upper surface of the yolk. This germ spot contains the life principle of the egg. Note the whitish cords of denser albumen which serve to keep the yolk properly suspended in the white of the egg.

Note the clear, watery appearance of the white of the egg. This is the albumen, the food in liquid form upon which the young chick lives while in the shell. (If the contents do not come out whole, another egg must be broken for this part of the lesson.)

4. The chemical composition of the dry substance of the inside of the egg is (Snyder: Poultry Book.):

	Protein.	Fat,
White (albumen)	88.92	.53
Yolk	20.62	64.43

5. Make a drawing of the egg shell obtained above.

6. If it is not possible to boil the eggs at the school, ask each pupil to bring a boiled egg for this part of the study.

Carefully remove the shell piece by piece. Observe the air space, and the two membranes beneath the shell. Cut the egg lengthwise through the middle, and make a drawing of the section, showing all the points mentioned in paragraph 3.

DECEMBER

On the farm.—December is a good month for the farmer to balance his books and see whether his management has been profitable or unprofitable. The successful farmer will know whether each field is yielding up to the standard every year. He will know whether his farm animals are paying their board. He will know how much money he should spend and how much he should save to be progressive. To be able to manage the farm as a successful merchant does his business, the farmer must keep records and books in some simple and accurate way.

LESSON XXXVI

FARM ACCOUNTS

Keeping accounts.—Every farmer should keep accounts. Often it is desirable to know how much cash is received and paid out during the year. A simple cash account will show this. All kinds of accounts require two columns. The columns may be placed side by side, with double ruling down the center of the page, dividing them. This method will be used in this lesson. The following explanation of the *cash account* system is taken from Hatch's Elementary Agriculture with Practical Arithmetic:

Cash accounts.—In keeping a cash account the word cash is first written across the top of the page. All cash received is placed in the cash space in the left-hand side, and all cash paid out is placed in the cash space in the right-hand side. At the extreme left of each side the date is placed, and between the date and the cash space the item, for which cash has been received or paid, is written. The total amount of cash received, or paid out, is easily found by adding the amounts on each side, and the difference of these two sums represents the cash on hand. Cash on hand should be carried over into the received side at the top of the next page, when any page is filled up with entries. If it is desired, the totals may be carried over into their respective columns instead, and the new page kept in exactly the same way as the preceding page. This is all there is in keeping a cash account. It is a very simple and easy thing to do. For example:

Cash

Date 1905		Item	Rec'd		Date 1905		Item	Paid	
Jan.	1	Cash on hand..	$ 24	40	Jan.	2	Groceries	$ 3	00
Jan.	3	For hogs	102	75	Jan.	15	For coal	14	40
Jan.	30	For butter ...	42	84	Jan.	17	For books	5	00
Feb.	1	For eggs	2	25	Jan.	20	For overcoat ..	12	00
					Feb.	1	For rubbers...		75

Balance the above account and determine how much cash is on hand Feb. 1, 1905.

Personal accounts.—In a personal account the name of the person is written across the top of the page, and the record is kept as in the cash account. Whenever the person against whom the account is made receives anything, an entry is made on the left-hand side under the word *debtor,* and when he pays anything on this account, this entry is made on the right-hand side under the word *creditor.* The following example is taken from Hatch's Agriculture:

FIG. 41. GOOD MATERIAL FOR A PRODUCE ACCOUNT

John Smith

Date 1905		Item	Dr.		Date 1905		Item	Cr.	
Sept.	22	To 1 pig	$12	50	Oct.	3	By 3 d'ys' wk.	$ 4	50
					Oct.	10	By cash.......	2	00
					Oct.	25	By 1 d'y's wk.	1	50
					Oct.	30	By bal. cash.	4	50
			$12	50				$12	50

Produce accounts.—A produce account is a record of the receipts and expenditures on certain crops or animals. Suppose that you wanted to keep an account of your chickens. The word *chickens* is written across the top of the page. Whenever there are any expenditures made for the chickens, this is entered on the left-hand side of the page under *debtor*. Whenever the chickens return an income in the form of eggs or young chickens, this entry is made on the right, under the word *creditor*. The account below is taken from Hatch's book:

Chickens

Date 1905		Item	Dr.		Date 1905		Item	Cr.	
May	1	To l'mb'., c'ps.	$ 3	20	May	30	By e'gs f'r mo.	$ 2	50
June	2	To feed		75	June	30	By e'gs f'r mo.	1	80
June	30	To corn meal.	2	40	July	30	By e'gs f'r mo.	2	10
Aug.	1	To corn	3	00	Oct.	1	By y'g ch'kens.	6	00
Oct.	1	Profit	10	05	Oct.	1	By yg. ch. etn.	3	00
					Oct.	1	By eggs e't'n..	4	00
			$19	40				$19	40

What does the above account show as to profit or loss on the investment?

LESSON XXXVII

1. THE YEAR'S ACCOUNT BY MONTHS

Prepare twelve pages in your agricultural note-book, one for each month of the year. Use the cash account system as shown below:

Cash

Date 1905		Item	Rec'd		Date 1905		Item	Paid	
Jan.	1	Cash on hand.	$ 24	40	Jan.	2	Groceries	$ 3	00
Jan.	3	For hogs	102	75	Jan.	15	For coal	14	40
Jan.	30	For butter	42	84	Jan.	17	For books	5	00

Beginning with September of our year on the farm, fill out the receipts and expenditures of each month, estimating them as best you can from the probable accounts of the general farming operations upon this farm for an average year.

What should be a fair net income from a forty-acre farm, providing the farmer does as much of the labor himself as he can?

LESSON XXXVIII

2. CROP RECORDS

It is an important business matter for the farmer to keep, year by year, a record of the production of each field. This lesson should impress upon the pupils the importance of keeping such records neat and accurate. Use the form below, and require each pupil to keep a record of one of the fields at his own home. Neatly fill out the form in the agricultural note-book, and add the data from time to time as the field is farmed.

Name.......................... P. O................................
Crop........................... Previous Crop......................
Kind of Soil .... No. of Acres ....

Preparation of the Soil

Date of plowing................	Date of cultivation...............
Depth of plowing...............	Implement used ....
Cost of plowing.................	Cost of prep. seed bed............

Seeding and Cultivation

Date of seeding..................	Cost of fertilizer..................
Amount of seed................	Dates of cultivation..............
Cost of seed.....................	Implements used ....
Fertilizer used	Cost of cultivation ....

Harvest

Date of harvest..................	Quality of the harvest............
Cost of harvest..................	Yield, grain ....
Total cost of the crop............	Yield, fodder ....
Insect injury	Yield per acre.....................
Fungous injury	Net profit per acre................

NOTE: In connection with this lesson it would be a valuable supplementary exercise to establish a school bank. The pupils of the school should elect a president, board of directors, cashier, and clerk. The teacher should provide a suitable receptacle for money deposits and the proper bank books, checks, etc. Encourage the pupils to make deposits, keep bank books, and draw out money only with properly signed checks. Our boys and girls should become familiar with these simple business proceedings.

LESSON XXXIX

3. RECORD OF A GOOD CROP ROTATION

Compare the data given in the ten-acre rotation below, with prices and conditions in your home vicinity. The figures below are the actual record of an Illinois field under standard conditions of cultivation:

A Good Typical Ledger Ruling

1. Clover sown in wheat in March—

Number of bushels	1
Cost of seed	$6.50
Cost of labor	$1.25

2. Wheat cut in July. Threshed and marketed—

Yield, bushels	200
Value of yield	$160.00
Total cost of labor..................................	$17.50

3. Pasture in clover in the Fall—

Number of head	5
Number of months	2
Income from pasture	$12.00

4 Clover hay harvested next June—

Number of tons	12
Price per ton	$5.00
Cost of labor	$12.00

5. Clover seed crop in the Fall. Husked and marketed—

Number bushels yield	15
Value of yield	$90.00
Cost of labor	$20.00

6. Plow for corn the following Spring, and plant—

Cost of labor	$10.00
Cost of seed (1½ bushels)	$1.00
Four cultivations—cost of labor for cultivation	$7.50

7. Seeding wheat in the corn in September—

Cost seed (1½ bushels per acre)	$12.00
Cost of labor	$4.00

8. Corn harvest in the Fall—

Number of bushels	500
Value of the yield	$200.50
Cost of labor	$15.00

Calculate the total cost and receipts of this rotation, and the net gain on one acre for one year.

The last census shows that the average annual crop per acre in this country is valued at $11. How does this annual crop compare with the average?

What does the farm upon which you live yield per acre?

What crops yield the highest net returns per acre in your locality?

Problems

1. A farmer's boy hires out to a neighbor for five months at $22 per month. He begins work April 1, with $7.35 cash on hand. He receives his pay at the end of every month. April 2, he pays $2.75 for shoes. April 20, 25c for a straw hat. May 3, he spends $1.25 for a coat. May 31, he buys a colt for $42. July 1,

he pays $14.75 for more clothing. July 4, he spends $2.35. July 20, he sells his colt for $55. August 15, he pays $6.50 for a watch, and, during the summer he spends $4.85 for sundry small articles.

Write out his account and determine how much cash he has on hand when his time is out.

2. Two boys rent for $4 a half acre of land on which to plant onions. They allow themselves 75c each per day for their time. It costs them $2 to get this piece of land fertilized and plowed. They each spend ten days' time planting and cultivating their onions, and four days more each when harvesting time comes. They sell $14.30 worth of green onions, and harvest 142 bushels more. For 100 bushels they get 75c per bushel, and 60c per bushel for the remainder.

Write out their onion account, and find their profit.

3. A farmer runs an account with George White, a merchant. July 7, he buys a pair of shoes for $2.40 and has them charged on account. July 20, he takes in twelve dozen of eggs at 11 cents per dozen and gets 50c worth of sugar. August 3, he takes in twelve pounds of butter at 20 cents per pound and gets nine yards of calico at 6 cents per yard, one pound of tea at 50 cents, four pounds of coffee at 18 cents per pound, and a barrel of salt at $1.25. August 14, he gets a pail of fish at 75 cents and 100 pounds of sugar at $5\frac{1}{2}$ cents per pound, and pays $2 in cash. How does his account stand on August 15?

Write out this account with Geo. White.

LESSON XL

4. COMPARISON OF AGRICULTURE PRODUCTS

Take the data from the Year-book of the Department of Agriculture for 1905, and fill out the tabulation below:

	CORN		WHEAT		OATS		HAY	
STATES	Acres	Value	Acres	Value	Acres	Value	Acres	Value
New York	.....	.....	.....	.....	.....	.....	.....	.....
West Virginia	.....	.....	.....	.....	.....	.....	.....	.....
Ohio	.....	.....	.....	.....	.....	.....	.....	.....
Indiana	.....	.....	.....	.....	.....	.....	.....	.....
Illinois	.....	.....	.....	.....	.....	.....	.....	.....
Pennsylvania	.....	.....	.....	.....	.....	.....	.....	.....
Virginia	.....	.....	.....	.....	.....	.....	.....	.....
Georgia	.....	.....	.....	.....	.....	.....	.....	.....
Alabama	.....	.....	.....	.....	.....	.....	.....	.....
Iowa	.....	.....	.....	.....	.....	.....	.....	.....
Kentucky	.....	.....	.....	.....	.....	.....	.....	.....
Maryland	.....	.....	.....	.....	.....	.....	.....	.....

Compare the products of your state with those of other states.

Construct a similar table for the data on live stock.

1. Horses: number and value.
2. Mules: number and value.
3. Milch cows: number and value.
4. Sheep: number and value.
5. Hogs: number and value.

The Year-book may be secured free from the Department of Agriculture, Washington, D. C., through your Congressman or Senator.

LESSON XLI

5. AN ASSESSMENT OF FARM VALUES

(a) Make a list of the real and personal property owned by your parents, with values such as could be received from sale. Use the form given below, and make a neat record of the assessment in the notebook:

Assessment Record

Name of Farm............................ Date..................

PROPERTY	Number	Valuation
1. Acres of land	....	....
2. Buildings	....	....
3. Horses	....	....
4. Cattle	....	....
5. Sheep	....	....
6. Hogs	....	....
7. Poultry	....	....
8. Farm machinery	....	....
9. Oats	....	....
10. Wheat	....	....
11. Corn	....	....
12. Household furniture	....	....
13. Hay	....	....
14. Money in bank or notes..........	....	....

Total ....
Rate of taxation ....
Total tax ....

(b) Use the above form and fill out the assessment record of our forty-acre farm as you think it should be equipped.

LESSON XLII

FARM MACHINERY

The drudgery of farm life is gradually being reduced by the invention and improvement of farm tools and machines. Improvement in kitchen machinery comes slowest of all upon the farm, but with the progress of domestic science, we may look for much improvement in kitchen equipment. The following comparisons show the great development in farm implements.

THE OLD WAY	THE NEW WAY
The hoe.	The horse-drawn cultivator.
The grass sickle.	The horse mower and rake.
The grain cradle.	The steam-drawn harvester.
The single plow.	The steam gang plow.
The corn knife.	The corn reaper and husker.
The "up and down churn"	The "quick coming" churn.
The open crock.	The cream separator.

Points in the care of farm machinery:

1. The farmer must know how to manage his machine.

2. Farm machines must not be left in the field to rust and rot.

3. As soon as any tool or machine has finished its work for the season it should be carefully cleaned, oiled and housed.

4. Every machine, implement, and vehicle should be properly oiled.

5. All needed repairs should be promptly made.

6. "Such care, which is neither costly nor burdensome, will add many years to the life of a machine."

Practical Exercises

If the school is in a town, the teacher should go with the class to an implement store and observe the different farm machines, tools, and implements.

Make a list of the different kinds of plows, harrows, reapers, planters, and grain separators that you know of.

Each pupil should make a list of the different farm implements at his home, and the make of each implement.

NOTE.—Some farm machine or implement, such as the plow, should be brought to school, to be taken apart and set up again by the pupils.

LESSON XLIII

AGRICULTURAL OUTLOOK—WEST VIRGINIA AS A TYPE STATE

Geographical and climatic conditions seem to indicate that there are three principal agricultural operations which would pay the farmers of West Virginia to develop:

1. **Fruit-growing.**—Many hillsides, poorly adapted to grain cultivation, would produce profitable orchards of apple, peach, cherry, and other smaller fruits. Some of the best fruit plantations of the United States are in West Virginia, and what has been done in one place can be done in many other parts of the state, for the conditions of successful fruit culture are similar. It would be better for the soil of many farms, and for the purses of many farmers were their hillsides planted to fruit trees, rather than to grain fields with weed-filled washouts.

2. **Dairying, grazing, and stock raising.**—West Virginia has ranked among the first states in the production of fine-wooled sheep, and there is no reason that this rank should not be maintained. The hills will produce the finest of blue grass, timothy, and clover, and there are many natural advantages which may be used in the winter protection of the flock. The increased demand for dairy products should encourage grazing and cattle raising. With the improvement of country roads, and the extension of the railroads and trolleys, the sale of milk, butter, and live stock will be

greatly facilitated, and the dairy business become a profitable agricultural operation in the state.

3. **Truck gardening.**—As the mines, and wells of oil and gas are developed throughout the state, more and more laborers leave the farm and become consumers of farm products rather than producers. In the many mining towns which have sprung up in all parts of West Virginia are thousands of laborers who do not even have a kitchen garden. The homes of these men must be supplied with the vegetables and products of the farm. If West Virginia farms and gardens do not furnish these, those of other states will. There are many fertile valleys and fields near these industrial centers that could produce far more than they now do, toward supplying the demand for food products.

Practical Exercises

Students of other states using this book should write similar paragraphs upon the agricultural outlook of their own state, using this lesson on West Virginia as a type.

JANUARY

On the farm.—There is little outdoor work to do on the farm this month. It is a good month in which to read and to plan for the coming year. These are the farmers' days of leisure when the demands of his calling are not so exacting as usual, when he and those of his household may enjoy the accumulated fruitage of the year. But the wise farmer will not waste his time even now. Live stock are to be fed and cared for, farm conveniences are to be planned, and systems of cropping worked out. In school the class in agriculture may profitably study soils and fertilizers this month.

LESSON XLIV

COUNTRY LIFE CONVENIENCES

Stay on the farm.—Why do the young people leave the farm in such great numbers to go to the city? Perhaps the boys and girls who read these pages could give a better answer than the statesmen and professors who are trying to answer this question. The usual answer given and the one most nearly correct, perhaps, is that young people leave the farm because they cannot make enough money there, and because the social life and home conveniences are not attractive. Although the country people do not receive for their products a just share of what the consumer pays, there are brighter days ahead, and with better legislation, closer organization, and more education for the farmer, the country boys and girls are going to have as good a chance to enjoy the best things of life as their city cousins have.

Conveniences in the country.—Country life conveniences are already coming, and from the kitchen to the church the work and life of the country is becoming more interesting and attractive. There is no reason why the country home can not have its hot and cold water supply with sanitary plumbing. It would cost no more than a good team of horses or an automobile. Progressive farmers are lighting their homes with electricity or gasolene. They are equipping their kitchens as well as their barns and fields with conveniences to save labor. Into every community there has come the rural free mail delivery and the telephone, and we can safely prophesy that the parcels post, the postal savings bank, the interurban car service, good public roads, consolidated schools, and live country churches are soon to enrich and enlarge the life in the open country.

Great forces for rural progress.—Many strong institutions, and men of mind and money are devoting themselves to the interests of country life. State departments of education are providing supervisors of rural schools and encouraging the teaching of agriculture and domestic science in these schools. Agricultural colleges are sending extension schools, farmers' institutes, and instruction trains into every corner of their states. The national grange is developing leaders among the men and women who live on the farms, and extending its work of education and organization into every state in the union. The national department of agriculture is sending expert men and helpful literature to every farm and rural institution, organizing and making more effective all the forces for rural progress.

Practical Exercises

Pupils may make special reports on the following topics as relating to the community in which they live:

1. Modern conveniences on the farm.
2. Community improvement clubs.
3. Consolidation of rural schools.
4. Rural mail delivery.
5. Postal savings banks.
6. Parcels post.
7. Rural telephones.
8 Interurban car lines.
9 Automobiles.

LESSON XLV

THE FARMERS' READING

The farmers' library.—The progressive farmer of to-day finds time to read, and his library is supplied not only with good books and periodicals of general literature, but with the latest books, bulletins, and farm papers as well. Men in all other vocations find both profit and pleasure in keeping up with the times by attending meetings, and reading the literature of their profession. This could not be said of the farmer until very recently.

Who are writing farm books?—The writers of the best modern books and periodicals of agriculture are men who not only have the theoretical knowledge of their subjects, but the practical experience; and they have thus gained the confidence of the farmers, because they are in the field, wearing overalls with them. The progressive farmer no longer speaks lightly of "book farming," for he knows that good farmers have written, as well as wrought, successfully in agriculture.

Farm papers.—There are many good farm papers, and every progressive farmer is a subscriber to one or more periodicals relating to the work in which he is interested. He reads and experiments and thus finds greater interest and profit in his work.

Farm books.—The following vocational books should should be in every farmer's library:

Chapters in Rural Progress, Butterfield.

The State and the Farmer, Bailey.

The Education of the Farmer, Bailey.

The Country Home, Powell.

Practical Farming, McClennan.

Encyclopedia of Agriculture, Bailey.

Checking the Waste, Gregory.

The Country Life Movement, Bailey.

The Country Church and the Rural Life Problem, Bailey.

The Rural Life Problem of the United States, Plunkett.

Most of the above are supplied by the Orange Judd and Macmillan companies, New York City.

Practical Exercises

1. Pupils should bring copies of farm papers from their homes and start a reading table in the school.
2. Send for copies of farm papers for the reading table.
3. Each pupil should report some interesting article he has read in a farm paper.
4. Write to the College of Agriculture for reading circle books, and try to organize a reading circle among the farmers of the community.

LESSON XLVI

SOIL

During some mild day this month, let us go to various places on our farm, gather samples of soil, and make a more careful study of them in our farm laboratory.

Since the soil is the place where all our plants must grow, and since our animals must be fed from the plants we raise, our soil is the real foundation of our farm.

How soils are formed.—Geologists tell us that at one time a great rock mass formed the surface of the earth. Earthquakes probably made great breaks in this rock mass, then by the decay of the rocks, the grinding of the water and ice, and the depositing of sediment, soil was formed. Water has been continually dissolving away and depositing particles of the rocks to form soil. Frosts, winds, rains, running streams, plant roots, burrowing animals, and other forces of nature are constantly changing the rocks to soil.

Kinds of soil.—Since all soils come from rocks, the kind of soil must therefore depend on the kind of rock from which it was made. Sandy soil must come from

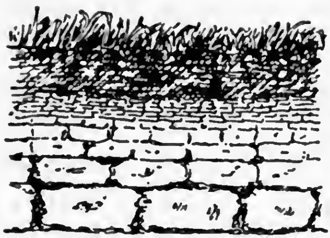


Fig. 42—Drawing, showing how rock gradually breaks up and decays from the top downward.

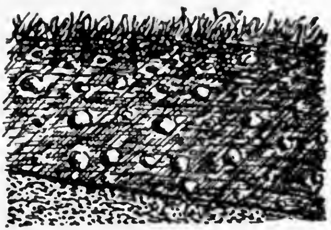


Fig. 42*a*—Drawing, showing glacial drift deposited on top of the solid rock.

sandstone, lime soil from limestone, clay soil from clay stones, etc.

Humus.—Humus is the decaying and partly decayed plant and animal life in the soil. It is usually dark colored. Humus greatly improves the soil for plants, because in its decay acids are set free which help dissolve plant food in the soil, and because it improves the quality of the soil, making clay less and sand more compact, thus increasing the water-holding capacity for plants. The loss of humus makes hillside land wash badly, and unless the farmer is careful, his sloping fields are soon "worn out." All weeds, stubble, clovers, etc., should be plowed under to form humus, and thus keep the soil in good condition.

Clay soil.—Most soils contain both sand and clay, and the class to which a soil belongs is determined by the relative amounts of these of which it is composed. A clay soil is composed of very fine particles, which, when dry, seem to contain no grit or sand. Clay soils retain water a long time, and become very hard in drying.

Courtesy of D. W. Working
FIG. 43. THE WEATHERING OF ROCK
Under the influence of the weather —heating and cooling, wetting and drying—the solid rock is then broken into fragments.

Sandy soil.—Sand varies greatly in fineness. Sand particles are very hard, and have sharp edges, giving a gritty feeling in handling. Water passes through sand very freely. Sandy soils are quickly warmed by the sun in the spring. They wash badly and are not durable under tillage. Both sand and clay may contain organic matter; that is, decaying plant or animal life.

Loam.—Loam is a mixture of sand, clay and humus in such proportions as to be easily tilled, and suitable for most crops. Good soil must also have a constant supply of moisture and air. Loam is neither too coarse nor too fine to allow the best supply of air and moisture in the soil.

Practical Exercises

(Use notebooks and record results and observations)

1. Comparison of Soils

With samples of clay, sand, and humus loams, spread on sheets of paper before each pupil, let the student fill out the following table:

Soils.	Color.	Size of particles.	Weight.	Feeling.
Clay Loam........				
Sand Loam.......				
Humus Loam.....				

The use of a hand lens will help in this study.

2. Composition of Soil

Carefully weigh a small handful of rich black soil. Then dry it thoroughly, being careful not to burn it, and weigh again. The difference is the weight of the water content of the soil. What per cent of this soil was water? Now place the dry soil in a dish or iron pan and burn it. Cool, weigh again, and examine carefully. The loss is the weight of the humus or organic matter. What per cent of this soil is organic matter? Do you believe that you could burn all of the soil? The portion remaining is the mineral matter. What per cent is mineral matter? We shall learn what this mineral matter consists of. Record the result of this exercise and write answers to all the questions.

3. Water-holding Capacity of Soils

Fill three small earthen flower pots with finely pulverized soils, one with clay, one with sand, and one with humus loam. Weigh these, and if possible make them weigh the same. Then slowly pour water into each pot until the soils are saturated and the water

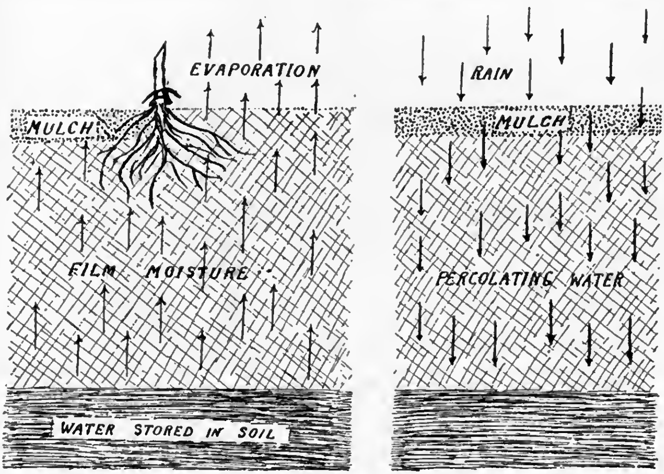


FIG. 44. APPARATUS TO TEST THE CAPACITY OF SOILS TO TAKE IN RAINFALL

begins to run out from the hole at the bottom of the pot. Weigh the pots of wet soil, and determine which is holding the most water. Which soil took in water most rapidly? Which most slowly? Which of the soils could absorb the heaviest shower? Which soil continues to drip longest? Which drains most readily?

Does this experiment have any bearing on farm practice? What?

4. Capillarity of Soils

Fill three soil tubes respectively with fine dry sand, clay, and loam. The soil is held in the tubes by a cloth tied over one end of each of the tubes. Set the tubes in a rack as shown in the figure, so that the cloth ends reach down into the tumblers, filled to equal heights

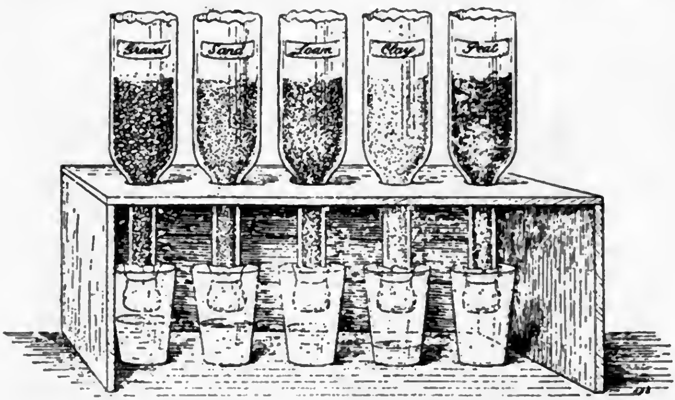


FIG. 45. DIAGRAM SHOWING ACTION OF WATER IN SOIL

with water. Observe the rise of water in the different soils. Note how high it rises in each tube, and the time it takes. In which soil does the water rise most rapidly? In which to the greatest height? Which soil draws up the greatest amount of water? This power of soils to draw water up from below is called capillarity, and the water is called capillary water. Because of this capillarity, plants are able to get moisture from the sub-soil in times of drought. How may the farmer increase the amount of humus in his soil, and thus the drawing and holding capacity for water be increased?

5. Soil Mulch

Fill two tin pans or cans with the same kind and amount of soil, and thoroughly saturate each pan of soil with water. Then cover the wet soil of one pan with an inch or more of dry earth, finely pulverized, and leave the other pan unmulched. See that both pans of soil now weigh the same, by transferring soil from one to the other as necessary. Set the pans aside for twenty-four hours, then weigh again. Weigh the pans every twenty-four hours for several days, and record the comparative weights of the two pans of soils. The dust mulch prevents evaporation, and enables the soil to retain its moisture. What bearing does this experiment have upon any farm operations?

6. Field Observations

Take a walk to a suitable field near the schoolhouse. Take pencil and notebook and answer the following questions:

1. How does the weathered surface of rocks compare with the freshly broken surface?

2. Are the boulders and pebbles you find of the same material as the rock ledges to be found in the neighborhood?

3. How do the pebbles in the bed of a stream compare with those back from the stream, in size and shape? Explain the difference.

4. Find some rich soil and dig a hole about 18x12

inches, and about 2 feet deep. Describe the difference between the soil and sub-soil. Repeat this experiment by digging the hole on a steep slope. Account for the difference between the soil of the two places. Which do you think will grow the better crop? How deep is the soil in both places?

5. Name the places at which you see soil forming, and explain agency in each case.

7. Soils on the Home Farms

Each student in the class should bring samples of soil from the home farm. Place the samples in separate vessels on a table where all can observe them, and fill out the following outline:

Owner of Soil.	Kind of Soil.	Condition of Soil.	Color of Soil.

Free Bulletins, U. S. Dept. of Agriculture

Bureau of Soils

Circular No. 4.—Soils of Salt Lake Valley, Utah.
Circular No. 8.—Reclamation of Salt Marsh Lands.
Circular No. 13.—The Work of the Bureau of Soils.

Table showing fertilizing substances in average soils:

Soil.	Nitrogen.	Phos. Acid.	Potash.
	Pounds per Ton.		
Loam	7 lbs.	3 lbs.	8 lbs.
Clay	3 lbs.	3 lbs.	15 lbs.
Sand	1 lb.	2 lbs.	5 lbs.

(Adapted from Stockbridge.)

Problems

1. Suppose soil is cultivated to the depth of 4 inches. How many cubic feet of cultivated soil per square foot of area? Per square yard? Per square rod? Per acre?

2. If a cubic foot of soil weighs 75 pounds, how many pounds of cultivated soil per square yard? Per square rod? Per acre?

3. Find the number of pounds of nitrogen, potash and phosphoric acid in the cultivated soil per acre for each of the four kinds of soil.

4. If the soil is cultivated to the depth of eight inches, how many pounds of each of the three fertilizing substances per acre in each of the soils given in the table?

5. How many pounds of nitrogen, potash and phosphoric acid are used, annually, per acre, by a crop of 20 bu. of wheat? In how many years will one-half of the nitrogen in clay be used up by this crop feeding to the depth of eight inches?

6. How will this affect future crops?

7. Work the same problem for other soils.

8. Use a 50 bu. corn crop per acre and work problem 7. Also a 60 bu. oat crop. A 120 bu. potato crop.

LESSON XLVII

PLANT FOODS

While we are waiting for spring to come, when we shall be almost too busy on our farm to read, we shall continue our studies of soils and plant foods.

Elements of the earth.—Chemists have found that all the substances of the world can be separated into about eighty different things. These are called elements. Iron, gold, silver, tin, carbon, sulphur, etc., are elements.

No one has been able to separate them into different things. Gold cannot be separated into anything but gold. For centuries men tried to make gold out of other things, but they failed. Water is not an element; it is a compound. A chemist can separate it into two gases, hydrogen and oxygen.

Elements and compounds.—All living things are made up of different compounds of elements. The starch of corn is a compound of carbon, hydrogen, and oxygen. Only a few of the eighty elements are necessary for the growth of plants and animals. The following elements are commonly found in plants, and the first ten are absolutely necessary for good plant growth: oxygen, hydrogen, carbon, nitrogen, iron, potassium, phosphorus, calcium, sulphur, magnesium, sodium, chlorine, and silicon. Oxygen, hydrogen, and nitrogen are invisible gases, so we do not see them. Gold and sulphur occur as free elements. Calcium is not ordinarily seen, but ordinary quicklime is either calcium or magnesium combined with oxygen. Silicon and oxygen combined make up the large part of sand. Salt is a compound of sodium and chlorine. A green plant is mostly water. Of the other substances, carbon makes up nearly one-half; nitrogen comes next; and there are smaller amounts of other elements.

Essential elements for plants.—No plant can grow unless supplied with the first ten elements mentioned above. The soil furnishes iron, sulphur, magnesium, sodium, chlorine, and silicon; a farmer does not need to give special attention to these. The carbon dioxide gas of the air furnishes carbon; water furnishes hydrogen and oxygen; and the remaining elements, nitrogen, potassium, phosphorus, and calcium, are often insufficient in the soil, and must be supplied if a good crop is to grow. So these, particularly the first three, are the elements that the farmers buy in their fertilizers.

Soil elements.—The following table shows the composition of a typical soil, containing 100 pounds of matter. It will be noted that all these elements and compounds enter into the plant as food:

Water		12.67 lbs.
Carbon		
Silica	71.55	
Aluminum	6.94	
Iron	5.17	
Magnesium	1.08	
Soda	.43	
Sulphuric acid	.04	
		85.21 lbs.
Nitrogen	.12	
Phosphoric acid	.43	
Potash	.35	
Lime	1.22	
		2.12 lbs.

The first and second groups given above are more or less constant in the soil and in sufficient quantities that the farmer need not concern himself about supplying them. The third group, nitrogen, phosphoric acid, potash and lime, although constituting so small a portion of the soil, must be held up to a good standard amount and proportion or the plant cannot grow. These elements are often used up in the soil and must be artificially supplied by fertilizers of various kinds.

Elements in a wheat plant.—The following table shows the composition of 100 pounds of wheat plants:

Carbon	47.69	
Water	45.86	
		93.55 lbs.
Sodium	.09	
Magnesium	.20	
Sulphuric acid	.31	
Iron	.04	
Chlorine	.06	
Silica	2.75	
		3.45 lbs.
Nitrogen	1.60	
Phosphoric acid	.45	
Potash	.66	
Lime	.29	
		3.00 lbs.

This table is interesting in that it shows that so small a per cent of the composition of the plant is made up of the nitrogen, phosphorus, potash and lime—the elements that exist in so small a proportion in the soil; yet it is this small proportion of these elements with which the farmer must concern himself in intelligent practice.

Plant starvation.—Now, if these foods are not found in sufficient quantity in the soil, the plant grows slowly and finally dies. Again, the soil may contain plenty of plant food, but it may not be in a form readily soluble by the water, and the plant suffers from a lack of food, just as one may starve within ten feet of plenty of food that is securely locked up so that he can not get at it. One problem which the farmer is called upon to solve is, how to make the plant food in the soil of his farm more easily soluble.

Soil exhaustion.—From what we have learned it is clear that, if the farmer raises grain on his farm to sell, and never returns manure to the soil, he will rob it of its plant food, and it will soon begin to show evidence of being "worn out." Plant foods are being continually used up by the growing plants, and removed with them, and none are returned to take their place. The heavier the crop the greater will be the loss. Tobacco and root crops, being so much heavier, exhaust the soil faster than small grains.

But worn-out soil does not mean soil in which all the different kinds of plant foods are used up. In fact, soil usually contains all plant foods in inexhaustible quantities with but three exceptions, namely: potash, phosphoric acid and the nitrogen found in ammonia. To restore the fertility of the soil means only to restore these three substances.

Practical Exercises

1. Collection of Plant Foods

Place specimens of the following plant foods in small bottles and label properly: *Lime, muriate or sulphate of potash, phosphoric acid, nitrate of soda, iron-rust, magnesia, sulphur,* and *pure sand.*

2. Experiment with Plant Food Tablets

A plant food tablet has been prepared which contains the food essential to plant growth. Each tablet is composed of the following ingredients:

Common salt (sodium chloride), 2½ grains.

Plaster of Paris (calcium sulphate), 2½ grains.

Epsom salts (magnesium sulphate), 2½ grains.

Phosphate of lime (calcium phosphate), 2½ grains.

Salt-petre (postassium nitrate), 5 grains.

Compounds of iron and chlorine (ferric chloride), 1-10 grain.

To demonstrate the effect of plant foods as prepared in these tablets, fill two cans or flower pots with perfectly clean sand which has been heated to the boiling point of water. Plant six grains of wheat and three grains of corn in each pot. Keep one pot of sand moist with rain water. Keep the other in the same condition as to moisture, to which has been added plant food to the proportion of two tablets to each pint of water.

At first there will be no difference perhaps in the growth of the plants, but in two or three weeks, when the food stored up in the grain is exhausted, the difference in vigor and growth is clearly evident. Such substances as those contained in these tablets, when applied to the soil, are known as fertilizers.

Table showing proportions of fertilizing substances in farm crops:

	Ounces per Bushel.		
Crop.	Nitrogen.	Phos. Acid.	Potash.
Wheat	20 oz.	8 oz.	5 oz.
Rye	17 oz.	9 oz.	5 oz.
Corn, shelled	14 oz.	5 oz.	3 oz.
Barley	12 oz.	6 oz.	4 oz.
Buckwheat	12 oz.	4 oz.	2 oz.
Oats	10 oz.	3 oz.	2 oz.
Potatoes	3 oz.	1 oz.	4 oz.
Root crops, average	3 oz.	1 oz.	2 oz.
Cotton seed	13.8 oz.	5.8 oz.	5.4 oz.
	Ounces per 100 lbs.		
Cotton lint	3.8 oz.	1.6 oz.	8 oz.
	Pounds per Ton.		
Crop.	Nitrogen.	Phos. Acid.	Potash.
Timothy or red top hay	20 lbs.	9 lbs.	30 lbs.
Clover hay	40 lbs.	10 lbs.	40 lbs.
Tobacco (leaves)	60 lbs.	13 lbs.	80 lbs.
Straw (average)	10 lbs.	4 lbs.	20 lbs.
Sugar beets	3 lbs.	1-5 lb.	4 lbs.
Cow-pea hay	47.2 lbs.	10.4 lbs.	29.4 lbs.
Soy Bean hay	46.4 lbs.	13.4 lbs.	21.6 lbs.

Problems

1. How many pounds of each of the three important fertilizers in a crop of wheat that yields 20 bu. per acre? 25 bu. per acre?

2. A corn crop of 50 bu. per acre? 60 bu.? 75 bu.?

3. An oat crop of 40 bu. per acre? 50 bu.? 60 bu.?

4. A barley crop of 40 bu.? 45 bu.? 50 bu.?

5. A potato crop of 110 bu. per acre? 120 bu.? 150 bu.?

6. A clover hay crop of 3½ tons per acre? 4 tons? 5 tons?

7. A meadow hay crop of 2 tons per acre? 2½ tons? 3 tons?

8. A tobacco crop of 1,500 lbs. per acre? 1,800 lbs.?

9. Compare the results and notice which crop is hardest on the soil.

10. Pupils should furnish data for similar problems. Tell how many acres of corn, wheat, hay, etc., were raised on the farm at home, the number of bushels or tons per acre, and find the amount of the three essential fertilizers taken off with the crop.

LESSON XLVIII

FERTILIZERS

During this month we shall begin the work of fertilizing on our farm. We shall mix the commercial fertilizers in our farm laboratory. Barnyard manures and other fertilizers must be spread upon the orchards, pastures, fields and gardens, as we shall learn in this lesson.

Important elements of the soil.—As was suggested in the last lesson, the three elements likely to be lacking in our soils are nitrogen, phosphorus, and potash. The fertilizers we use must, therefore, contain these essential elements. The crop will usually tell the farmer by its appearance the kind of food it most needs. Good,

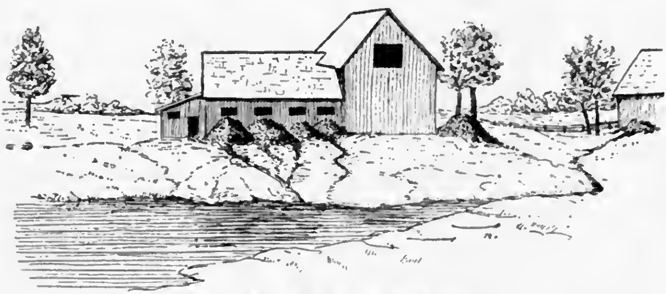


FIG. 46. WASTE OF MANURE

fertile, well-drained soil, properly cultivated, usually produces healthy, dark green plants with strong, good-sized stalks, and numerous, well-filled seeds.

Nitrogen.—The growth of the stalks and foliage of the plant is largely due to the nitrogen, providing the heat, light, air, and moisture conditions are favorable. If the plant has a yellow, sickly appearance, and under cultivation refuses to grow, it is likely starving for want of nitrogen. The best fertilizer, and the one nearly always giving best results, is barnyard manure. It has right amounts of nitrogen, phosphoric acid, and potash, in forms readily available to the plant. Especially will barnyard manure improve yellow and sickly plants. Besides acting as a fertilizer, barnyard manure improves the texture of the soil, increases its water-holding capacity, and its decay sets free humic acids which render mineral foods of the soil more available.

Clovers, cow-peas, and other like legumes, also serve as fertilizers, because they have the power of using the nitrogen of the air in a way that will be explained in a later lesson. These plants store up the nitrogen that they take from the air, and if they are plowed under when mature, they add this nitrogen to the soil, as well as large quantities of humus, which in decaying liberates other mineral foods already in the soil.

The principal commercial nitrogen fertilizers are cottonseed meal, nitrate of soda, dried blood and tankage, and refuse from slaughterhouses. Nitrate of soda is the best and quickest acting of all these fertilizers. It dissolves quickly when applied to the soil, and is at once available as food for the plants. High grade nitrate of soda contains 15% nitrogen. Two hundred pounds per acre is a heavy application.

Phosphoric acid.—Phosphoric acid is the one compound in our soils soonest likely to be wanting, and the one which in the future it will be most difficult to provide. Undeveloped and shrunken seeds usually indicate shortage of phosphoric acid in the soil. Barnyard manure contains a good percentage of phosphoric acid. Ground bones and phosphate rocks are the commercial sources of this fertilizer. There are great deposits of phosphate rock in Tennessee and the Carolinas, and it is being rapidly mined away, large quantities being taken to European countries. In the manufacture of high grade phosphates, the rock is ground fine and is then treated with sulphuric acid, which makes it soluble, and thus available as a plant food. High grade phosphates contain 15% acid phosphate. Two hundred pounds per acre is an average application.

Potash.—Potash is especially essential in the production of fruits, potatoes, and root crops. Other conditions being favorable, undersized, shriveled, and imperfect fruits are due to a lack of potash. Here again barnyard manure will supply a good percentage of the element needed. Wood ashes are also valuable as a source of potash. The principal commercial potash fertilizers are muriate of potash and sulphate of potash. They contain about 50% of available potash, and are seldom applied in excess of one hundred pounds per acre.

Lime.—Lime is not a fertilizer in the same sense as those discussed above, but it is used in connection with fertilizers because of its chemical effect upon the soil. Lime sweetens the soil, breaks up combinations so that plant food is set free for the use of the plants, and improves the physical condition of both clay and sand soils.

The subject of fertilizers is a large and important one to the farmer. It requires much thought and careful study, and each farmer must work out his own farm needs.

Practical Exercises

1. Experimental Tests with Fertilizers

Fill ten five-inch earthen flower pots with clean sand, and add fertilizers to the different pots as follows:

1. Nothing.
2. Nitrate of soda (one-half teaspoonful).
3. Acid phosphate (one teaspoonful).

FIG. 47. LIMING THE SOIL

4. Muriate of potash (one-fourth teaspoonful).
5. Nitrate of soda and acid phosphate.
6. Nitrate of soda and muriate of potash.
7. Acid phosphate and muriate of potash.
8. Nitrate of soda, acid phosphate, and muriate of potash.
9. Same as No. 8, but double the amount of each.
10. Stable manure.

Mix the fertilizers into the soil; then plant about a dozen grains of wheat in each pot. Label each pot with the names of the fertilizers used. Place the pots in a window or light place, and keep the soil moistened. When the wheat seedlings come up, thin out to the same number in each pot. Note the difference in the color of the leaves in each pot. Which fertilizers give the greatest increase in growth?

Make a complete record of this experiment in the note-book.

2. *Effects of Lime on Soils*

To see the effect of lime on clay soil, make two clay balls, one with water, and the other with lime water, and set aside to dry. In a few days examine and see which is more mellow.

Repeat the experiment with water and humus-water and note the result.

Is lime used on soils in your neighborhood?

Fertilizers

Showing average amount of nitrogen, phosphoric acid and potash in fertilizers:

	Pounds per Ton.		
Substance.	Nitrogen.	Phos. Acid.	Potash.
Clover hay...............	40 lbs.	10 lbs.	40 lbs.
Straw	10 lbs.	4 lbs.	20 lbs.
Barnyard manure.........	10 lbs.	6 lbs.	9 lbs.
Wood ashes...............	..	60 lbs.	160 lbs.
Burned bones.............	..	500 lbs.	..
Ground bones.............	..	400 lbs.	..

Problems

1. Suppose a load of barnyard manure weighs a ton. How many pounds of nitrogen in it? Of phosphoric acid? Of potash?

2. How much of each of the above in 15 loads? 20 loads? 50 loads?

3. How many loads of manure were hauled onto your land last year? How much of each fertilizing substance was supplied?

4. If you put 15 loads on an acre, how much of each fertilizing substance per acre?

5. Suppose you harvested 50 bu. of corn per acre. How much of each fertilizing substance did you take off with the crop?

6. Was your soil richer or poorer after the corn was harvested? Did you take off more than you put on? How much of each kind?

7. How much of each of these fertilizing substances is taken off with a 25 bu. crop per acre of wheat? A 40 bu. crop of barley?

8. How many loads of manure per acre are necessary to restore the fertility lost when a 25 bu. per acre wheat crop is harvested?

9. If $5 per acre spent in fertilizer increases the yield of potatoes 50 bu. net. Find the gain per acre by fertilizing.

10. A farmer who uses fertilizer costing $6 an acre grows 560 lbs. of cotton per acre; one who uses no fertilizer grows 350 lbs. per acre. At the present market price of cotton which plan is the more profitable? How much is gained on 80 acres?

11. The usual prices of the common fertilizers is as follows:

Nitrate of soda, $57.00 per ton.

Acid phosphate, $12.50 per ton.

Muriate of potash, $42.00 per ton.

How much would a pound of each cost?

When a farmer speaks of a fertilizer as being 2:8:10, he means that it contains 2% nitrogen, 8% phosphoric acid, and 10% potash.

How would 2000 pounds of fertilizer of this type be made up?

NOTE. Assume in the above problem that nitrate of soda contains 15% nitrogen, the acid phosphate 14% phosphorus, and the muriate of potash 50% potash, determine how much of these commercial fertilizers would be required to furnish the essential amount of pure elements.

12. At the College of Agriculture, Cornell University, two tons of manure that had been weighed and analyzed were left exposed from April 25 to September 22, with the following results:

	April 25.	Sept. 22.
Total weight	4,000 lbs.	1,730 lbs.
Nitrogen	19.6 lbs.	7.72 lbs.
Phosphoric acid	14.8 lbs.	7.79 lbs.
Potash	36. lbs.	8.65 lbs.

What was the value of the nitrogen, phosphoric acid, and potash in this manure on April 25, and on September 22? (Use the values given above). How much was lost?

There are two ways to prevent such losses—the manure may be hauled and spread on the land every few days, or it may be kept in covered sheds.

13. A good fertilizer for timothy hay has been found to be one containing 200 pounds of nitrate of soda, 100

pounds of acid phosphate, and 50 pounds of muriate of potash, per acre.

How much would this cost per acre?

What percentage of each would this fertilizer contain?

About how much hay at the price in your neighborhood would be worth this much?

FEBRUARY

On the farm.—During this month we shall have a variety of interests and plenty of work to engage our attention on the farm. There are fences to repair and build, hotbeds to prepare, tile ditches to dig, spring orders to make, and live stock to feed and care for. No one great work is to claim our time, but many different plans and preparations are to be made.

LESSON XLIX

DRAINAGE

Plan for draining our forty acres.—A period of open weather has come, the ground has thawed out, and we have seen that fields numbers 1 and 2 of our farm need drainage. If the ground is dry enough to work in, we shall run two ditches, each forty rods long, across the centers of fields numbers 1 and 2, and connect each with Spring Hollow. We shall use five-inch tiles, twelve inches long, and they will cost us 5c each. We should have a bookkeeping account of our year on the farm, and record the expense of our tile drainage.

Values of drainage.—Removes the excess of surface water. Plants cannot grow without air, and much water in the soil keeps out the air. The level of the underground water must be below the depth to which the roots of the crops ordinarily penetrate the soil. Good tile drainage lowers this water level. Stiff clay soils both on low, flat land and upon hillsides often hold an excess of surface water, and need drainage.

Aerates the soil. As was stated above, plants require air at the roots as well as about their foliage. The presence of air in the soil promotes the action of bacteria, the germs that aid in breaking up the humus, as was shown in a previous lesson, and in the fixation of nitrogen in legumes. Air circulating through the tiles tends to draw the air through the soil from the surface above and thus to aërate the whole root-feeding area of the plants.

Warms and sweetens the soil. In wet soils so much heat is used in evaporating the water that these soils never become warm. Often such soils are sour, and cannot become sweet until the water is drained off and the heat and air let in. Well drained land warms up earlier in the spring, facilitating earlier planting, thus extending the growing season of the crop.

Conserves moisture. We were told a moment ago that drainage removes the excess of moisture, and it may seem a contradiction to state that drainage conserves the moisture, but this fact can be shown. Soils that are aërated and tilled, as good drainage permits, are more porous and are in better condition physically both to receive and hold the rainfall and to promote capillarity from the table water below.

Methods of drainage.—The tile system of drainage is better than the open ditch, though more expensive. The tiles should be placed about three feet below the surface, so that the water level in the ground will be lowered to this point, and that the ground may be cultivated without interfering with the tiles. The size of the tile and the distance apart of the mains and branches will

FIG. 48. LAYING TILE

depend upon the slope of the land and the nature of the soil.

Farmers' Bulletins

No. 40.—Farm Drainage.
No. 187.—Drainage of Farm Lands.

Table showing average cost of drainage tile in large quantities:

3 in. tile cost about 3c each.
4 in. tile cost about 4c each.
5 in. tile cost about 5c each.
6 in. tile cost about 6c each.

All sizes are 12 inches in length.

Problems

1. A farmer owns a plat of low ground 80 rods long and 50 rods wide; how many acres in this plat?

2. A creek runs lengthwise through this land. The level of the water in the creek is 4 feet below the level of the land. Can it be drained?

3. Will the creek answer as a channel to carry off the water from the tiles?

4. Suppose he puts the tiles crosswise of the field, 4 rods apart, so that they open into the creek. How many rods of tiling will it take? How many feet? How many 4 in. tiles?

5. What will be the cost of these tiles according to the above table?

6. What will it cost to dig the ditches and lay the tiles at 20 cents per rod?

7. What will be the entire cost if 4 in. tiles are used? 3 in.? 6 in.?

8. What will be the cost per acre for each kind of tile?

9. Suppose open ditches costing twenty cents per rod will answer. How much more will the tile system cost than the open ditches?

10. If the farmer is able to grow only 1½ tons of marsh hay worth $4 per ton on this land before draining and can grow 60 bu. of corn worth $0.35 per bu. after draining, what is the increase in the value of the crop due to drainage?

11. In how many years will this increase alone pay

for the open ditch? For the 4 in. tile system? For the 6 in. tile system?

12. Suppose the open ditch costs 5 cents per rod annually for repairs. In how many years will the open ditch cost as much as the tile drain?

13. If the above is a true example of the cost and value of drainage, does it pay?

14. What would it cost to dig an open ditch on each side of a slough 10 rods wide and 100 rods long at $0.25 per rod?

15. Is there a place on your farm that needs draining? Measure it. Draw a plan for ditches and estimate the cost of both systems.

16. Estimate the cost of the drainage suggested at the beginning of this lesson.

LESSON L

FENCES

Good fences and thrift.—We shall have a few spare days this month, and it would be well to look to our fences. The construction and care of the farm fences are indications of thrift or shiftlessness of the farmer. If the fences about the yard, gardens, and fields are neatly kept, and the weeds and bushes are cut from the rows and corners, it is a sign that the farmer takes pride in his home and farm, and that he is successful in the details of his business. The scarcity of timber is necessitating the use of wire, hedges, and cement for fencing purposes. Wire fences, supported by the locust or catalpa posts, are perhaps the best fences to construct at the present time.

The Ferguson fence.—When the fence rails get old and broken, farmers sometimes utilize them in building what is known as the Ferguson fence. In this arrangement posts are set in the ground and the fence rails are attached to the posts by means of fencing wire and staples. This is a very economical fence, not only from the standpoint of materials, but also on account of the saving of space in the fence row.

Osage hedge fence.—Some years ago there was a great deal of enthusiasm over the Osage hedge fence, but the interest in these fences is waning now, in fact, many of the hedges are being pulled up and burned. The chief objection to the hedge is that the extensive network of roots saps the life and nourishment of the soil to such an extent that farm crops can not be grown within twenty or thirty feet of the fence.

Since 1870 many states have passed stock laws requiring every man to fence in his own stock, instead of fencing out those of his neighbors. The result has been a great saving to farmers in every case.

Practical Exercises

1. Fences on Home Farms

Make a list of all the different kinds of fences that you have on the home farm. Explain how they are made, tell how long they have been constructed, and in what condition they are at present.

2. *Excursion to Observe and Repair Fences*

At the conclusion of this lesson, go to observe some fence near the school. Make note of the fence, filling out the following table:

Kind of Fence.	Materials Used.	State of Repair.	Attention Needed.

If there are any fences needing repair about the school yard or in the neighborhood, it would be an excellent thing, as an application of this lesson, to repair them and to put them in as good condition as possible.

3. *Cement Fence-posts*

Since recent fence-post and walk construction have made use of the Portland cement about the farm, it would be valuable exercise to make a few cement posts or blocks at the school. The following formula is used:

Cement ....1 part.
Sand ....2 or 3 parts.

Stone (from one to two inches diameter) 5 parts.

Moisten and mix until the mortar slides easily and smoothly from the shovel.

Problems

1. How many rods of fence will it take to fence in a 160-acre farm? Estimate for differently shaped farms.

2. How many locust posts would be required to fence the 160-acre farm with wire?

3. What would be the cost of woven wire fence for this farm?

4. How long should such a fence last?

LESSON LI

KNOT TYING IN ROPES

A rainy day has come. Having read our farm papers until we are tired, let us go to the farm laboratory and practice tying knots in ropes.

1. The tying of useful knots, rope splicing, making of hitching ropes, halters and other useful things of this kind, are industries that belong to the farm, and should be included in a course of agriculture for the schools. The teacher should provide a rope and make models of each of the eight knots shown in the figure, and hang them up before the class.

2. Each pupil should have a piece of rope about one yard in length, and practice making these knots until he can do it with ease.

3. Names of the useful knots:

a. The single loop.

b. The overhand knot.

c. The overhand knot repeated. Used to keep the

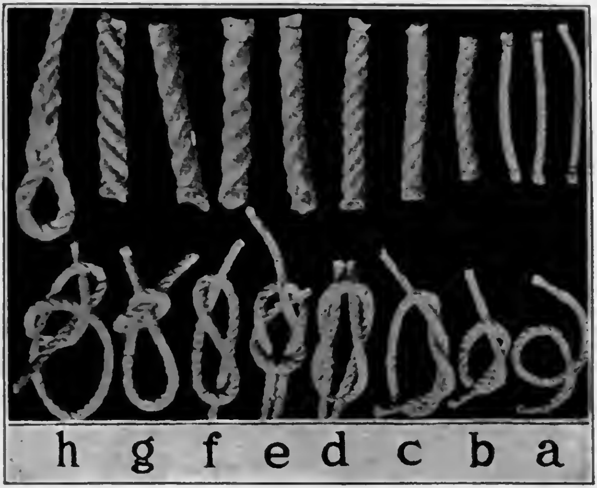


FIG. 49. USEFUL KNOTS

rope from slipping before making the square knot in tying bundles.

d. The square or reef knot. A strong knot which will not untie by pulling, but which can be easily broken and untied.

e. The loop knot. Used in making a halter that will not slip.

f. The figure of 8 knot.

g. The slip knot. Commonly used in hitching horses to racks.

h. The bowline knot. Used in tying the anchor of ships.

NOTE. Practical exercises in splicing ropes, riveting harness, and sewing halters, etc., may be given.

LESSON LII

A HOTBED GARDEN

During the latter part of this month we must begin to plan for our hotbeds and cold frames for our early vegetables and flowers.

Even in school the teacher and pupils may well undertake to work out this lesson together. Proceed as follows:

Making the hotbed.—Select a place at the south side of some building for the hotbed. Dig an oblong space three feet wide, six feet long, and eighteen inches deep. Make a wall of posts and boards, fitting close to the sides of the bed. Make the back wall three feet high and eighteen inches above the surface of the ground. A piece of two-by-four joist set in from back to front across the middle, will make a support for the window sashes which are to cover the bed. When the bed is ready, put in a layer of strawed manure that has been piled for some time, fill in about nine inches of the manure and tramp it down firmly. Then add a second layer of nine inches, and tramp firmly as before.

Then spread four inches of rich garden loam over the manure, and the bed is ready. Perhaps some of the pupils can bring whole window sashes from home to cover the beds. Two sashes three feet square would make the necessary cover.

Plants for the hotbed.—Early lettuce, radishes, early Jersey Wakefield cabbages, the Earliana tomato, onions, and other vegetables may be sown thickly in rows about

FIG. 50. A HOTBED IN WINTER

four inches apart, and by the time warm weather comes, the school will have plants to supply the neighborhood, the children will have seen many interesting things, and the school will have found a new source of co-operation with the home.

Ventilating the hotbed.—In the hotbed the manure warmed the soil, and the glass kept the heat in the frame. The soil should be watered every few days, and on the bright days the sash should be raised to admit fresh air to the little seedlings.

Draw the plan of the hotbed, and describe the preparation and planting.

LESSON LIII

RURAL FREE MAIL DELIVERY

Using the free delivery.—As the spring approaches we begin to think of catalogs of seeds and plants, and of the agricultural bulletins, which will give us the latest information to help us in our work. We are fortunate in having a rural free delivery at our door, and we shall make use of this service.

Rural free delivery and good roads.—There is no modern convenience of greater importance to the country people than the rural free mail delivery. Although it is not self-sustaining, and costs the people large sums of money, it has come to stay, for the farmer sees that its service is a great necessity in the promotion of his welfare. In order to promote the greater efficiency of the rural delivery service, and at the same time render effective aid in the improvement of roads throughout the United States, the Post Office Department, and the Office of Public Roads have entered into a plan of co-operation looking to the betterment of all roads where the rural service is extended. Through this co-operation, recently a county in Indiana spent $85,000 for the improvement of the rural mail routes. Upon the advice of the Post Office Department, the Office of Public Roads sends its engineers to inspect and advise as to the construction of local roads.

Practical Exercises

1. Information About the Local Carrier

Find out from your local carrier the following points of information and write them up in the record of this lesson:

1. How many miles does the carrier travel in a day?
2. What is the carrier's salary?
3. What is the condition of the roads?
4. How many daily and how many weekly papers are delivered on the route?
5. What is the average daily stamp cancel on this route?
6. Does the postage of the route pay expenses?

2. How to Use the Rural Free Delivery

Each pupil in the class should write a letter to the Department of Agriculture, addressed to the Secretary of Agriculture, Washington, D. C., or better still, to your Congressman or Senator at Washington, and ask for at least ten of the following Farmers' Bulletins: (Copy this letter neatly in the note-book record of this lesson.)

Farmers' Bulletins

No. 22. The Feeding of Farm Animals.
No. 28. Weeds, and How to Kill Them.
No. 35. Potato Culture.
No. 41. Fowls: Care and Feeding.
No. 42. Facts About Milk.
No. 43. Sewage Disposal on the Farm.
No. 44. Commercial Fertilizers.
No. 49. Sheep Feeding.
No. 51. Standard Varieties of Chickens.
No. 54. Some Common Birds.
No. 55. The Dairy Herd.
No. 59. Bee-keeping.
No. 62. Marketing Farm Produce.
No. 66. Meadows and Pastures.

No. 77. The Liming of Soils.
No. 80. The Peach Twig Borer.
No. 86. Thirty Poisonous Plants.
No. 91. Potato Diseases and Treatment.
No. 95. Good Roads for Farmers.
No. 99. Insect Enemies of Shade Trees.
No. 109. Farmers' Reading Courses.
No. 111. Farmers' Interest in Good Seed.
No. 113. The Apple.
No. 126. Practical Suggestions for Farm Buildings.
No. 127. Important Insecticides.
No. 128. Eggs and Their Uses as Food.
No. 132. Insect Enemies of Growing Wheat.
No. 134. Tree-planting in Rural School Grounds.
No. 136. Earth Roads.
No. 141. Poultry Raising on the Farm.
No. 154. The Home Fruit Garden.
No. 155. How Insects Affect Health in Rural Districts.
No. 156. The Home Vineyard.
No. 161. Practical Suggestions for Fruit Growers.
No. 170. Principles of Horse Feeding.
No. 173. Primer of Forestry.
No. 184. Marketing Live Stock.
No. 185. Beautifying the Home Grounds.
No. 187. Drainage of Farm Lands.
No. 192. Barnyard Manure.
No. 196. Usefulness of the American Toad.
No. 198. Strawberries.
No. 199. Corn Growing.
No. 203. Canned Fruits, Preserves, and Jellies.
No. 208. Varieties of Fruits Recommended for Planting.
No. 213. Raspberries.
No. 215. Alfalfa Growing.
No. 218. The School Garden.
No. 220. Tomatoes.
No. 228. Forest Planting and Farm Management.
No. 229. The Production of Good Seed Corn.
No. 231. Spraying for Cucumber and Melon Diseases.
No. 235. Cement, Mortar, and Concrete.
No. 240. Inoculation of Legumes.
No. 241. Butter Making on the Farm.
No. 252. An Example of Model Farming.
No. 243. Fungicides and Their Use.
No. 245. Renovation of Worn-out Soils.
No. 247. The Control of the Coddling Moth and Apple Scab.
No. 248. The Lawn.
No. 250. The Prevention of Smuts in Grain.
No. 255. The Home Vegetable Garden.
No. 256. Preparation of Vegetables for the Table.

No. 260. Seed of Red Clover in Its Impurities.
No. 265. Game Laws for 1906.
No. 266. Management of Soils to Conserve Moisture.

NOTE. The first rural route ever established was from Charlestown, West Virginia, by W. L. Wilson, Postmaster General, under President Cleveland.

Sample Letter for Bulletins

22 Perry St., Morgantown, West Va.,
February 22, 1911.

Secretary of Agriculture,
Washington, D. C.

Dear Sir:—

Please send me the following Farmers' Bulletins for free distribution—address as above:

No. 109.—Farmers' Reading Courses.
No. 134.—Tree Planting on School Grounds.
No. 161.—Practical Suggestions for Fruit Growers.
No. 173.—Primer of Forestry.
No. 185.—Beautifying the Home Grounds.
No. 199.—Corn Growing.
No. 218.—The School Garden.
No. 247.—The Control of the Codling Moth.
No. 41.—Fowls, Care and Feeding.
No. 35.—Potato Culture.

Also put me down to receive the Monthly List of Publications. I am a student of agriculture in the ——————— School.

Yours sincerely,

———————.

LESSON LIV

AGRICULTURAL SOCIETIES

Organization of boys' and girls' agricultural society.—In the school, early in the year, let a Friday afternoon be devoted to the organization of an agricultural society. All boys and girls should know how to organize themselves, for in this way is learned that great lesson of co-operation so vitally needed to-day in rural life.

Let one of the older boys, at the suggestion of the teacher, call the meeting to order. Then let some boy rise and say:

"Mr. Chairman, I nominate John Reihle (for example) for president." Another rises and says:

"Mr. Chairman, I second the nomination."

Then let some one rise and say;

"Mr. Chairman, if there are no other nominations, I move that John Reihle be declared elected president of this society."

Some one says, "I second the motion," then the boy who is acting chairman says:

"It has been moved and seconded that John Reihle be declared president of this society. Are there any remarks?" Hearing none, he says, "All those in favor say, 'Aye' ". He estimates the vote. "All those opposed say, 'no' ". If he receives more for than against, the chairman declares that John is elected.

John then takes the place of the chairman, and conducts the meeting. A secretary is then elected as above, preferably from among the girls. The following Constitution and By-Laws should be read by one of the pupils, and adopted by the society as a tentative working plan:

Constitution and By-Laws of the Green Valley School Agricultural Club

Article 1.

The name of this society shall be the Green Valley School Agricultural Club.

Article 2.

The objects of this society shall be to encourage the study of Agriculture in the school and home; to promote contests in plant growing, animal raising, literary work, etc.; and to cultivate a love for the farm and home.

Article 3.

All the boys and girls of the school over eight years of age are eligible for membership. Any person over eight and under fifteen, in the district and not in school, may be elected to membership by a majority vote.

Article 4.

The membership fee shall be ten cents, and the annual dues, five cents, payable at the beginning of the school year.

Article 5.

The officers shall consist of President, Vice-president, Secretary, Treasurer, Speaker, and Usher.

Article 6.

It is the duty of the President to preside at all meetings, preserve order, and command obedience to all rules. His emblem is a red ribbon worn on the lapel of his coat. The Vice-president assists the President and presides in his absence. His emblem is a blue ribbon. The Speaker will assist the President and Secretary in arranging the literary program for the regular meetings. His emblem is a green ribbon. The Secretary will keep a record of all meetings, receive the fees and dues of the members, pay the same to the Treasurer, take and keep his receipts therefor. His emblem is the white ribbon.

The Treasurer shall take charge of and keep all the money of the society, and pay out the same only upon orders signed by the President and Secretary. His emblem is the yellow ribbon.

The Usher guards the door, shows members and visitors to seats, and helps the President preserve order. His emblem is a blue rod.

Article 7.

This society shall meet every two weeks at the school house, either in the afternoon or evening as the teacher decides. Meetings may be held at the homes of members.

Article 8.

The order of business at the regular meetings shall be as follows:

1. Roll call.
2. Reading the minutes of last meeting.
3. Report of committees.
4. Proposals for membership.
5. Voting on new members.
6. Literary program.
7. Miscellaneous business.
8. Adjournment.

By-Laws

1. The literary program prepared by the Speaker, President, and Secretary, shall consist of music, recitations, readings, essays, orations, and debates. The program shall be announced by the Speaker, two weeks in advance.

2. An annual exhibit should be arranged, perhaps best in the autumn, in which the boys will exhibit field or garden products they have grown, and the girls,

flowers, vegetables, or cookery. In preparing for this exhibit, the boys should each select in the spring the plat of ground, not to exceed one acre, nor less than 1-10 acre, prepare, plant or sow any crop he may desire. Send for the best seeds, either to the Department of Agriculture at Washington, D. C., or to the State Agricultural College. From either of these places the pupil may get bulletins on any crop he chooses to grow for the exhibit.

3. The teacher and the club shall organize committees to solicit prizes to award at the exhibit for the best vegetables, grain, animals, cookery, etc., brought by the pupils.

4. The club shall take an annual excursion, visiting the farms and homes of the district. This may take the form of a picnic and be the happy ending of the school term.

5. This constitution and by-laws may be amended at any meeting by a two-thirds vote, provided the proposed amendment is posted in the school rooms two weeks before adoption.

(To the teacher:) This society may be, and if a Grange is in the district, should be developed into the Juvenile Grange, a national order, recognized by the Patrons of Husbandry.

The Juvenile Grange is a most excellent organization for young people of the country. It has just enough secret work about it to make it attractive to young folks, and the ceremonies are beautiful and full of good lessons which every boy and girl should heed. In changing the above society to the Juvenile Grange, write to Prof. T. C. Atkeson, Morgantown, W. Va., Overseer of the National Grange, or to C. M. Freeman, Tippecanoe City, Ohio, Secretary, for the Manual of the Juvenile Grange. Juvenile Granges must be organized under the special charge of a Subordinate Grange.

LESSON LV

THE GRANGE

Let us learn something of the greatest farmers' organization in the world—the Grange, or the Order of Patrons of Husbandry.

The following facts about the Grange were submitted by Prof. T. C. Atkeson, Master of the West Virginia State Grange and Overseer of the National Grange:

Origin of the grange.—"The idea of a farmers' fraternal organization originated in the mind of Oliver H. Kelley, a Minnesota farmer, while on a trip through the southern states in 1867, soon after the close of the great Civil War, where he had been sent by President Johnson to see what might be done to rebuild the devastated agriculture of that great agricultural region. Mr. Kelley was a high degree Free Mason, and naturally his idea of a farmers' organization took the form of a secret society. Soon after his return to Washington, where he reported to the Department of Agriculture, he paid a visit to his niece, Miss Carrie A. Hall, who resided in Boston, and outlined to her his proposed farmers' organization. Miss Hall suggested that farmers' wives and daughters be admitted on full equality with the men, and from the first, the organization which followed has made no distinction on account of sex. Mr. Kelley unfolded his plans to a number of gentlemen in the Department of Agriculture and elsewhere, who became interested in the matter.

Patrons of Husbandry.—"The first meeting was held in the office of William Saunders, the horticulturist of the Agricultural Department at Washington, on the evening of December the fourth, 1867, which has ever since been known as the birthday of the order. The organization was named, 'Patrons of Husbandry,' and the word, 'Grange,' which means a farm home, was substituted for 'lodge' as used by other organizations.

Officers.—"There are Subordinate, Pomona, State, and National Granges, each one of which is represented by delegates in the next highest body up to the National Grange which is the supreme authority. All Granges have the same officers as follows: Master, Overseer, Lecturer, Steward, Assistant Steward, Chaplain, Treasurer, Secretary, Gate Keeper, Ceres, Pomona, Flora, and Lady Assistant Steward.

Purposes of the grange.—"The purpose of the organization is to promote the interest of agriculture in every legitimate way possible, educationally, legislatively, cooperatively, and socially, with a view to develop a better manhood and womanhood on American farms. In its forty odd years of history, the Grange has accomplished a vast amount of good for American farmers, and practically every advancement made by agriculture in that time originated with the Grange or has been effectively promoted by it. The Grange was an important factor in the establishment of agricultural colleges and high schools, and originated the idea of teaching elementary agriculture in the public schools. Experiment stations are mainly the product of Grange advocacy. Rural mail delivery, the Department of Agriculture, the Interstate Commerce Commission, and hundreds of other measures of state or national legislation originated with the Grange or were promoted by it. Its value to agriculture is beyond computation.

Work of the grange.—"The grange is a live institution. It is satisfying a great need in rural society. It is based on correct principles: organization, co-operation, education. It is neither a political party nor a business agency. It is neither ultra-radical nor forever in the rut. Its chief work is on cultural lines. It includes the entire family. It is now growing, and its growth is of a permanent character.

"The Grange is ambitious to take its place beside the school and the church, as one of the trinity of forces that shall mold the life of the farmer on the broadest possible basis—material, intellectual, social, and ethical. Is there any good reason why this ambition is not worthy, or why its goal should not be won?"

(President Butterfield of the Mass. Agricultural College, from his Chapters on Rural Progress.)

Why Farmers Should Join the Grange

(By the authority of the Master of the National Grange.)

1. Because it is inexpensive.

2. Because it is the farmer's only organization, national in character.

3. Because it has stood the test for more than forty years, and has never been found wanting in any respect.

4. Because it has exerted greater influence in securing state and national legislation in the interest of agriculture than any other agency in the country.

5. Because it is officered by those engaged in agriculture, who know from experience the needs of farmers, and are sincere in their desire to aid them in every possible way.

6. Because it is the duty of farmers to co-operate with one another, if they would successfully meet the influence of organization in every direction, and secure for wife and home a fair share of what the harvest yields.

7. Because it has exerted the greatest influence known in breaking up the isolation of farm life, and in making farm life attractive to the boys and girls, bringing sunshine and happiness into the farm home to such an extent as has never before existed.

After the teacher has discussed this lesson with the pupils, all the text-books should be laid aside, and the pupils asked to write a brief essay in their note-books on the Grange, its history, plan of organization, purposes and work.

MARCH

On the farm.—With the coming of the spring months we begin to get interested in seeds and growing plants. This month on the farm we shall select our seed corn more carefully, make germination tests, spray our fruit trees against scale, prune the grape-vines, bushes, and fruit trees, sow clover seed in the wheat, sow oats, and begin planning for the corn crop. It is to be a busy month.

LESSON LVI

STRUCTURE OF SEEDS

Possibilities in seeds.—Seeds are such common objects to farm boys and girls, that I fear sometimes we do not appreciate what wonderful things they are. I say wonderful, because no one understands all about them, because from them come nearly all our plants, and upon them we depend for most of our food. Within the little seed is wrapped up all the possibilities of size, color, flavor, shape—in fact, all the qualities of the grown up plant it is to become.

Value of seeds.—Seeds are a great deal like yourselves. They are little plants, dressed up, carrying dinner baskets, and sent forth by their parents into the world to grow up as nature intended them, into perfect plants. Ought we not to be interested in them since they do so much for us? What can we do for the seeds? We can care well for them, plant them and nurture them. But we must learn more about them—learn how they are made, and why every part of the seed is formed as it is.

Plants live to produce seed.—Plants grow, bear leaf, stem, flower, and fruit for the sole purpose of producing a seed. Why does the plant do so much for the sake of a seed? Because in the seed is the young plant and the food to start it, well protected against drought, cold, and other forces that might injure it, and if the old plant should die when winter comes, the seed may live on and produce a new plant again.

In the practical exercises which follow, we shall see how the seed is made.

Practical Exercises

1. Study of the Lima Bean

To facilitate the study of seeds they should be left in water over night.

Observe the following points of the bean, and make a sentence note of each of the words in black type.

1. Markings on the surface:

(a) Scar or hilum where the seed was attached to the pod.

(b) Near the hilum a small opening, the micropyle.

2. Remove the coat or testa. Near the hilum a small pointed body, the caulicle, will be seen.

Separate the halves or cotyledons, observe that the caulicle bears two small leaves, the plumule.

The cotyledons, caulicle, and plumule constitute the embryo.

Make a drawing of the whole bean showing these parts, and of the single cotyledon with the caulicle and plumule in place.

2. Study of the Grain of Corn

Soak a few grains of corn in hot water for twenty minutes or use grains that have soaked in water over night. With a sharp knife remove the tip cap at the end of the kernel. Beginning at the end where the

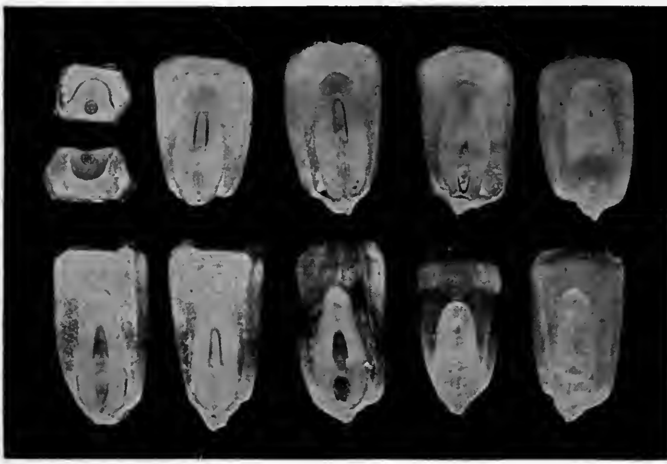


FIG. 51. KERNELS OF CORN IN SECTIONS SHOWING THE GERM

hull has been broken at the tip cap, remove the hull from the entire grain in strips. The part immediately under the hull is called the horny gluten. Carefully remove it by shaving it off with a sharp knife. Now remove the germ or embryo. Make out the caulicle and plumule as you did in the Lima bean. After the tip cap, hull, horny gluten, and germ have been removed, there remains only starch, of which there are two kinds—the horny starch and the white starch. The horny starch lies at the back and sides of the kernel. The white starch is at the crown end of the kernel above the germ, and nearly surrounds the germ toward the tip of the kernel. Separate as far as possible the horny starch and the white starch. Make an enlarged drawing of the front view of a grain of corn, showing and naming the parts.

NOTE. All seeds except the seeds of conifers, are of one of these two types. In the bean, there are two cotyledons, and the food material of the seed is stored in these cotyledons.

In the corn there is only one cotyledon, and the food material is stored outside of the embryo, in a part called the endosperm.

3. Study of a Grain of Wheat

Soak a few grains of wheat in warm water. With a sharp knife try to remove the covering of the grain. There are four of these coverings on a grain of wheat, three epidermic layers and one testa or true seed coat. These coats constitute the bran and make up about 11% of the grain. Immediately under the testa is the endosperm. This makes up a large part of the seed and is the flour of commerce. Note the position, form, and size of the embryo. Make a diagram representing a cross section of a grain of wheat, showing all these parts.

NOTE TO TEACHERS. Send for "School Set of Economic Seeds," to Edgar Brown, Seed Laboratory, Department of Agriculture, Washington, D. C.

LESSON LVII

GERMINATION OF SEEDS AND GROWTH OF SEEDLINGS

Plant-food in seeds.—Plants, like animals, must have food and drink, and like animals they perish without

FIG. 52. GROWING CORN

them. We have told what some of these plant foods are, and now we shall find out the way in which the young plants get their first food. You will remember the little bean plant which you saw snugly tucked between the two halves of the seed. These two fleshy cotyledons, as they are called, serve as a storehouse for the food of the little bean plant. In the kernel of corn the same kind of a little plant was seen, but instead of two cotyledon storehouses of food, there is only one cotyledon. We are often told that the plant stores up food in the seeds for our use, and although we do use this stored up food for our own food in many cases, nature intended this food matter, not for man, but for the little plant, to use for its own growth until it is large enough to get food for itself directly from the soil.

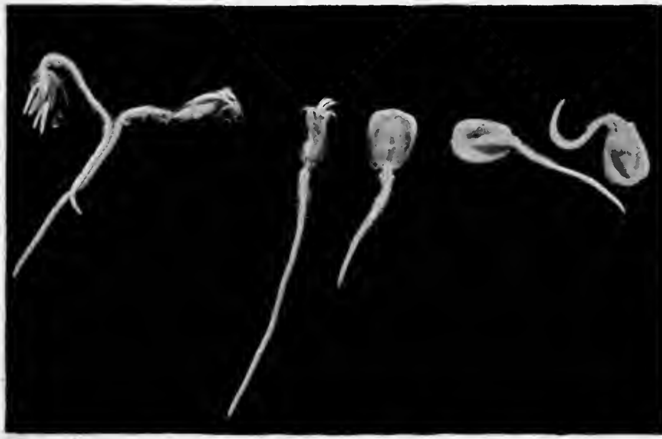
Essentials to plant growth.—The little bean plant between the cotyledons of the seed cannot begin to grow or germinate with its stored up food alone; it must have outside help. We usually plant the seed, and in the ground it finds the needed help. Of course, we know that in the ground the seed finds moisture, heat, and air, and these are the essentials of germination. These points we shall try to prove in the practical exercise. Good seed and proper conditions of soil, moisture, air, heat, and light are essentials to plant growth, and a part of the study of agriculture consists in determining how to control these conditions.

Practical Exercises

1. Essentials of Germination

Place a dozen good seeds of any kind on a woolen cloth or blotting paper in each of two tin pans. Cover the seeds in the first pan with water and keep them completely covered. In the second pan keep the cloth or paper on which the seeds are placed always moist, but do not allow water to stand around the seeds. Invert other tin pans over these seed pans. Which seeds germinate? Why?

Prepare two pans of seeds as you did the second one above. Place one pan out of doors in a cold place, and



Courtesy of D. W. Working

FIG. 53. GERMINATING CORN SHOWING ROOT HAIRS

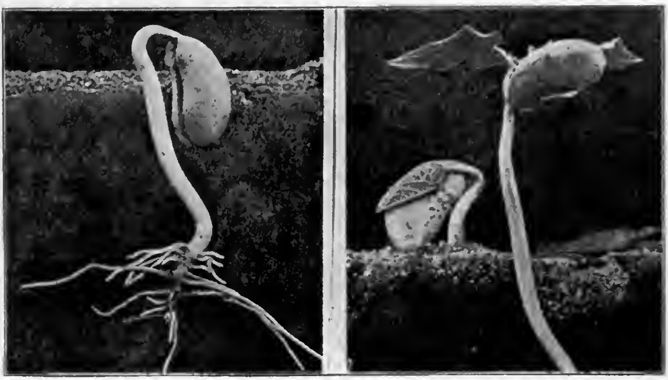
leave the other in the house where it is warm. Note the difference in the germination. Explain.

2. To Show the Function of Cotyledons

Remove the two cotyledons of a germinating bean, and insert the growing roots through a piece of mosquito netting, tied over a tumbler into the water with which the glass is filled. Insert another germinating bean from which the cotyledons have not been removed. Note the comparative growth of the two seedlings. Explain.

3. Testing Seeds for Germination and Purity

Send to the Extension Department of Purdue Agricultural College, at Lafayette, Indiana, enclosing 35c, for their collection of mounted weed seeds. This is a very valuable collection, and will serve in a practical lesson. Get samples of clover seed from the stores or from home, and spread out a quantity of the seed on a sheet of white paper. Examine it very carefully with



Courtesy of D. W. Working

FIG. 54

a hand lens, and by the aid of the weed seed collection, pick out the seeds that are not clover. Count out one hundred seeds and determine what per cent of them are weed seeds. Place the remaining clover seeds, from which the weed seeds have been taken, on the moist cloth in the germinating pan, and cover for a few days. Count the number of seeds that failed to germinate, and calculate the percentage of good seeds there were in the original one hundred. At the price paid for the clover seed with all its impurities, how much does the farmer pay for the pure seed?

4. Absorption of Water in Germination

Fill a bottle with dry pea seeds, and add as much water as the bottle will hold. Cork tightly, and secure the stopper by means of a wire. Set the bottle of peas aside for a few hours and note the result. Explain.

Table showing legal weight per bushel of farm products:

Wheat	60 lbs.	Buckwheat	50 lbs.
Peas	60 lbs.	Oats	32 lbs.
Beans	60 lbs.	Clover Seed	60 lbs.
Irish Potatoes	60 lbs.	Cotton Seed	28 lbs.
Sweet Potatoes	50 lbs.	Millet	50 lbs.
Onions	56 lbs.	Orchard Grass Seed	14 lbs.
Corn (shelled)	56 lbs.	Peanuts	23 lbs.
Corn in ear, shucked	70 lbs.	Red Top Grass Seed	14 lbs.
Rye	56 lbs.	Timothy Grass Seed	45 lbs.
Barley	48 lbs.	Italian Rye Grass Seed	20 lbs.

Handy Values

A bushel requires about 1¼ cubic feet of space.

A bushel of corn in the ear requires about 2 cubic feet of space.

A barrel of water requires about 4 cubic feet of space.

A ton of hay fills about 512 cubic feet of space, or 8x8x8 cubic feet.

A cubic foot of water weighs 62½ pounds.

NOTE. I: All the above should be memorized.

NOTE II: Pupils should also memorize table of avoirdupois weight, dry measure, liquid measure, long measure, square measure, and cubic measure, with all the necessary abbreviations.

Problems

1. How many pounds of wheat are grown on an acre yielding 25 bushels?

2. How many pounds are grown on eight acres at the same rate? How many tons?

3. How many square rods in an acre? How many pounds would that be per square rod?

4. What is the value per acre of the above at 80c per bushel?

5. At the same rate what is the value of all the wheat grown on a piece of land containing 240 square rods?

6. At 90c per bushel what is the value of the wheat grown on an acre if the yield is 20 bushels?

7. Which is the more valuable, the crop in problem 4 or that in problem 6?

8. If 20 bushels of 90c wheat can be grown on an acre, how many pounds is that per acre? What is the price per pound? How many pounds are grown on a square rod? What is the value of the wheat grown on a square rod?

9. At the same rate and price, what is the value of the wheat grown on a piece of ground 14 rods wide and 20 rods long?

10. How many acres in a field 40 rods long and 24 rods wide?

11. If a man can plow 2 acres per day, how long will it take him to plow the above field? What will it cost at $2 per day?

12. What will be the cost of plowing a 40 acre field at the same rate?

13. If a man and team can seed 8 acres per day how long will it take to seed a 40 acre field? What will it cost at $2 per day?

14. At 50c per acre what will be the cost of cutting this crop?

15. It will cost about $0.25 per acre to stack the grain. Find the cost of stacking.

16. What is the threshing bill at 2 cents per bushel? Find the entire cost of the crop.

17. If the yield has been 20 bushels per acre, worth 90 cents per bushel, how much has the farmer made over and above the entire cost of labor?

18. How much has he made if the crop has yielded 25 bushels per acre, worth $0.80 per bushel?

19. Have any items of the cost of producing this wheat been omitted? If so, what? Should we allow for them? Let us do so and find the result.

20. With a crop of 50 bushels of shelled corn per acre, worth $0.40 per bushel, work the same series of problems, omitting such as do not apply to corn raising.

LESSON LVIII

JUDGING AND SCORING SEED CORN

Selecting seed corn.—We must now make a careful selection of our seed corn stored away last autumn. It is our plan to plant ten acres—field number 1, on our farm, and it will take about 150 ears of corn to make sure that we have enough. It is now time to find out what a good ear is, and to determine this it is necessary to see it in all its parts. Not knowing the germinating quality without actual trial, we shall have to be content in this first step of corn judging with what might be termed a good show ear. The object of corn judging is to determine the corn of highest quality, either for feeding or market, and which is consequently most profitable to grow.

The score card.—The study of the desirable characteristics of corn has led to the formulation of a standard scale of points or "corn score card." The use of the score card has been adopted as the best means of comparing samples of corn, and is a valuable guide to the student of corn judging in estimating the merits of points in samples of corn.

Samples for scoring.—In corn-judging contests or in schools, ten ears of corn are usually scored as a single sample. Each ear may be scored separately, or the whole ten may be averaged in one grade on each point of the score card. For practical planting purposes and for our school lesson we shall judge each ear separately. Study carefully the illustrations of prize corn, and note as best you can what may be required to make a perfect ear.

NOTE. This lesson may be given in the fall in connection with Lesson 14, if so desired.

The following score card is used by the Indiana Corn Growers' Association. The number opposite each of the twelve points represents the perfect grade:

Name of variety.................................. Table No......
Name of scorer.................................. Sample No......

			1	2	3	4	5	6	7	8	9	10
1.	Trueness to Type or Breed Characteristics	10										
2.	Shape of Ears	5										
3.	Color of Grain and Cob	10										
4.	Vitality or Seed Condition	10										
5.	Tips of Ears	5										
6.	Butts of Ears	5										
7.	Kernel Uniformity	10										
8.	Kernel Shape	10										
9.	Length of Ears	5										
10.	Circumference of Ears	5										
11.	Space between Rows and Kernels	10										
12.	Proportion of Corn to Cob	15										
	Total - - - - - - - - -	100										

Explanation of the Score Card

1. Trueness to type or breed. Ten points perfect.

The ear should be true to the breed characteristics in size, shape, color, shape of kernel, etc.

2. Shape of ear. 5 points perfect.

The ear should be full and strong in the middle, and should not taper too rapidly towards the top. Rows should be straight.

3. Color of grain and cob. 10 points perfect.

The color should be true to the variety, and free from mixture. White corn should have white cobs, and yellow corn, red cobs. Cut about one point for five or six colored grains.

4. Vitality or seed condition. 10 points perfect.

The ear should be well matured, firm, and sound. The germ should be large, fresh, and vigorous looking.

5. Tips of ears. 5 points perfect.

The tip should be regular and not too tapering. Tip should be well covered, with straight rows of regular kernels. Cut one-half point for tips exposed one inch.

6. Butts of ears. 5 points perfect.

FIG. 55. PRIZE EARS AT WEST VIRGINIA CORN SHOW

The rows of kernels should extend in regular order over the end of the cob, leaving a depression when the shank is removed.

7. Kernel uniformity. 10 points perfect.

The kernels should be uniform in size, color, shape, and identation, and true to the variety type.

8. Kernel shape. 10 points perfect.

The kernels should be deep and so shaped that their edges touch from tip to crown. The tips of the kernels should be full and strong.

9. Length of ear. 5 points perfect.

The length should conform to the standard for the variety used. From eight to ten inches is the usual standard length. Cut one-half point for each inch of deficiency.

10. Circumference of ears. 5 points perfect.

The circumference should be in proportion to the length, that is, about three-fourths the length, measured at one-third the distance from butt to tip. For each inch deficiency or excess, cut ½ point.

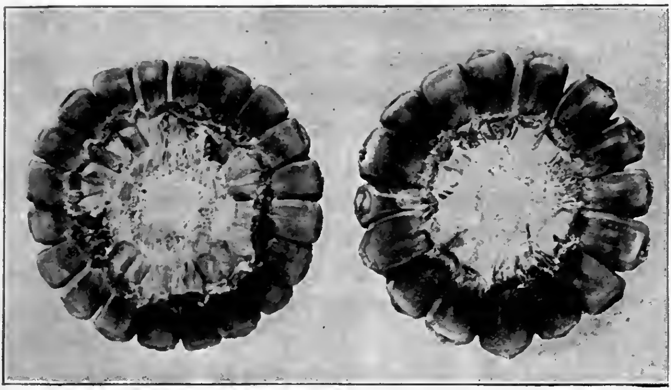


FIG. 56. PROPORTION OF CORN TO COB

11. Space between rows and kernels. 10 points perfect.

The furrows between rows should be wide enough to allow the ear to dry out readily, but not so wide as to lose in proportion of corn to cob. Much space between kernels is highly objectionable.

There should be not less than 16 rows, and 6 or 7 grains to an inch in each row.

12. Proportion of corn to cob. 15 points perfect.

The proportion should be determined by weight. The proportion of corn to cob should not be less than 86%. Cut 1½% for each per cent below the standard.

Practical Exercises

1. Scoring Seed Corn

Copy the foregoing score card in your permanent notebook. Select ten ears of corn, keeping the idea of "mates" in mind. The ears should look as much alike in every way as it is possible to find them. Find ears all the same length, the same circumference, the grains the same size and shape, without any indications of mixture, the rows running straight from tip to butt, and measuring up to the standard of the score card as much as possible.

Grade each ear of corn on each of the points, and put down on the score card your estimate of how the ear measures up to the perfect grade. It is not expected that you will become expert in one lesson, but you will enjoy the improvement you make in this work.

2. Selecting Seed Ears

Using the ear of corn which you have graded the highest on your score card as a model, look over your entire lot of seed corn, and select one hundred ears which according to your judgment most closely resemble this sample ear. Number all these ears from 1 to 100, by tying to each a numbered tag, or by sticking a numbered peg into the butt of each cob. These are now to be laid away for the germination test described in the next lesson.

LESSON LIX

TESTING SEED CORN

We have now selected the ears of corn with which to plant our ten acres on the farm. We have numbered each ear and placed it by itself, and we are now ready to make the germination test, for we wish to be sure that every grain we plant will germinate vigorously.

Value of good seed.—One of the most important modern movements for the improvement of agriculture in this country consists in the proper selection, care, and testing of the seeds to be planted. When we remember that the seed carries with it all the characteristics of the parent plants from which it came, we want to be sure that these parent plants are just as nearly perfect as possible. When we remember that the seed is a living thing, containing a young and tender plant, we see the necessity of properly caring for the seed during its resting period. And when we understand that sickly or dead seeds cannot grow into valuable plants, we shall no longer be willing to put them into the ground, which we expect to cultivate, and from which we expect to gather a full harvest.

Testing seed corn for life and vigor.—It has come to be true that almost every farmer and country school boy now understands the importance of testing seed corn before planting—and testing it in the ear rather than after shelling. But many farmers fail to *do* as well as they *know* in this matter, as well as in many other matters, because it is "too much trouble." Many farmers say that they can tell whether a kernel of corn will germinate by cutting or biting off the tip cap and examining the germ. No doubt most experienced corn growers can do this, but even by this simple method they can not tell which ears of corn will germinate most vigorously, and it is the sure and healthy germination that counts most throughout the entire life of the growing corn plant. The boys and girls of the school will want to use the surer and better method of testing seed corn.

Practical Exercises

1. The Germinating Test Box

Make a shallow box about two inches deep inside, fifteen inches wide and twenty-three inches long. Partly fill the box with fine sand. The box may now be divided into small squares by a checkboard lacing of wire or twine across the top. It is convenient to have these squares about 1½ inches on a side, ten of them in a row across the narrow way, and fifteen the other way. Another way to obtain the squares, is to place over the sand a cloth which has been checked into 100 squares by an indelible pencil, or better still, with ink. Number each square from one to one hundred. The figure below shows the manner of wiring and numbering when the first method is used.

Now take each ear separately, and with the point of a pocket knife remove five kernels from the ear. The kernels should be taken in succession from about an inch above the base of the ear to the same distance below its tip, passing spirally around and lengthwise of the ear, so that no two grains are taken from the same row. Place the kernels in the square corresponding in number to the number of the ear, place the germ side of the kernels against the wet cloth or sand, and lay the ear away in its place. When the box has been planted

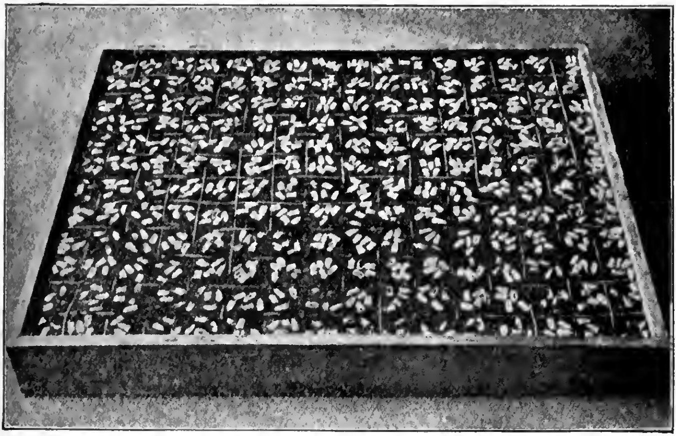


FIG. 57. A GERMINATING TEST BOX

the sand should be thoroughly watered. If the cloth has been used, the corn should be covered with a second wet cloth, and this with a dry cloth to prevent excess of evaporation. The box should be kept in a warm room where it will not be disturbed until the test is finished. The planted tray should not be allowed to dry out until the young corn plants are an inch or two above the sand. The ear that does not show all five kernels germinating vigorously should not be planted in the field. Every poor ear planted spoils about one-fifteenth of an acre in the cornfield—and yet some farmers would blame it on the crows or the weather, or something else which they could not help. This is certainly a better way to get a "stand" of corn than to plant "one for the blackbird, one for the crow, one for the cut-worm and two to grow."

After selecting the ears that will be used as seed, place them where they will be protected from freezing, moulding, or getting wet. Each pupil should bring samples of seed corn from his home and make the germinating test at school, or have a box of his own at home and test the seed corn there and report the results at school. Keep a note-book record of the results of these tests.

NOTE. The practice of smoking the seed corn before shelling and planting has proven an effective preventive against the corn-root louse and other insect pests of the sprouting grain.

References: Farmers' Bulletin, No. 253, No. 409.

LESSON LX

THE PLANT AND WATER

We are now ready to study the growth of the plant from the seed into root, stem and leaf, and to understand how the plant gets its food. We have already learned that the seed furnishes the food for the little plant until it is large enough to get food from the soil.

We also learned in a former lesson that the most important plant foods are: Water, lime, iron oxide, soda, ammonia, silicon, magnesia, potash, carbon dioxide, phosphoric acid, etc.

Water as a plant food and solvent.—Perhaps the most important plant food is water. Every one knows that plants cannot live without water, but few persons stop to think of the enormous amount of water consumed daily by an acre of growing vegetation. Plants make use of water in two ways. In the first place they use it as a food, just the same as animals do. In the second place a plant cannot eat solid food. It has neither mouth nor teeth, and it must take in its food in liquid form through its roots, or in gaseous form through its leaves. The solid foods mentioned above dissolve in water, just as sugar dissolves in coffee, and in this dissolved condition they are easily taken in by the plant roots. The plant fluid containing these dissolved foods is called sap. The solid food and some of the water taken up by the plant roots and carried through the stem to the leaves is used by the plant for growth, and the remaining water not used for food is thrown off into the air through little pores in the leaves. This is the reason why plants need so much water. Grains, grasses, and orchards use up hundreds of tons of water during the growing season.

Control of water for plants.—We have also learned that the farmer can regulate the amount of water in the soil to a certain extent. If there is too much water, he can drain it away. If there is need of saving all the rainfall possible, he can by deep plowing and

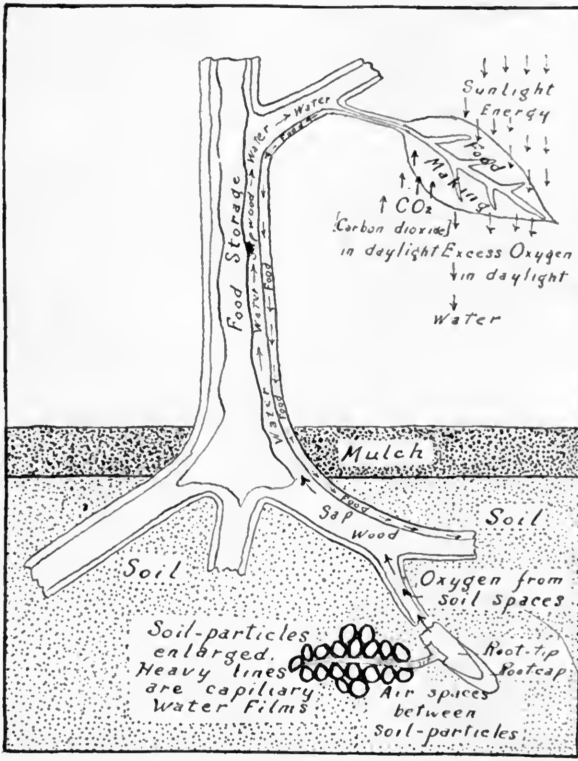
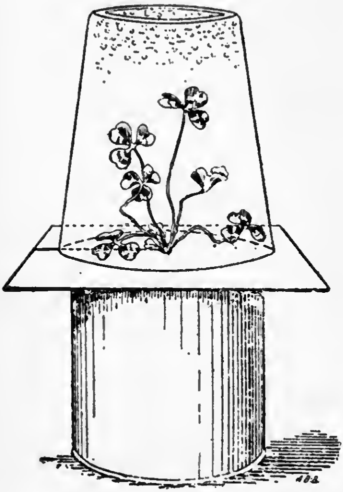


FIG. 58. DIAGRAM OF A PLANT, SHOWING ITS MOST IMPORTANT RELATIONS: SUNLIGHT, MOISTURE, OXYGEN, AND SOIL

careful cultivation save a large share of the moisture in a time of drought.

Practical Exercises

1. To Prove that Plants Throw off Water



Put the same amount of water into similar vessels — tumblers or glass fruit jars. Pull up any thrifty growing plant and put its roots into one of these vessels of water. Stand both vessels on a table side by side. Note the difference in the amount of water in each vessel day by day. What has caused the loss of water in each vessel? Why the difference?

The same fact may be shown by placing a clean dry glass vessel over a growing plant. Where does the moisture come from that appears on the inner surface of the glass? How can you show that this does not come from the soil?

2. Air-derived and Soil-derived Foods

Select a dry plant or a piece of dry wood. Weigh it carefully. Now burn it and weigh the ashes. What per cent of the plant burned? What per cent is ashes? The ashes represent the food derived from the soil when the plant was growing, and the part that burned represents the food derived from the air.

Free Bulletins, U. S. Dept. of Agriculture

Farmers' Bulletins

No. 46.—Irrigation in Humid Climates.
No. 116.—Irrigation in Fruit Growing.
No. 138.—Irrigation in Field and Garden.
No. 158.—How to Build Small Irrigation Ditches.

Table showing proportions of water in farm crops:

One bushel of root crops contains about 55 pounds of water.

One bushel of potatoes contains about 45 pounds of water.

One bushel of corn (dry, shelled) contains about 5 pounds of water.

One bushel of wheat contains about 6 pounds of water.

One bushel of oats contains about 3 pounds of water.

One ton of dry hay contains about 300 pounds of water.

One ton of green feed contains from 1,500 to 1,800 pounds of water.

NOTE. This represents only the water left in the plants and seeds as a part of them. By far the greater amount used by the plant passes off to the air through the pores in the leaves.

Problems

1. If rain falls an inch deep on the level, how many cubic inches is that per square foot? Per square yard? Per square rod? How many cubic feet per square rod? Per acre?

2. About how many barrels of water fall on an acre with one inch rainfall?

3. How many tons will this water weigh?

4. The total rainfall during the year in West Virginia is about four feet. What does the water weigh that falls during the year on a square yard of ground? On a square rod? How many tons to the acre?

5. Suppose the plants use one-eighth of this, what is the weight of the water used by a square yard of vegetation? A square rod? An acre?

6. Suppose potatoes contain three-fourths of their

weight of water. How many pounds of water in a bushel of potatoes?

7. If 150 bushels per acre of potatoes is a good yield, how many pounds of water in the potatoes grown on an acre?

LESSON LXI

THE ROOT SYSTEM OF THE PLANT

Kinds of root systems.—The root system of the plant consists of the entire group of roots upon the plant. There are two kinds of root systems:

(1) Tap-root—central main root with smaller roots coming out from it. Examples may be found in the beet, radish, and turnip.

(2) Fibrous root—many roots of nearly the same size. Examples of this type are seen in the grasses, such as timothy and blue grass. Either of these two types may have many modifications.

Roots and tillage.—Methods of cultivation should take into account the nature of the roots of the plants. Tap-rooted plants require depth of soil, and will permit deeper and closer cultivation than fibrous rooted plants. On the other hand, fibrous rooted plants, such as the corn, are often injured by too deep cultivation during the growing season. The fibrous roots of such plants are near the surface of the ground, and when destroyed by deep cultivation, much of the food supply of the plant is cut off, and to that extent the plant is injured or retarded in its growth.

Root-hairs.—On the roots of the corn in our germination test box, we saw great numbers of fine root-hairs. These are the principal feeding organs of the plant. They have the power to transfer the water and the plant food from the soil to the rootlets. If water does not exist as capillary water in the soil, the root-hairs are unable to do their work.

Purpose of roots.—The root system in all its modifications serves three purposes to the plant:

(1) It absorbs and conducts water and plant food dissolved in the water.

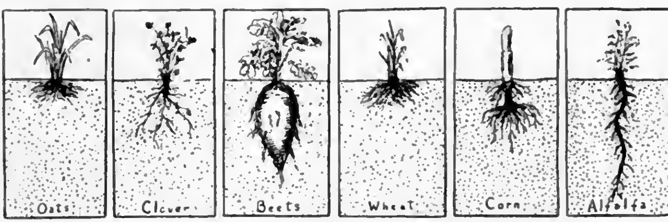


FIG. 81. ROOT SYSTEMS OF PLANTS

(2) It reaches long distances in the ground and thus holds the plant firmly in its place.

(3) It furnishes a storehouse for much food material, as in the case of the radishes, beets, and turnips.

Practical Exercises

1. A Study of Roots

Dig up a clover plant and remove the soil from it. Observe that it has a strong central root which joins the stem. Make a drawing of the clover root system.

Dig up a single timothy plant with as many of its roots as possible, and remove the soil from them. Observe the many similar roots projecting from the stem. Make a drawing of the root system of the timothy.

Examine the beet, turnip, or carrot. Observe that these vegetables are a thickened or fleshy tap-root, and contain large quantities of stored food material. Make a drawing of this type of root.

Make a list of the common plants of the farm, and classify them as to the character of their root system under the following divisions:

Slender tap-roots.	Fleshy tap-roots.	Fibrous roots.

2. The Root System of the Corn Plant

Carefully remove as much of the entire root system of a growing corn plant as possible. Wash all the soil away from the roots. Remove and measure each root separately, and find the total length of the whole root system.

Place a corn seedling with its root system in a glass of water, which has been colored with red ink. Note the rise of the colored liquid into the stem and leaves. Explain.

LESSON LXII

CLOVER AND OTHER LEGUMES

On some mild day in March, when the wind is not blowing and the ground is thawing, we shall sow clover seed in our wheat field, number 2, on the farm. It will require about one bushel of seed to sow the ten acres, and our seed will cost about $7 or $8. We must charge this to our expense account to be balanced up with profits later.

Restoring nitrogen to the soil.—Nitrogen is the element which under ordinary conditions of farming is likely to be soonest exhausted. The farmer's attention must early be turned to methods of restoring nitrogen to his soil. Of course the best method of restoring all elements of fertility to the soil is by the use of barnyard manure, but it is not always possible to do this. There is a class of plants, however, called legumes, that have the power of adding nitrogen to the soil. Peas, beans, clovers, alfalfa, etc., belong to this class. It is the purpose of this lesson to discover how these plants add nitrogen to the soil.

Nitrogen in the air.—Air is composed largely of two gases, nitrogen and oxygen. About one-fifth of the air is oxygen and the other four-fifths is nitrogen. It is the oxygen that causes iron to rust, coal to burn, or wood to decay. On the other hand, nitrogen does not combine readily with other substances. It dilutes the oxygen of the air by being mixed with it, and prevents the oxygen from burning up everything in the world, and thus makes the air fit for animals to breathe. Farm crops cannot use this "free" nitrogen that is in the air.

Nitrogen - gathering bacteria. — Little plant - like germs, called bacteria, live in the soil, and these feed upon this free nitrogen in the air. These germs fasten themselves to the roots of the legumes, such as clover and cowpeas, and build little colonies that are called tubercles. These tubercles are about as large as pinheads, and may easily be seen on the roots of clover, beans, and peas. The interesting thing about these germs is that they do not seem to grow without the clover, and the clover does not thrive without the germs. In most soils the germs will find the clover, but occasionally soils from old clover fields have to be sprinkled over the new clover fields in order for the young clover to "catch."

FIG. 59. TUBERCLES ON THE ROOTS OF SOY BEANS

These germs found in the tubercles on the roots of legumes, in feeding upon the nitrogen of the air, store large quantities of the nitrogen in the plant and in the soil about the plant. If this crop is plowed under, additional nitrogen is added to the soil, and the physical properties of the soil are also improved by the humus which the clover affords. This is the secret of clover-growing on the farm. Crimson clover, cowpeas, soy beans, and vetch will serve the same purpose to the farmer as the red clover, and each farmer must learn which of these legumes are best suited to his locality.

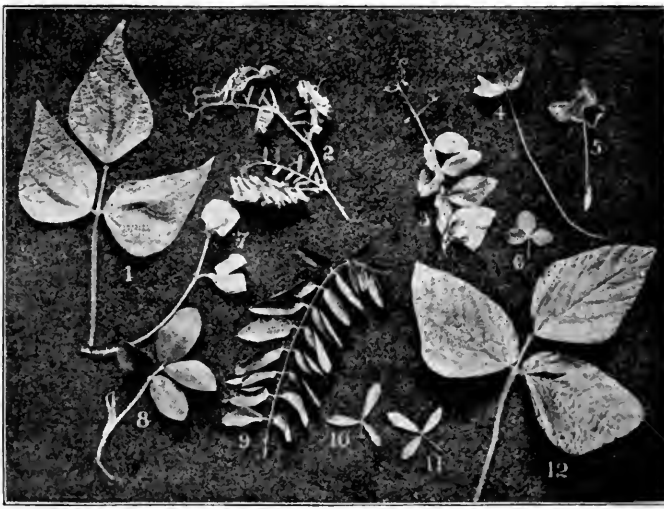


FIG. 60. LEAVES OF LEGUMES

Practical Exercises

1. Observational Studies of the Legumes

Find in the fields and bring to the school for study the following legumes, or as many of them as possible: Clovers, cowpeas, vetch, beans, alfalfa, black locust, etc. Be sure that you find roots of clover showing the tubercles or nodules on them. The following outline for study is suggested. (Make all records of your observation and your drawings in your notebook):

1. Observe the number, size, shape, and arrangement of the leaves. Make a drawing of each kind of legume leaf you have.

2. Observe the number and length of the stems from a common root. Are the stems erect, spreading, trailing, or twining?

3. Are there many, few, or no branches?

4. If in bloom notice the place, size, form, and color of the blossom. Make a drawing of the blossom of each legume.

5. If in seed, note the kind, number, and shape of the seed pods. Note the number of seeds in the pods, and the size and form of a single seed. Draw a seed pod, and an enlarged sketch of a single seed.

6. Observe the form, size, number, and length of the roots. Look closely for nodules on the roots. Make a drawing of the roots of one legume.

2. Sowing Legumes

Write a paragraph describing the methods of sowing clover seed, alfalfa, cowpeas, or any other legume which you have seen sown at home or in the neighborhood.

Problems

(See page 148.)

1. How does clover compare with other kinds of hay in the amount of nitrogen it contains? Phosphoric acid? Potash?

2. If two tons of hay per acre is an average yield, how much of each fertilizer is removed yearly with the crop from eight acres of ground?

3. Which kind of hay makes the richest manure? Why?

4. How much more of nitrogen in a crop of twenty-five acres of clover hay, yielding three tons per acre, than in the same number of acres of mixed hay yielding two tons per acre? Where does this extra nitrogen come from?

5. How many tons of each kind of hay did you raise on the farm last year?

6. How many tons of hay did you sell last year? How many pounds of each of the three important kinds of "soil fertility" did you sell? How many pounds altogether?

Free Bulletins, U. S. Dept. of Agriculture

No. 89.—Cowpeas.
No. 194.—Alfalfa Seed.
No. 214.—Beneficial Bacteria for Leguminous Crops.
No. 215.—Alfalfa Growing.

LESSON LXIII

CROP ROTATION

Necessity for crop rotation.—The sowing of clover seed on our wheat ground and the spring planning for corn, suggests the subject of crop rotation. If we are to farm wisely and be prosperous, we must study and practice crop rotation. The farmer tries to raise those crops which will give him the largest returns in money, but in doing this he often loses sight of the future. He may reason thus: "If corn is a high price and my soil will raise good corn, then corn is the crop for me to raise." So year after year he raises corn on the same fields until he finds that his soil will not raise a good crop of corn. The cause is not far to seek. Corn requires the same kind of plant food year after year, and unless this food is restored in some way, the soil becomes exhausted of some of its fertility. So the farmer needs to consider, not only the returns he will get from his crop this year, but the effect that the crop will have upon the soil.

Cover crops.—On all sloping lands, if neglected, the soil may wash into gullies, and in a few years a fertile field may be completely ruined. Such lands should be kept in grass as much as possible, and when such lands are cropped, the rows should run lengthwise the hill and not up and down the slope, thus checking the tendency to wash. One of the best means of preventing washing of the soil is to plant a crop in the fall that will cover the ground thickly before freezing weather, and thus not only hold the soil, but prevent its being packed by the rain. Such crops are called cover crops. Rye or the clovers are especially used for this purpose.

A system of crop rotation.—Crop rotation consists in growing one kind of crop on the ground this year, another kind of crop requiring different plant foods the next year, still another the year following, and so on, the crops following each other in succession, and at regular intervals. For example, our field number 2 (see map of the farm) at present in wheat will be sown to clover this spring. After the wheat is cut in July, the clover will be allowed to grow all summer and fall, and to go into the winter as a cover crop, with all the advantages mentioned above. Next spring the clover will be allowed to grow into blossom, and will then be cut for hay. A second crop of the clover will spring up, and we allow this to go to seed and to be thrashed out in September, or to go into the winter as a cover crop again. The following spring we shall plow under the clover, and plant our field to corn. The following September we may sow the field to wheat, and the next spring return to clover again. This system of rotation is well suited to the central states. Of course, there may be special reasons for modifying it, and other methods of rotation equally good will occur to the thoughtful farmer.

Results of rotation.—During this rotation period a cover crop has been plowed under, and a sod of clover two years old has been turned into the soil. The clover has added to the food supply for the two grain crops, and has improved the texture of the soil by the humus it will produce, besides it has furnished pasture, hay, cover crop, and seed in the meantime. If the clover sod be treated with lime and phosphoric acid, just before it is turned under for the corn crop, the yield of the corn will be greatly increased, and the wheat following the corn in the rotation, will be favorably affected by the additional fertilizer.

Practical Exercises

1. Systems of Crop Rotations

Copy the two following systems of crop rotation in your notebook and memorize them:

I

(a) Sow clover seed in the wheat in March or April.

(b) Harvest the wheat as usual, and allow the clover to remain as a cover crop for the winter.

(c) Plow up the clover sod the following April.

(d) Plant to corn.

(e) Sow wheat in the corn in September.

(f) Sow clover seed in the wheat again in March.

II

If the land is much reduced or of a poor soil, the rotation begins and proceeds as in (I) above, except at (c), instead of plowing up the clover for corn in the spring, allow it to stand another season. A hay crop may then be harvested in June or July, and a seed crop in the following September, after which proceed as in (I).

Tabulate the following in your notebook:

Rotation of Crops

Series a.	Series b.	Series c.	Series d.	Values of Rotation.
Clover Corn Wheat Clover	Clover Hay and seed Corn Wheat Clover	Clover Corn Oats Wheat Clover	Clover Corn Potato Wheat. Clover.	Preserves food supply. Increases food supply. Eradicates weeds. Exterminates insects. Enlarges the resources.

2. Crop Rotations on the Home Farm

Describe the system of crop rotation used on your father's farm. Give in detail each step as the outline suggests above.

Compare the system used at your home with those described by the other members of the class. Criticize and discuss the various methods.

Free Bulletins, U. S. Dept. of Agriculture

No. 289.—Practices in Crop Rotation.
No. 320.—Relation of Sugar Beets to General Farming.

Problems

1. If corn is planted in rows four feet apart each way, how many hills to the acre? With three good ears to the hill, how many ears to the acre?

2. If it takes 100 ears to make a bushel, how many bushels to the acre?

3. Which is the better crop? Five stalks to the hill that bear ears requiring 200 to make a bushel, or three stalks to the hill that bear ears requiring 100 to make a bushel?

4. How many bushels per acre is one crop better than the other?

5. Suppose a ten-acre field produces sixty bushels of corn per acre the first year, but falls off five bushels per acre yearly when corn is continually grown on it, what will be the yield the fourth year?

6. What will be the total loss in the four years? With corn worth 30 cents per bushel, what is the money loss?

7. Suppose this loss can be avoided by rotation of

crops. What is saved yearly, per acre, on this basis from rotation of crops?

8. What is the value of one acre of tobacco, 1,500 pounds, at 8 cents per pound?

9. What is the value of one acre of oats, sixty bushels, at 30 cents per bushel?

10. What is the value of one acre of clover, three tons, at $6 per ton?

11. What is the value of one acre of corn, fifty bushels, at 40 cents per bushel?

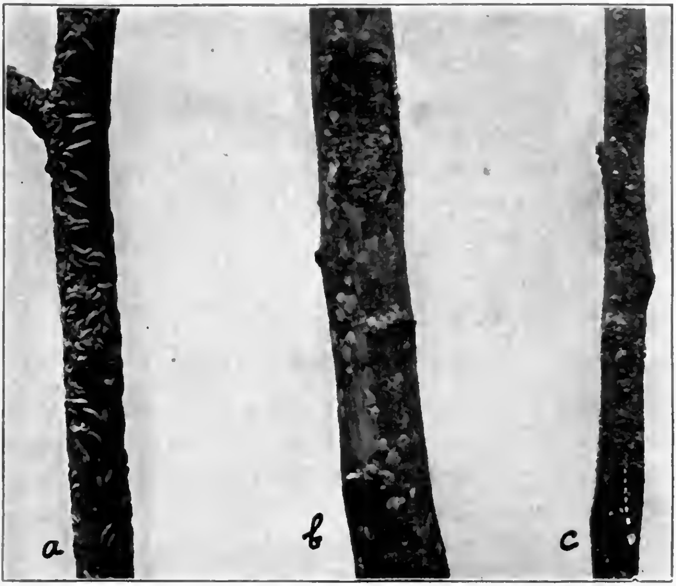
12. What is the value of one acre of peas, twenty bushels, at $1.50 per bushel?

LESSON LXIV

SPRAYING FOR SCALES

During this month we must spray our peach and apple trees to rid them of San Jose and other scale insects, or to insure against them should there be none present. The reason for doing this work in March is because the insecticides we must use against the scale would be injurious to the foliage of the trees.

San Jose scale.—The San Jose scale is one of the most dreaded enemies of the fruit trees. In most states it is an illegal act to sell fruit trees infested with it. This insect is very minute, yet it spreads rapidly and soon covers the branches of the trees with a grayish scale, beneath which is the living pest, sucking the life from the tree. Probably the best thing to do when one finds that the scale has almost completely covered his fruit trees, is promptly to cut down and burn the trees that are in a dying condition. If taken in time there are several insecticides that may be successfully used. There are a number of reliable firms that put up ready



Courtesy of W. E. Rumsey

FIG. 61. A. OYSTER SHELL SCALE. B. SCURFY SCALE. C. SAN JOSE SCALE

mixed preparations, such as the lime-sulphur solutions, whale-oil soaps, and the miscible oils, and where only a few trees are to be sprayed, it is best to buy the ready-made mixtures. Full and easily followed directions for use accompany the materials.

Lime-sulphur.—If one wishes to prepare his own spray material, the best insecticide for scale when the plant is in the dormant season is the lime-sulphur wash, prepared as follows:

Lime	8 pounds.
Sulphur	16 pounds.
Water	10 gallons.

Boil together for about forty minutes, then dilute one gallon of the mixture with ten of water. The solution is now ready for the spray pump.

Practical Exercises

1. Spraying for Scale

It may not seem possible for the school to do the practical work suggested in this exercise, but every effort should be made to make it possible.

If any farmer in the neighborhood has a spray pump, ask him to loan it for use at the school. He may have a gallon of ready-mixed lime-sulphur solution which he would let you have. Dilute the gallon to about ten or twelve gallons with water, place in the spray pump, and spray a few trees in the vicinity of the school. Make a notebook record of this lesson.

2. Spraying House-plants against Lice

The following mixture is often used for scale and plant lice when the foliage is on the trees, or it may be used to rid house plants of the plant lice or scale:

Hard soap	1 oz.
Water	1 pt.
Kerosene	2 pts.

Shave the soap into the water and heat almost to boiling. Remove the soap solution from the fire, and add the kerosene. Stir the mixture into a creamy consistency. Now dilute this mixture with two gallons of water, and it is ready to apply to the foliage. This mixture is called kerosene emulsion.

Both the lime-sulphur and the kerosene emulsion destroy the sucking insects by corroding their bodies and stopping up their breathing pores.

Problems

1. Fifty gallons of properly diluted lime-sulphur solution will spray about twenty young fruit trees. The material for a fifty-gallon barrel will cost about $1. How much will it cost to spray 100 trees?

2. What are the proportions necessary to make up a barrel of kerosene emulsion, using the same as suggested in the second exercise given above?

3. How much will it cost to spray the five acres of orchard on our forty-acre farm, counting one acre in peach trees and four acres in apple trees? The apple trees are ten years old, and the peach trees seven years old. Determine the number of trees of each that should occupy the ground.

Reference: Farmers' Bulletin, No. 127.

LESSON LXV

PRUNING FRUIT TREES

Time to prune.—Before the buds of the trees begin to swell and the leaves to appear we must prune our vines and fruit trees. Perhaps there are old trees that should be renewed, young trees that have dead or crowded limbs to be removed, or mild prunings to be made on very young trees and vines. Proper pruning requires much skill and study, and each tree is a separate problem in pruning.

Reasons for pruning.—We prune for the following reasons:

1. To modify the vigor of the tree.
2. To produce larger and better fruit.
3. To keep the tree within manageable shape and limits.
4. To remove superfluous or injured parts.
5. To facilitate spraying and harvesting.
6. To facilitate tillage.
7. To produce new wood growth.

Mild pruning every year tends to maintain the balance of the tree, aids the fruit grower more easily and surely to shape the tree to his ideal, and makes the tree more fruitful.

Pruning young trees.—In pruning very young trees, that is, one- and two-year-old stock just set out, two methods are usually pursued:

First, the method of cutting off all the side branches to one or two buds, leaving a straight central stem which is headed back severely. This method is used especially in pruning young peach trees.

Second, the method of cutting away all of the branches but one leader and three or four main side branches, cut back to four or five buds, left to furnish the bases of the lower spreading limbs. This method is used with two-year-old apple trees in starting the first main branches.

It is best to leave the branches growing rather low down on the trunk of the young tree in order to afford shade for the trunk and ground beneath, and to facilitate the spraying and the gathering of the fruit. Fruit trees are not grown for lumber, but for fruit, and peaches and apples will not grow on the trunks of trees.

Renewing old orchards.—It is a fascinating pleasure to buy and set out young trees, and to look forward to the time when they will repay us for the long wait and careful tending. But there is that long interim between the planting and the harvesting which we must expect. Perhaps while we are waiting for the young trees, we are forgetting the old orchard that stands neglected, though still trying to renew its life with the coming of every season. Let us turn to these old trees with the same skill and labor that we are bestowing on our young trees, and they will repay a hundredfold, yielding us an abundance of fine fruit before our young trees have learned to blossom.

The tops of the trees are old and high, and from their unexplored and unsprayed heights, only a few wormy apples drop prematurely. Cut away one-third or one-half of this top, and the new life of the tree will manifest itself in a vigorous growth of water sprouts, lower down on the tree. These should then be cut away the next year, except a few which should be pruned and left to form new branches. All cut surfaces should be painted with white or red lead to prevent decay.

The dead and dying branches, which are always found in old trees, should be removed, and all such branches should be cut close to the main stem from which they branch. The dead branches are a menace to the rest of the orchard, for in them live and breed the insect and fungous pests.

FIG. 62. YOUNG APPLE TREE PROPERLY PRUNED FOR SETTING OUT

Perhaps in our old trees there are bad forks. These should be bolted together. Perhaps there are great rotten cavities. These should be cleaned out, washed with copper sulphate solution, and filled with cement. The rough bark should be scraped off, and the trunk of the tree washed with lime or soap suds. The trees should then be sprayed for scale, as suggested in the last lesson, and when the blossoms fall next month, the trees should be sprayed for codling moth, as will be explained in a later lesson. If the soil in our old orchard is poor and has not been cultivated for many years, a top-dressing of stable manure and lime worked into the soil will help to renew it, and bring the old trees into new fruitfulness.

Practical Exercises

1. Pruning a Young Apple Tree

Bring to the schoolroom young nursery stock—apples and peach trees, one and two years old. Select a good specimen of apple tree that has grown several side branches and a strong leader. Prune back the side branches to four or five buds, leaving an outside bud just below the cut surface on each pruned branch. Head back the leader to six or seven buds. The little tree is now ready to enter its season of growth.

Next March the portion of the tree left as a leader the year before would have to be pruned as the little tree was at first, and so on until a scaffold of strong, stocky branches were formed low down on the trunk of the tree. See figure 62.

2. Pruning an Old Apple Tree

Go to an old orchard where the trees have been neglected and have grown tall and unshapely. First cut out all dead and dying branches. Remove all limbs that cross each other and rub together, or that grow toward the center of the tree. Cut all the top branches down at least one-third or one-half of the crown of the tree. Always notice to cut a large limb off just above a branch that is to be left, in order that the leaves on this branch may help to heal the wound. Cover all wounds with paint. Be careful in sawing large limbs that they do not split down as they fall. Saw an inch or two into the limb on the under side and back of the cut which removes the limb. All limbs removed should be cut close to the main branches from which they are taken in order that the wound may heal properly. Experience has shown that this is the best way to renew the old trees. Within three years after such severe treatment, if properly followed up with careful pruning of the water sprouts, the tree will bear large quantities of fruit on a newly formed tree-top. (See cut below.)

Reference: Farmers' Bulletin No. 181.

FIG. 62*a*. OLD APPLE TREES PRUNED

APRIL

On the farm.—During this month we shall be very busy on the farm. There is spring plowing to do, garden to make, trees and shrubs to plant, fruit trees to propagate and spray, and corn to plant.

LESSON LXVI

GRAFTING FRUIT TREES

In the early April when the sap begins to flow in the fruit trees, we shall propagate some new varieties of apples in the tops of the older trees. By a process known as grafting, we can force trees to produce different varieties of fruits. There are two common methods of grafting—the tongue or whip graft, and the cleft graft.

Practical Exercises

1. The Tongue Graft

If the class cannot go to an orchard for this lesson, bring several branches of apple tree into the schoolroom. Choose a stock upon which you intend to graft the desired variety. Then select from the variety desired a twig that is about the thickness of the young tree at the point where you wish to graft. Be careful to select the shoot or scion from a healthy part of the tree. Cut the scion and stock as you would the mouth parts of a boy's whistle, then make a vertical slit across the cut surface. Join the cut end of the scion to the cut end of the stock and wrap with raffia or waxed cord. When you join them, notice that under the bark of each is a thin layer of soft, juicy tissue. This is called the *cambium*. To make a successful graft, the

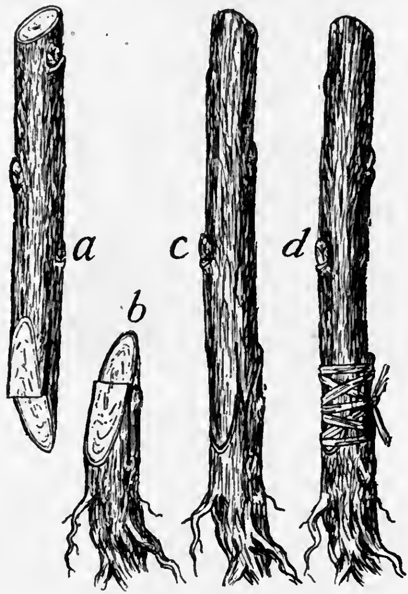


FIG. 63. WHIP GRAFTING
a, Scion; b, stock; c, united; d, tied.

cambium in the scion must exactly join the cambium in the stock.

2. The Cleft Graft

For the grafting of larger scions or for the grafting of scions of various kinds of apple trees upon the branches of one stock, the cleft graft method is used.

The stock is cut square across, and the scions, either one or two, are cut into wedges at the end, and slipped into a cleft of the stock. The cambium of the scions must come in contact with the cambium of the stock, as in the former method. After the scions are forced

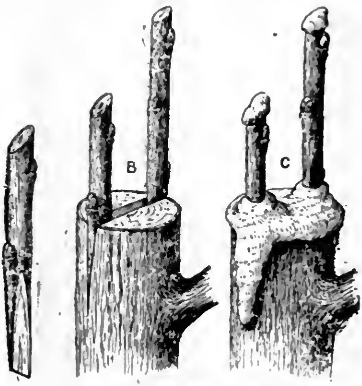


FIG. 64. CLEFT GRAFTING
Prepared scion; b, scions in place; c, graft waxed over.

into the cleft of the stock, the whole exposed surface, and the cleft left open, should be covered with the grafting wax. (See figure.) (1 part tallow, 2 parts beeswax, and 4 parts resin.)

Trees may be budded or grafted upon one another only when they are nearly related. There are some rare exceptions to this rule.

Have pupils write a description of these methods and make drawings of the grafts. Each pupil in the class should make these grafts for himself, and if possible, the work should be done in the orchard.

References: Farmers' Bulletins, Nos. 113, 161, 154, and 157.

LESSON LXVII

PLANT PROPAGATION FROM CUTTINGS

Purposes of plant propagation.—The purpose of all plant propagation is to obtain more individual plants or newer strains of plants; to perpetuate a particular variety; or to renew the generation and keep the stock from dying out. Most farm crops and garden vege-

FIG. 65. STEM CUTTING, OR SLIP, OF COLEUS

tables reproduce the varieties wanted from seeds; but most fruit trees and shrubs do not, and in such cases the plants have to be reproduced by buds, grafts, layers, or cuttings. We have already learned how plants propagate by seeds, and how fruit trees may be made over to the desired varieties by grafting. There remains another common method of plant propagation to study, known as *cuttings*. Cuttings may be made from soft or unripe wood, or from hard and fully matured wood. Of the soft kinds are cuttings (or slips) of geraniums, fuchsias, and the like. Of the hard kinds are cuttings of grapes and currants.

Soft cuttings.—Soft cuttings are made of shoots which are sufficiently mature to snap when bent double. They are composed of from one to three joints of the plant. The leaves of cuttings are removed from the

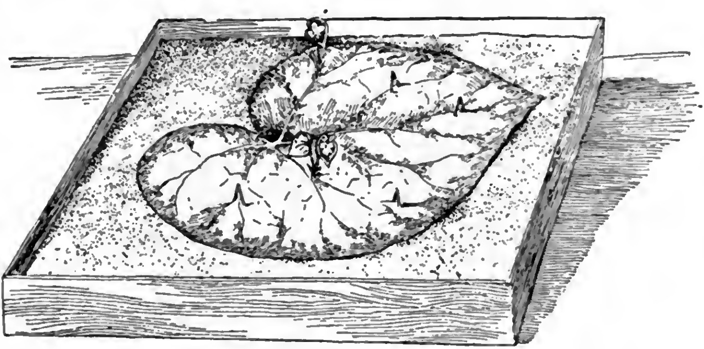


FIG. 66. LEAF CUTTING—WHOLE LEAF

lower end, and if the upper leaves are large, they should be cut in two to prevent too rapid drying out. Sandy soil free from vegetable matter is best for soft cuttings.

Hardwood cuttings.—Hardwood cuttings are usually taken in the fall or winter. They are composed of two or more buds. If these cuttings are taken in the fall, they are buried in sand to be kept until spring, when they are set in the ground up to the top bud. However, such cuttings may be taken and placed during this month.

Practical Exercises

1. Soft Cuttings

Provide a neat painted window-box; fill it with moist sand and keep in a warm place. Bring stem cuttings of geraniums, coleuses, fuchsias, begonias, or other house plants, which may be obtained from home, insert the slips into the moist sand, and firm the sand well about the cuttings. Remove all but two or three of the leaves. Keep the sand warm and moist, and watch the growth from day to day.

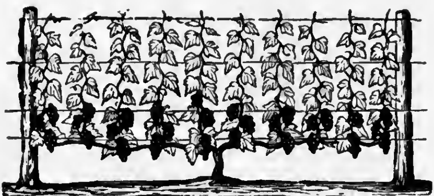


FIG. 67. GRAPEVINE WELL TRELLISED

The leaves of the Rex begonia and wax plant may be propagated by inserting the edge of the leaf or even a piece of the leaf in sand and supplying it with plenty of moisture and warmth. A leaf may be laid flat, right side up, on the surface of the sand and fastened down at intervals by splinters through the veins. Plants will spring up at the bottom edges of the leaf or at cut places in the veins.

2. Hardwood Cuttings

Select a dozen or more freshly made cuttings of grape vines, taken from the previous year's growth. The cuttings should consist of three or four buds. Spade up and thoroughly pulverize the soil in some warm rich corner of the school grounds, making a plot about three feet square. Insert the grape cuttings in a slanting position in the fine, loose soil, leaving one bud exposed. Press the soil very firmly about the cuttings, and cover the plot with a mulch of hay or grass, except the exposed buds of the cuttings. If the plot could be kept well watered all summer, and free from weeds, a fine lot of new grape plants would grow, ready to be set permanently the next spring.

Poplar and willow trees may easily be propagated from hardwood cuttings.

References: Farmers' Bulletins, Nos. 157 and 218.

LESSON LXVIII

PROPAGATION OF RASPBERRIES

Layering.—The black raspberry illustrates a method of plant propagation, known as layering. A layer is a shoot or root, which while still attached to the plant, is made to take root with the intention that it shall be severed and form an independent plant. In the case of the black raspberry, the tip of the stem or the whole stem is bent to the ground and covered with earth. At the tip or the joints, as the case may be, roots are emitted. The layers are usually allowed to remain one season before they are severed and set out as new plants. Almost any plant having shoots which can be bent to the ground can be propagated by layers; but the best result in layering is obtained in plants which have rather soft wood.

Practical Exercises

1. Field Practice in Layering

Go to some neighboring garden or berry patch and find black raspberry plants that have bent over during the previous summer and taken root at the tips. Pull up one of the tips and note the beginning of a new root system. See if you can find where a new stem has already begun to grow from a tip layer. Cut off the stem that has bent over, about six or eight inches above where the tip has rooted. Dig up the roots at the tip,

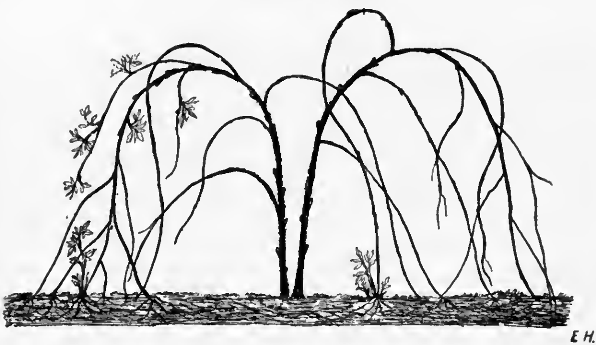


FIG. 68. RASPBERRY LAYERING

and you have a little raspberry plant that is ready to be transplanted. Make some tip layers by bending down other stems and covering the tips with earth. To prune the raspberry vines, cut away the last year's bearing canes. Cut back the present year's growth to about three feet during the month of July.

Notice that the red raspberry does not bend over and root at the tip as the black raspberry does, but that new stalks spring up at intervals from the root underground. The red raspberry thus spreads rapidly and if left to itself will spend its energy in growing canes rather than producing berries. This can be prevented by cutting off all the new shoots but two or three for the next year's growth.

Make a notebook record of all these observations, and write a paragraph describing the difference between the methods of propagation of the black and red raspberries.

LESSON LXIX

SCHOOL GARDENING

Awakened interest in school gardens.—It may be of interest to the boys and girls who read this lesson to learn something about the value, the development, and the nature of school garden work in this country. It has been a common practice in several European countries for fully a century to conduct gardens in connection with the work of the public schools, and the idea of making gardening a part of the school work is rapidly growing in favor in our own country.

In gardening, two practical lessons in agriculture are taught first hand: first, the thorough preparation of the seed bed; and, second, the results of good cultivation in providing the surface mulch and in killing the weeds.

Essentials of gardening.—The ground for the garden should be of a warm, rich, sandy loam, and be well under-drained. In preparing the ground for planting, great care and patience should be exercised in enriching it and thoroughly pulverizing the top soil. The seeds should be pure and healthy, and not planted too deep, and the surface of the soil should not be allowed to become too dry while the seeds are germinating. These are fundamental requirements in all gardening.

Practical Exercises

1. Selecting and Preparing the Garden

The size and shape of the school garden will, of course, depend upon the amount of land available. The school garden should not encroach upon the playgrounds. If the school lot is too small, perhaps a farmer whose land

Fig. 69. School Garden

adjoins would be willing to give or rent a plot for school garden purposes. If the teacher and pupils are willing to have a school garden, there need be no trouble to find land enough for it. If the school is in session this month, a school garden should by all means be begun.

If it is not feasible to have a large garden with individual or group plots, select a corner of the school grounds, on which to make a sample garden plot, as a demonstration lesson from which the pupils may learn how to make similar garden plots at home. Select a space with rich soil, about four feet wide by sixteen feet long, and thoroughly clean away all weeds and trash from this plot.

Spade up the ground as deeply as possible. About a pound of commercial fertilizer may now be sprinkled over the plot, or a few shovelfuls of well-rotted manure may be worked into the ground. Rake over the plot and break up all the clods. It is a good plan to go over the ground with the hands, crumbling the soil as fine as meal. Level the bed up slightly higher than the rest of the ground. Stake the four corners and mark off a sharp, clean-cut edge for the bed, and make a neat, clean path around it.

The garden is now ready for planting.

2. Planting the School Garden

In plenty of time before this lesson is given the teacher should take a penny collection from the pupils, and send to the Home Gardening Association, Cleveland, Ohio, for seed packages. Many of the seeds may easily be obtained at the homes of the pupils. Under the direction of the teacher, the garden plot prepared in the previous exercise should be marked off for planting. The accompanying diagram should be drawn on stiff cardboards by each pupil, before going to the garden for this exercise.

The plot, which is four feet wide, should be cross-furrowed, according to the scale shown above. Make the furrows about two inches deep. Place the seeds in the furrows, as shown by the stars in the diagram. Cover with the soil according to the size of the seeds, and press it down firmly with the hands. Now we are ready for the seeds to grow. Each pupil should now make

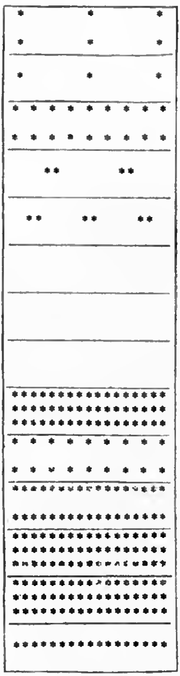


Fig. 70. Garden Plot. One-Fourth Inch Equals One Foot

a garden plot similar to this one, at his home, and report daily to the class the progress of his garden. As the garden grows, weeds must be pulled, insects watched for, and replanting done, if necessary.

The following table should be copied in the notebooks and filled out in connection with the exercises of this lesson:

Plants	When Planted	How Deep	Distance Apart	When Appear	Injuries

Free Bulletins, U. S. Dept. of Agriculture
Farmers' Bulletins.

No. 218.—The School Garden.

Extracts.

No. 113.—Experimental Gardens and Grounds.

LESSON LXX

HOME GARDENING

Importance of the garden.—What has been said about school gardens will, much of it, apply to the home garden. Every family in the country should have a garden because of the profit and satisfaction which it affords. The garden is, or should be, the best part of the farm, but it is often neglected by the farmer for other work which he thinks more important. Every dweller in town or city could very materially lessen the cost of living as well as promote the health of the family, by having a home garden. By the use of flowers and shrubs in the proper relation to the vegetable garden, the whole garden may add much to the beauty of the home grounds.

Some essentials of gardening.—1. The soil of the garden should be a warm, well-drained, sand loam. It should be well fertilized with barn manure.

2. The ground should be plowed deeply and well, so that all litter and manure will be turned under. The ground should be harrowed and raked until the top soil is fine. All sticks and trash should be removed.

Fig. 71. Type of Home Garden

3. Seeds should be pure, fresh and viable. Small seeds should be covered only slightly with finely pulverized soil. Larger seeds should be planted deeper. Full directions are usually given on seed packages.

4. Seeds should be planted on a level in rows far enough apart to allow for easy cultivation, and not up

on elevated beds to dry out more easily during the hot summer days.

5. The time of planting will depend upon the nature of the vegetable. Onions, peas, radishes, lettuce, and potatoes may be planted as early as the ground can be worked. Flower seeds, beans, cabbage, melons, tomatoes, etc., should be planted later when the ground is thoroughly warmed.

6. In transplanting tomatoes, cabbages, etc., care should be taken that the plants are set deep and are well shaded for a while from the direct sun light. On cloudy days or towards evening is the best time to do transplanting.

7. Seed beds should not be allowed to dry out on the surface during germination. After the plants have come through the ground, the soil should be frequently stirred, to provide the surface mulch, and to keep down the weeds. The plants should be thinned out where they are overcrowding each other.

8. All vegetables should be carefully watched as they begin to develop leaves, to protect them from the bugs. Professor Hatch recommends the use of Hammond's "Slug Shot," sprinkled dry on such vegetables as melons, cucumbers, cabbages, etc., to kill the insect pests appearing on these plants. The spray to use on potatoes will be described in a later lesson.

Practical Exercises

1. To Grow Early Melons or Cucumbers

Cut several turfs of sod, about six inches square, as many pieces as you mean to have hills of melon. If the grassy side is firmly matted, slightly loosen the fibers, but not enough to allow the turf to fall apart.

Place the sod, bottom side up, in a shallow box of wood or pasteboard; if the earth is not thick enough, add a few handfuls of good mealy soil. Plant about six or eight seeds in this soil. Place in a sunny window and keep warm and moist.

This will constitute the first part of the lesson, but the germinating seeds will keep up the interest in the experiment for many days. When the green seed leaves have freed themselves from the shell, notice which are the thriftiest plants, and remove all but the best two. Care for these tenderly, and they will thrive well, free from frost and the striped beetle. They may safely acquire three or four true leaves, and be five or six inches tall, before they are planted out of doors.

When the warm late May days come, dig holes about eight inches deep and six feet apart in the sunniest part of the garden; put in the bottom of each hole a spadeful of old well-rotted manure; cover this with two inches of sand or fine soil; and on this place the sod with the growing melons, so gently that they will not know they have been moved. The sod should be level with the ground, and well firmed in place. See that the plants never suffer from thirst. Keep the weeds pulled, and stir the surface soil about the hill often until the vines begin to run.

When each vine has set about a half dozen melons, pinch off all blossoms that form, and also the tips of the branches, so that all plant food may go into the melons first chosen.

2. Growing Cucumbers Intensively

Select a fertile spot and dig a hole in the ground large enough to sink a barrel midway. Knock the bottom out of the barrel, and set it in the hole in the ground. Fill the earth in about the outside of the barrel, and mound the soil up to the rim of the barrel on the outside. Now fill the barrel with manure, packed firmly, and keep it covered to prevent the house flies from breeding in it.

The bed is ready for planting. Plant five or six hills of cucumber seeds in the mound heaped up about the outside of the barrel. Put about ten seeds in a hill, and when the plants get large enough to vine, remove half of them.

Pour several pails of water into the barrel of manure each day, and the water leaching through the manure will furnish the best of fertilizer for the plants, and the necessary moisture for their thrifty growth. These few hills will furnish an abundance of cucumbers, and upon a very small space of ground.

3. Cultural Requirements for Vegetables

Learn to fill out the following table from memory, when the column of vegetables is given;

The Vegetable.	Soil Requirement.	Season Requirement.	Care Requirements.
1. Radish.	Loose, deep, cool, rich soil.	Short season crop.	Clean cultivation. Protect from maggot.
2. Beet.	Sandy loam soil, loose and rich.	Full season.	Good tillage. Weeds kept down.
3. Turnip.	Cool moist soil.	Short season.	No care after sowing.
4. Potato.	Deeply Pulverized, cool soil, rich in potash.	Early planting, full season.	Level culture, frequent tillage, spray against beetles.
5. Sweet potato.	Loose, warm soil, sandy loam.	Long season. Sunny.	Clean tillage, wood ashes fertilizer.
6. Onion.	Moist rich soil with loose surface.	Cool season. Early and late.	Good surface tilth. Good seed needed.
7. Cabbage.	Cool deep soil.	Full season.	Frequent tillage. Destroy the worm.
8. Spinach.	Cool moist soil.	Spring and Fall crop.	Grow in drills.
9. Lettuce.	Mellow, moist soil.	Short season.	Good soil preparation.
10. Celery.	Cool, rich, moist soil, well prepared.	Full season.	The best surface tillage, blanching.
11. Pea.	Light soil.	Short season.	Grown in drills. Easy culture.
12. Bean.	Light, sandy loam.	Warm season, partial.	Clean tilth. Poles for tall varieties.
13. Tomato.	Rich, "quick" soil.	Long, warm season.	Hill planting. Careful pruning and frame supports.
14. Cucumbers, Melons, etc.	Loose, rich, well prepared seedbed.	Long, warm season.	Frequent tillage until vines run. Combat melon beetles.
15. Asparagus.	Deep, rich, moist, cool soil. Fertilize often.	Full season. Perennial.	Cut in fall and top dress with manure. Cease cutting in early summer.

Free Bulletins, U. S. Dept. of Agriculture

No. 94.—The Vegetable Garden.
No. 154.—The Home Fruit Garden: Preparation and Care.
No. 156.—The Home Vineyard, with Special Reference to Northern Conditions.
No. 198.—Strawberries.
No. 213.—Raspberries.

LESSON LXXI

BEAUTIFYING HOME AND SCHOOL GROUNDS

During this month we shall plant trees, shrubs, and other ornamental plants about our home grounds. Earlier in the season, and in plenty of time for planting, we should have ordered our stock from some reliable house, and when the plants arrive, we should plant them at once. Our home grounds on the farm, as shown in Lesson I, contain about two acres. See practical exercises and problems for further plans.

Beautiful home grounds.—It does not require wealth nor rare plants to beautify the home or school grounds. With little expense, good taste, a knowledge of the above principles, and a willingness to work, the homes and schools of our country could be made more attractive and more natural. The woods are full of wild shrubs and flowers that could be growing on our home and school grounds, if we would only transplant them there. On Arbor day every school should revive the interest of the community in tree planting and other means of beautifying the home grounds. Back yards with barren ground covered with old tin cans and broken down chicken coops are not the surroundings in which boys and girls can grow up into beautiful and useful characters. Our minds are influenced by what we continually look upon, and if we must look upon ugly landscapes, we tend to grow sordid and ugly in spirit; on the other hand, if we grow up in a home and school surrounded by beautiful natural scenes, our lives must grow more refined and appreciative.

FIG. 72. BEAUTIFUL HOME GROUNDS

Principles of landscape gardening.—1. Provide an open unbroken greensward in front of the house. There is nothing more ornamental than a wealth of green grass. It furnishes the canvas upon which the landscape gardener draws his picture. It should not be daubed up with circular flower beds or other artificial things.

2. Plant trees and shrubs in masses at the background, against buildings, or on the borders of the lawn. Aim to hide by the trees and shrubs all objectionable views and to open up pleasing vistas.

3. Plant flowers at the borders of shrub masses, along the walks and buildings, but not in circular or square beds in the open lawn.

4. Avoid the straight line in tree and shrub planting in all natural designs. Group the trees and shrubs, and allow them to swing in graceful curves into the lawn and about the turns of walks.

5. Select most of the trees and shrubs from native plants that are known to be adapted to the soil and climate.

6. Follow every rule for successful tree planting known to the horticulturist. (See next lesson.)

Setting the Plants.—In preparation for planting trees and shrubs the holes should be dug at least four feet in diameter and two feet deep. If the soil is hard and poor, it should be replaced by good earth, and the tree should be mulched with coarse litter, after the earth has been firmed well about the roots of the tree. Do not use water in planting unless the soil is very dry. The cut ends of all roots should be smoothly re-cut before planting. Probably one-half of the top should be pruned from the tree or shrub in order to give balance to the roots.

Plants suggested for home and school grounds.—I. List of annual flowers: Seed to be sown after the danger of frost is over. The best results are obtained if the plants are started in the house in April and set out after the tenth of May. Aster, Cockscomb, Cosmos, Dahlia, Mignonette, Myosotis, and Salvia.

2. Annuals: Seeds to be sown early. April or early May. Ageratum, Alyssum, Amaranth, Candytuft, Carnation, Chrysanthemum, Dianthus, Larkspur, Mari-

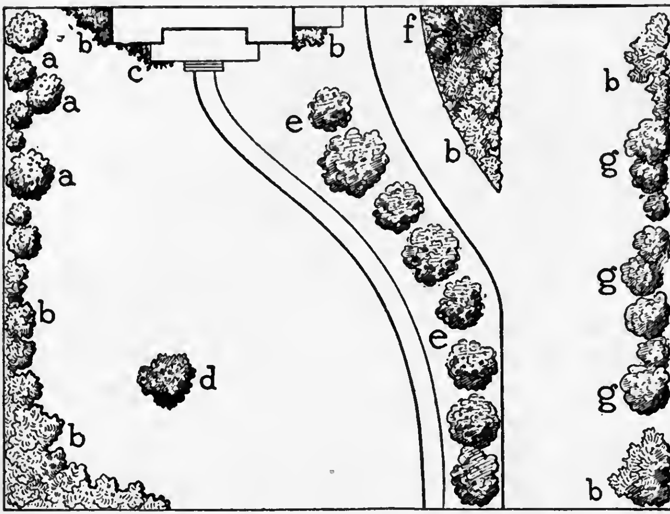


FIG. 73. SUGGESTIONS FOR A FARMYARD (PROF. WAUGH)

gold, Nasturtium, Petunia, Phlox, Poppy, Sweet Pea, Verbena, and Zinnia.

3. List of popular perennials: Plants to be grown the previous summer. Columbine, Campanula, Canna, Hollyhock, Poppy (hardy), Rudbeckia, Sunflower, Sweet William, Delphinium, and all hardy pinks.

4. List of shrubs for borders: Flowering Almond, Dwarf Cornus, Elder, Forsythia, Bush Honeysuckle,

Hydrangea, Japan Quince, Lilac in variety, Privet, Roses in variety, Snowball, Spirea, Sumac, Weigelia, Deutsia, Norway Spruce, and other evergreens.

5. List of trees for home and school grounds: Sugar Maple, Norway Maple, Box Elder, White Elm, Silver Maple, White Birch, Catalpa bungei, Tulip tree, Mulberry, White Oak, etc.

6. In planting trees about our homes and schools, we should not forget to plant a few such as the Serviceberry, Hackberry, Wild Cherry, etc., which furnish food for the song birds and attract them to our homes to add their life and cheer to the natural surroundings.

Practical Exercises

1. Planting Design for the School Grounds.

Measure the school grounds, and draw a map to a scale, locating all buildings, trees, and shrubs. Indicate in the drawing the plantings you would add to the grounds. (See diagram in the figure for suggestions.)

2. Planting Design for Home Grounds.

Draw a map of your home grounds, showing all buildings, trees, shrubs, and flower plots. Criticize the plan of the planting and suggest improvements. Make a list of all the trees, shrubs, and flowers that grow on your home grounds.

3. Beautifying the School Grounds.

Have a "cleaning up" week, during which the school yard is cleared of all trash and ugly objects. Carry this movement to the homes and enter into competition on beautifying home grounds. This work could be done in preparation for Arbor Day, and the planting of flowers, shrubs, and trees would be a fitting climax to the whole work.

Free Bulletins, U. S. Department of Agriculture
Farmers' Bulletins

No. 134.—Tree Planting on Rural School Grounds.
No. 185.—Beautifying the Home Grounds.

Extracts

No. 91.—Lawns and Lawn Making.

Problems

1. Draw a plan of the home grounds on the farm as shown in Lesson I, design the planting of trees, shrubs, and hedges, and estimate the cost of such plants as listed in the Moon Co. catalogue, Morrisville, Pa. Keep a record of the cost.

2. Estimate the cost of planting the school yard as you have designed it in the exercise above.

LESSON LXXII

FARM FORESTRY

This month we shall plow up an acre of our old farm wood lot, where the trees have all been cut away, and plant it in catalpa trees. The practical exercises given at the end of the lesson's discussion will explain the method of planting.

Importance of forests.—No other resource of the earth, except the soil, is of more importance to man than the forests. The fact is there would hardly be any soil at all if it had not been for the forests. The forests are our chief source of building material and fuel. They protect and hold the soil and water of the earth. Their presence makes our land more attractive and healthful.

Forests necessary for civilization.—Our civilization is built on wood. From the cradle to the coffin, in some shape or other, wood surrounds us as a necessity or luxury. Wood enters into the construction of nearly all our houses. It serves to ornament them, to furnish

FIG. 74. WOOD LOT AND RANGER'S CABIN

them, and to heat them. The forests furnish the plow handles and the harrow frames to cultivate our crops, the thrashing machines and mills to prepare them, the cart to bring them to market, the bottoms in which they cross the ocean, and the tar and pitch to keep the cargo safe. We are rocked in wooden cradles, play with wooden toys, sit in wooden chairs and benches, eat from wooden tables, use wooden desks, chests and trunks, are entertained by music from wooden instruments, and learn by information printed on wooden paper with black ink made from wood.

Forest influences.—Besides serving the great purpose as the source of our needed supplies, the forests exercise a great influence upon the earth and its inhabitants. Forests are often the source of streams, and here the rains and snows are allowed to sink slowly and deeply into the soil, through the leaves, roots, and mould, to run gradually into the streams through springs and underground levels, preventing excessive floods, and extremes of drought. The forests break the force of winds and temper the climate. In short, the forest is one of man's greatest blessings, and yet it is the one which he has abused with the most recklessness and ignorance. In no part of the world has this reckless waste been greater than in the United States.

The use of the forests.—It was not intended that the forests be hoarded up as a miser hoards his gold; they are to be used. But it is possible to use the forests so wisely that they may last as long as the earth stands. The destructive cutting by lumbermen, and the prevalence of forest fires have been the causes of waste in our great forest resources. Ex-President Roosevelt said that forestry is the art of saving the forests by a wise use of what they afford. Forestry teaches men how to keep the forests alive by cutting out only the trees that have got their growth, in such a way as not to injure or destroy the younger growth remaining. Young trees are given light, air, and room to grow. The forest floor of rich leaf-mould is preserved as a means of enriching the soil and holding the moisture.

The control of the forest.—Forestry also teaches the best way of replanting or "reforesting" areas in which the timber has already been destroyed. The responsibility for wisely caring for our forests may be laid upon three or four agencies—the United States Government or the state governments, the large private timber owners, and the American farmer. The Forest Service of the United States is doing a great and valuable service to the people in its wise management of millions of acres of forest reserves in the Western States; the large lumbermen of the country are doing little to save or use the forests wisely; it is to the American farmer we must turn with high hopes that he may realize that he is the most important trustee of the nation's wealth of forest resources.

The farmers' woodlot.—Every farmer who has a woodlot, and every farmer ought to have one, may practice the principles of forestry, and thus use his timber wisely. When our country was new, land had to be cleared to make room for the crops. Great trees were cut down and rolled into heaps to be burned. Wood was worth little except for fuel. Now all is changed. The price of wood is high, and is rising higher every year. The farmer who has a woodlot on his land has a valuable piece of property, and although it may not bring him much in turn in the way of money, it is almost a necessity for successful farming. The up-to-date farmer now values and cares for his woodlot. The following are some points to observe in caring for a woodlot:

1. Give all desirable young trees every advantage for growth, and cut out all undesirable ones for fuel or such use as the farmer can make of them.

2. It is injurious to a woodlot to use it as a pasture. The stock will browse on the young trees, tramp them down, and cut up the soil and forest tree roots.

3. Grass should never be allowed to get started in the woodlot.

4. Old and dead trees should be cut down and removed. All brush and old logs should be piled and burned, where fire cannot injure the young trees.

5. Where bare spots occur young trees should be encouraged to grow, either by planting seeds or seedlings.

6. It may be well to plow up sections of the old woodlot and plant seedlings of such trees as Black Locust, Catalpa, or Osage Orange. There are a few farmers in this country that have made the woodlot a profitable proposition, and have even gone so far as to set high priced corn lands to young forest trees.

Practical Exercises

1. Transplanting a Tree

Select a young tree to be transplanted. Locate the main roots by striking the spade into the ground parallel to the direction of the roots. Dig out from the tree as far as the roots extend, avoid cutting off too much of the main root system, and secure as many roots as possible in a ball of earth to be removed with them. If the tree is to be carried any distance, wrap the roots with a wet cloth or carpet. The roots must not be allowed to dry out before transplanting.

Dig the hole into which the tree is to be set, a little deeper than the one from which it came. Allow ample room for all roots. Before placing the tree, trim off neatly all injured and broken roots. Place some fine surface soil in the bottom of the hole, and with the hands work fine soil about the small roots. Fill the earth about the roots carefully, and *tramp it down well.* It is not best to use water in transplanting unless the soil is very dry, and then only a small amount. Round up the surface of the ground so that no water can stand next to the tree, and cover with a loose, fine mulch of earth. The inverted sod may be placed on top. Now the tree must be trimmed back so that the disturbed balance between root and top may be restored.

"Who does his duty
Is a question too complex for me;
But he, I venture the suggestion,
Does part of his who plants a tree."—Lowell.

2. Planting a Woodlot

Send to Ohio Valley Nursery Co., Lake, Ind., or to The Little Tree Farm Nurseries, Farmingham, Mass., for 1,000 seedlings of Catalpa Speciosa, will cost about $5. Select an acre of ground, plow it and prepare it as for a corn crop. Lay off the ground in furrows, six feet apart. Cross furrow these at right an-

Courtesy of O. J. Kern.

FIG. 75. HOW TO PLANT A TREE

FIRST

Dig a hole plenty large and deep. Do not be afraid to bend the back. Leave some pulverized earth in the bottom of the hole.

SECOND

"There gently lay the roots, and there
Sift the dark mould with kindly care,
As, round the sleeping infant's feet,
We softly fold the cradle sheet."

THIRD

After the roots are carefully covered then press the earth down solid as the hole is filled. Then the wind as it moves the tree will not disturb the roots.

FOURTH

Leave loose earth on top so moisture may soak in. Let the children plant nasturtium seed and thus cultivate the ground.

gles, the same distance apart. Plant the Catalpa seedlings at the intersection of the furrows. These little trees will be six feet apart and there will be about 1,000 trees on the acre. The trees must be cultivated three or four times during May and June. In July sow to cowpeas, vetch, or clover to serve as a winter cover crop. Keep up this system of cultivation and cover cropping for three or four seasons, or until the trees shade the entire ground beneath them. They will probably need some pruning to keep the stems straight and from forking too badly. If the wind blows any trees over or they persist in growing crooked, cut the trees off at the ground and new, strong, straight trees will grow from the roots.

For a school exercise any smaller area planted in this manner will serve. The author strongly recommends the use of this exercise in the rural schools.

Draw a plot of the ground and show the position of the trees.

NOTE.—Black Locust, White Willow, Osage Orange, and Yellow Poplar are good woodlot trees to plant and they yield quick returns.

3. An Excursion to the Woods

Let the class and teacher take a walk to the woods. Make notes of your observations on the following points:

1. The comparative temperature within and without the woods.

2. The rich humus soil of the forest floor, and how the roots and leaf mould hold the moisture and prevent washing. Point out examples of washes where

the forest has been cut away, and explain how the soil is carried to the streams, and its effects upon them.

3. Find trees of virgin growth and also the second growth. Note any dangerous firetraps.

4. If a freshly cut stump or log can be found,

Fig. 76. Catalpa Grove Three Years Old

count the rings of growth and determine the age of the tree.

5. Make a few estimations of the diameter and heights of the largest trees. Pupils might calculate the number of cubic feet of timber in a large tree, and by squaring the diameter in inches, minus four, it becomes board measure in a sixteen-foot log.

6. Make a list in the notebook of the names of all the trees you can.

7. Point out the ironwood, blue-beech, hazel, scrub oaks, and other useless "tree weeds" that should be removed in improvement cuttings.

By referring to Roth's First Book of Forestry, or to Pinchot's Primer of Forestry, many valuable lessons may be continued in this work.

Problems

1. At $6 per cord, what is the value of a pile of wood 240 feet long, six feet high and four feet wide?

2. A farmer gets six cords of wood from ten trees. With wood at $5.50 per cord, what is the value of these trees?

3. What is the value of a single tree at the same rate?

4. Suppose there are fifty such trees on an acre, what is the value of the wood on this piece of land?

5. What is the value of a woodlot of fifteen acres at the same rate?

6. Suppose a farmer removes the five biggest trees per acre from his woodlot each year. If each tree makes three-fourths of a cord of wood, worth $6 per cord, and it costs 80 cents per cord for cutting, what profit does he make per acre on his woodlot?

7. Compare this with the profit on an acre of oats.

8. Compare it with the profit on an acre of corn.

9. What will the profit on a twelve-acre woodlot be at the same rate?

10. If a Catalpa wood-lot contains 1,000 ten-year-old trees per acre, and each tree would make two fence posts, what would the trees on five acres be worth at 30c a post?

Free Bulletins, U. S. Dept. of Agriculture

Farmers' Bulletins

No. 54.—Some Common Birds in Their Relation to Agriculture.
No. 150.—Clearing New Land.
No. 173.—A Primer of Forestry.

LESSON LXXIII

SPRAYING FOR CODLING MOTH AND FUNGOUS DISEASES

Time to spray.—It is late in April and the apple blossoms have just fallen from the trees. We know now that the codling moth larva or "apple worm" will soon be eating its way into the blossom end of the apples, and we know, too, that unless we do something to check its ravages, our fruit will fall or be wormy and worthless. Fortunately we do not have to give up to the codling moth, for we may spray our trees, kill the moth, and save the apples.

Lime-sulphur and lead arsenate.—If any farmer in the neighborhood has a spray pump, he no doubt would be willing to loan it to the school for this lesson. The school should own some good spray pump, such as the Gould's Pomona, and use it for demonstration purposes in the orchards of the district. The spray material usually used is the combined lime-sulphur mixture and lead arsenate. The lime-sulphur checks the spreads of such diseases as apple scab, "frog eye" fungus, brown rots, etc., and the lead arsenate kills the "apple worm," leaf-eating caterpillars, and other chewing insects. Ready prepared lime-sulphur solutions may be purchased from reliable firms for between 10 and 20 cents a gallon, and a gallon and one-half diluted to about

FIG. 77. SPRAYING A FRUIT TREE

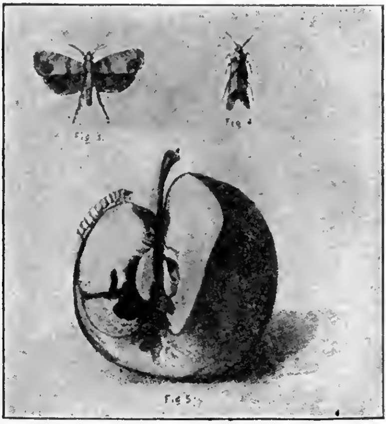
fifty gallons with water, will spray about ten average sized bearing apple trees. To this mixture should be added about three pounds of lead arsenate, to be used against the codling moth. (See Lesson 12 for making of Bordeaux Mixture.)

Practical Exercises

1. Preparing and Using the Lime-sulphur Lead-arsenate Mixture

If one wishes to prepare his own material, see Lesson 64. The stock solution is diluted and used as described above.

Force the spray thoroughly and completely onto



Courtesy of B. F. Johnson Pub. Co.

FIG. 78. THE CODLING MOTH

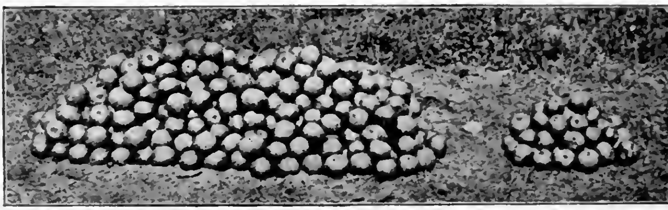
every leaf, twig, stem, and fruit of the tree. When the codling moth larva hatches from the eggs which have been laid on the leaves and the apples, and begins to crawl toward the apples, it may nibble at some of the poisoned leaves, but it is sure to get its last meal as it attempts to eat into the blossom end of the fruit.

If this operation of spraying is repeated in about three or four weeks after the blossoms fall, and then in mid-summer to combat the second brood, the trees and fruit will be saved from the moth and from the fungous diseases, and the apple trees may yield a hundredfold.

Applications to the State Experiment Station should be made for the latest spray calendars.

This exercise should by all means be carried out in the public schools.

Reference: Farmers' Bulletin, No. 243.



Courtesy of B. F. Johnson Pub. Co.

FIG. 79. APPLES FROM SPRAYED AND UNSPRAYED BRANCHES

Problems

1. Our farm orchard contains four acres of apple trees. How much will it cost to spray the orchard with the lime-sulphur and lead arsenate? Lime-sulphur at 20 cents a gallon, and lead arsenate at 15 cents a pound.

2. The Bordeaux-lead-arsenate mixture, ready prepared will cost $1 per gallon. This will make up fifty gallons of spray material. How much could we save by making our own mixture, if lime is 1 cent per pound, and copper sulphate 10 cents per pound? (See Lesson 12.)

3. Which is cheaper, *lime-sulphur* or *Bordeaux?*

LESSON LXXIV

PLANTING CORN

Preparation of seed bed.—Having selected our seed corn, and tested it for germination, the next step we must take in corn culture is to prepare the soil to receive the seed. A rich humus soil, loose, warm, and moist, will produce a better crop of corn than any other. If the field has been fall-plowed, it should now

Courtesy of Farm and Fireside.

FIG. 80. JERRY MOORE AND HIS 228¾ BU. OF CORN RAISED ON ONE ACRE

be double-disked and harrowed in preparation for the planting. In many cases corn follows corn, and the plowing must be done in the spring. In this case a disking before plowing will cut up the stalks and provide a fine layer which will fall into the bottom of the furrow, and help to restore capillarity. In soils that are liable to bake, each day's plowing should be harrowed as soon as possible. A little extra work at this time may prevent the formation of clods, and save ten times as much trouble in trying to pulverize them later. Three or four additional harrowings will usually put the ground into first class shape for planting. In our farm plan, as shown in Lesson I, we shall plant field number 1 to corn. This has been in clover for two years, and by deep plowing, rolling, and through harrowing we shall have a most excellent seed bed for our corn.

Planting the seed.—It is better to check than to drill when growing corn for grain, as it can be kept cleaner, with a resulting larger yield. For fodder or silage, drilled corn gives more tons of dry matter per acre and is more easily handled by the corn binder. In some of the states west of the Missouri River, where the soil is light and rainfall scanty, listing gives the best results.

The number of kernels to use per hill depends upon the richness of the soil. On the average corn belt soils three kernels per hill will give the best results. Very rich soils can support four, while on poor soils two are enough. It pays both in appearance and in ease of cultivating to drive straight while planting and to have the rows check straight crosswise.

Early cultivation.—As many harrowings as possible should be given the corn between planting time and the time it comes up. If heavy rains have packed the soil or if it is badly infested with weeds, it will pay to follow the planter marks with the cultivator before harrowing.

Practical Exercises

1. Entering a Corn Contest

Write to the Extension Department of your State College of Agriculture and ask to enter the boys' corn contest of the county or state. If a contest is on, and there will be one planned in almost every state in the union, you will be told where to get your seed corn, and how to plant and cultivate it for the corn show and contest.

If the teacher and pupils wish to work out a corn contest of their own, each pupil should be provided with one pint of high grade seed corn. Select a strip in your father's field, enough to plant two rows 3½ feet apart and 37 1-3 rods long—this will be a tenth acre plot. Select and test the seed corn as described in former lessons. Prepare the ground as described above. Plant the corn in hills, about three kernels to a hill, and each hill about four feet apart. Cultivate at least once a week (if the ground is dry enough) from the time the corn is big enough until it begins to tassel. (See Lesson 32.) From your plot you may gather the ears which will win the prize.

Such a contest should be arranged for and carried out by the Boys' Club of the school. (See Farmers' Bulletin, No. 385.)

2. Starting the Ear-to-row Plot for Raising Seed Corn

Place one hundred of the best ears of corn you can find on a table before you. Select from this lot twenty-five of the best ears, and number them from one to twenty-five. On the test plot of the farm (see Lesson I), prepare the ground thoroughly for planting as described above. Lay off twenty-five rows, and number each row from 1 to 25. Plant about half of ear number 1 in row number 1. Plant one-half of ear number 2 in row number 2, and so on to number 25. Give all the rows equal and thorough cultivation. At husking time we can judge which row has yielded most, which has the best corn in it, and so on for other desired points. By saving the seed from the best rows for our ear row test next year, we can soon breed up by selection an improved strain of corn.

Problems

1. How long will it take to plow a ten-acre field in preparation for corn planting? How long to harrow it? If the work were hired done how much would it cost at the usual price of labor?

2. How much seed corn will be needed to plant the ten acres if the corn is drilled? How much if checked with a planter?

3. What will it cost to hire all the labor and to buy the seed corn?

4. If the yield of corn were increased five bushels to the acre in your state, how much wealth would be added to the state by the increase? (See the Year Book of 1909.)

References: Farmers' Bulletins, Nos. 81, 229, 409, 281, and 385.

MAY

On the farm.—May is the month of planting, transplanting, and cultivation. The corn is to be cultivated constantly; potatoes, cucumbers, melons, beans, etc., are to be planted; tomatoes, cabbage, sweet potatoes, and celery are to be transplanted; and continual warfare against weeds and insects must be waged.

LESSON LXXV

CULTIVATION OF CORN

The proper time to begin the cultivation of corn is before it is planted. As was said in the previous lesson, the ground should be plowed deeply, the surface harrowed mellow and fine, and the corn planted in hills or in drilled rows.

Methods of cultivation.—As soon as the rows can be followed the cultivator should be started. If any deep cultivation is to be given it should be the first two times over, before the soil is filled with corn roots. After the corn is six or eight inches high some form of surface cultivator that will not disturb the soil to a depth of more than two or three inches should be used. In the western part of the corn belt, where the fields are large, the two row cultivator is becoming popular. If the corn is very straight both ways these cultivators work well after the first time over and enable one man to handle at least half as much more land.

The cultivator.—The problem of cultivating a cornfield several hundred acres in extent, such as is found in many of the great corn growing regions of the prairie states, has been greatly simplified since the two row cultivator came into use. With the perfect working corn planters now in the market the row of corn may be made so straight that the two row cultivator can be used without difficulty. This has brought about a facility of cultivation which has added largely to the yield in many parts of the country. Before the coming of the double row cultivator there was danger that much of the land of the western portion of the belt would become too weedy for corn culture.

Reasons for cultivation.—Corn is a crop that needs constant cultivation, and during the growing season should be cultivated at least four times. This cultivation is for three reasons:

1. To destroy weeds that use up the plant food and water.

2. To provide a soil mulch to prevent evaporation.

3. Because tillage is a fertilizer. Constant stirring of the soil allows the air to circulate through it, and provides available plant food.

Corn is king.—Corn is king of the cereals, and the most important crop of American agriculture. It is the backbone of farming in this country. The white man learned the value of this cereal from the Indians, and since then its culture has kept pace with the wonderful growth of our country.

Boys' corn clubs.—The following story, told by one of Dr. S. A. Knapp's agents in connection with the Boys' Corn Club movement illustrates how the boys are learning to follow scientific methods in corn culture:

"One boy in our club was very anxious to work an acre in corn. His father gave him one on condition that he dig out the pine stumps and pay all expenses. After the boy had gotten out nearly all the stumps in

FIG. 82. GROWTH OF CORN ROOTS

the field, the father took that acre and gave him another, upon the same condition. The boy went to work, cleaned this new field and plowed it. Then I advised him to plow it again. When the boy wanted some fertilizer his father refused to permit him to buy till I went security and promised to make good all losses, if any. The boy's corn was measured this week and made eighty-four bushels to the acre. His father's corn, on three sides of the boy's, made nine bushels per acre. When the corn was weighed and the father's went to the pigs and the son's sold for seed corn at two dollars per bushel, the father changed front."

References: Farmers' Bulletins, Nos. 199, 229, 385, 281, and 81.

Practical Exercises

1. The Stand of Corn

Select a field of corn near the school and secure the owner's permission to visit it. Invite the owner to go with you. Let each pupil begin with the first hill of corn in a row and count to the hundredth hill. If the corn has been checked and it was intended that there should be three stalks to the hill, there would be in a perfect stand 300 stalks. Now count back and find the number of stalks in the 100 hills. If there are but 150, the stand is 50 per cent. Each pupil should determine the percentage of the stand in the row he has counted. Each pupil should find out as nearly as possible the average stand of corn on the home farm and report to the class for the next lesson. It will be interesting to parents, and in many cases a surprise to them, to find that they have less than a 50 per cent stand when they thought it 80 per cent. In all cases discuss the reasons for the good or bad stand. It is clear that the farmer does not wish to lose his time and labor on vacant hills, when he might just as well have a liberal harvest from them.

2. Corn Roots in Cultivation

Go to a corn field where cultivation is in progress. Examine the soil, the method and depth of cultivation. Note the stand, health, and general condition of the crop.

Carefully remove a few stalks of corn—roots and all—and take them to the schoolroom to study as follows:

Carefully wash the soil from the young roots, and spread them out upon a sheet of paper. Get a root

FIG. 83. OHIO CORN FIELD IN SHOCK

from the mature plants and have it before you for comparison.

Note the following points of the corn root, and tabulate your answer below:

1. Length and number of principal roots.
2. Amount of branching from any one root.
3. Direction in which the roots extend from the base of the plant.
4. Amount of cubical space used as feeding ground.
5. How near the surface do the roots lie?

6. Difference between spur roots and the others. State reasons.

7. Can you find root-cap and root-hairs?

8. Does your observation lead you to any conclusions about the cultivation of corn? Explain.

9. Make a drawing of the corn root system.

LESSON LXXVI

TILLING THE SOIL

Tillage.—Since May is especially the month of soil cultivation, it seems best to study further into the essentials of tillage. Tillage is next to, if not equal to, fertilization of the soil. It includes the preparation, the planting, and the cultivation of the land.

Value of tillage.—As we have learned, the plant is fed by the roots, penetrating into the soil, gathering up the dissolved food and passing it on to the plant. If the soil is coarse and lumpy these feeding roots cannot get at the food held in the lumps, but must feed from their surface. Tillage breaks up these lumps, pulverizes them and allows the roots to get at the food they contain. Stirring the soil also allows the water to dissolve the plant food more readily.

Depth of plowing.—Deep plowing in most cases is best. It brings to the surface plant foods not reached by shallow cultivation, and it pulverizes the soil so that roots can enter the ground to a greater depth and have more soil to feed from. This is especially true for such root crops as beets, parsnips, etc., and for tubers like the potato. In fact, deep plowing serves the same valuable purpose for all plants, not only in giving more and better root feeding space, but in catching and holding more of the rainfall. We have already learned that water exists in the soil both as underground water and

Fig. 84. Deep Plowing

as capillary water, and that the water which supplies the roots of the plants is the capillary water drawn up from the underground water below. Now unless the ground is deeply plowed, there is less rainfall caught to supply this underground water, and hence less to supply by capillarity to the plant roots.

Surface cultivation.—If the deep plowing catches and holds larger quantities of rainfall than no plowing or shallow plowing, it becomes the part of good tillage to save as much of this ground water as possible by preventing its evaporation from the surface. We know that if we cover a vessel of water it keeps the sun from drying it up. In the same way a cover spread over the soil will check the evaporation of the capillary water. The simplest way to get this cover spread over the soil is to cultivate it. The layer of cultivated soil dries out rapidly, but it keeps the air from getting at the moist soil underneath and drying it out, and it also breaks the rise of capillary water and prevents its coming to the surface. The surface cultivation should be shallow to prevent injury to the plant roots, and it should be frequent to provide the dust mulch.

Constant cultivation.—When the writer was a boy, living in the corn belt of Illinois, it used to seem a terrible hardship when the father announced, after just finishing the cultivation of a large field of corn, that we must now go back to the beginning and go over it all again. Fishing and swimming never seemed more inviting to the boy, but the father knew what was best for the corn. He knew that constant cultivation was the price to pay for a good crop. He paid the price and got the reward.

Summary.—To summarize, we may give four chief reasons for tillage: (1) To pulverize the soil, so that plant roots can easily penetrate in every direction and get at the store of plant food the soil contains. (2) To increase the water-holding capacity of the soil. (3) To aerate the soil and thus sweeten and warm it. (4) To destroy weeds and form a soil mulch which will prevent rapid evaporation from the surface.

Practical Exercises

1. Field Studies of Tillage

Go to a field where plowing or cultivation is being done. Make notes of your observations as follows:

Depth of Plowing	Condition of Soil	Method of Cultivation	Moisture Condition

Free Bulletins, U. S. Dept. of Agriculture

No. 306.—Some Soil Problems for Practical Farmers.

Problems

1. How many square feet in one square yard? In one acre?

2. If soil is cultivated to the depth of four inches, how many cubic feet of cultivated soil per acre? How many, if cultivated to the depth of six inches? If cultivated to the depth of eight inches?

3. How much more plant food is made available with cultivation to the depth of eight inches than with a four-inch depth of cultivation?

4. How many times as much available plant food in soil cultivated to the depth of six inches as in soil cultivated only four inches deep?

5. If a man and team can plow one and a half acres six inches deep, or two acres four inches deep in a day, how much more does it cost per acre to plow land six

inches deep than to plow it only four inches deep? Labor worth \$2.40 per day.

6. If a man and team can till three acres thoroughly in a day, or five acres in a careless manner, how much more per acre does a good job cost, labor being worth \$2.40 per day?

7. How much more per acre does it cost to both plow and till well? How many additional bushels of oats worth 36 cents per bushel will it take to pay for the additional labor?

8. How much will be the gain if but forty bushels of oats can be raised with shallow plowing and careless seeding, and fifty-seven bushels with the extra work? How much will these oats be worth at 24 cents per bushel? At 30 cents per bushel? At the present price of oats?

9. A certain piece of land yields thirty-five bushels of corn per acre. By careful cultivation the farmer is able to increase this yield to sixty bushels. With corn worth 40 cents per bushel how many additional days' labor at \$1 per day will the extra yield pay for?

10. If he spends but twenty days' extra time on his twelve-acre field of corn to produce the increase in crop shown in problem 9, how much does he get per day for his extra time?

11. Suppose a farmer is able to double the average yield of 160 bushels of potatoes from an acre of land by putting fifteen days' extra time on it. What wages does he get with potatoes at 25 cents per bushel?

12. From answers to the following questions make

other problems similar to the above. What does labor cost per day? How many acres can a man plow per day? How many acres can he seed in a day? How many acres of corn can he cultivate? Will extra labor increase the yield of corn? etc., etc.

LESSON LXXVII

TRANSPLANTING

Plants transplanted.—Our plants growing in the hotbed will be ready to transplant this month. We shall transplant tomatoes, cabbage, celery, eggplant, pansies, and probably some young trees.

Principles in transplanting.—If the hotbed has been made at the school there will be plenty of material available. It is an important and practical lesson to learn. The following rules will guide to successful transplanting:

1. Transplant when the weather is cool and damp, preferably in the late afternoon.

2. Transplant when the plant is young.

3. Break the roots as little as possible in taking the young plant up, and keep them moist and shaded.

4. It is well to cut off some of the top in transplanting, in order to restore the balance between the root and top, since some of the roots were probably lost in transplanting.

5. The plant should be dipped in water and have moist fertile soil packed firmly about the roots. If water

is to be used it should be poured about the roots before all the soil is added.

6. The plant should have as large a space as that in which it originally grew. The soil should be put in first at the bottom of the hole in which the roots are to grow, and the subsoil, if any, at the surface. It is important to make the soil firm about the roots.

7. It is sometimes well to shade the young transplant a few days from the hot sunshine, or to protect the roots with a mulch of straw or grass.

The pupils in agriculture should by all means get some actual practice in transplanting, if in no other way than by going to the school yard and getting wild plants to transplant in pots or in out-door plots.

Practical Exercises

1. Transplating Garden Vegetables

If there is a window-box in the school, in which are growing seedlings of cabbage, tomato, or other vegetables to be transplanted, let each pupil transplant a few of the vegetables to the school garden. Be careful to follow the principles given in this lesson. If there is no school garden, the transplants should be taken home and set in the home garden, and reports made in school, from time to time, as to the success of the work.

2. Transplating Wild Flowers

Let each pupil find some thrifty-growing wild flower from the fields or woods, transplant it to some pot of good soil and bring to the school room. Explain the causes of its success or failure to live and grow.

In connection with this lesson, each pupil might bring some shrub or small tree from home or the woods to transplant in the school yard.

Reference: Farmers' Bulletin, No. 245.

LESSON LXXVIII

POTATOES

On our farm plan in Lesson 1, we have one acre to plant in potatoes. We are to learn something in this lesson about potato planting, potato culture, and potato pests.

Potato soil.—Light sandy soils, rich in humus, are the best soils for potatoes. Heavy clay soils interfere with the growth of the potatoes and often make them small. Soil for potatoes should be deeply plowed, and laid off in rows about three feet apart. The potatoes should be planted from four to five inches deep, and about eighteen inches apart in the rows.

Planting potatoes.—There is much difference of opinion as to the method of cutting the potatoes for planting. Excellent results have been obtained by planting the whole potato, a single one in a hill. The usual practice recommended is to cut the seed potatoes into halves or quarters, at least two eyes to a piece, using one or two pieces to a hill. The best potatoes should be used for seed and not the small discarded ones. A handful of bone meal should be dropped into the bottom of each hill and covered with an inch of soil before placing the seed.

Potato culture.—After the potatoes have been planted, and before they come up, the surface mulch should be provided, and this may be done by light harrowings. Throughout the whole period of cultivation the weeds should be kept out, the dust mulch provided, and shallow, level cultivation maintained. The old practice of ridging the potatoes serves to expose the soil to

FIG. 85. SPRAYING POTATOES

excessive evaporation, and to lessen the quality and quantity of the crop.

Potato pests.—The Colorado potato beetle is the most troublesome potato insect. It can be easily killed by spraying with three pounds of arsenate of lead mixed with fifty gallons of water, or four ounces of Paris green and a pound of lime with the same amount of water. Either poison can be added to Bordeaux mixture which is the remedy for the potato diseases. Methods of treating the potato scab will be described in the practical exercises.

Practical Exercises

1. Treating Seed Potatoes to Prevent Scab

The day before the lesson is to be given, the teacher should ask some pupils to bring about a peck of the scabbiest potatoes that can be found. The teacher should see that the other materials are provided for the lesson.

Place the potatoes in a burlap sack. Into a tub or barrel pour five gallons of water. To this add about one-sixth of a pint of formalin. This can be purchased at any drug store at 40 cents a pint. Place the sack of

FIG. 86. A GOOD POTATO A SCABBY POTATO

potatoes in the tub of formalin solution. Allow them to soak one and one-half hours.

(Experimental work of this lesson will have to end here. If there is a school garden, the work as outlined below should be continued at school; if none the teacher should fully explain the rest, and call for volunteer pupils to complete the experiment at home and report upon it.)

Remove the potatoes from the solution, and cut into pieces for planting. Cut the potato through the long way, and then divide each half. Do not put the potatoes back into the receptacle that has had in it scabby potatoes. The vessel to be used should be washed with the solution in the tub.

Plant the treated tubers in rows by themselves, and mark with stakes the rows so planted. To show the comparative results of the treatment, plant the same number of scabby potatoes, and give both equal care and cultivation throughout the season.

When the potatoes are ripe, dig the treated and untreated separately. Count the increase in the treated potatoes. A careful record of this lesson should be kept, including the cost of treatment, the price of potatoes, and the total gain from the treatment, due to the increased value of the yield.

It would be a good service to the district if pupils would bring all their scabby potatoes to the school to be treated, before planting. Any helpful co-operation between the school and the home is of incalculable value to both institutions.

Reference: Farmers' Bulletin, No.

Problems

1. If the average weight of seed potatoes is four ounces each, and if they are cut in halves and planted in rows three feet apart and eighteen inches apart in the row, how many bushels of seed will be required per acre?

2. How many bushels will be needed if whole potatoes are used? Quarters? Eighths?

3. Select seven potatoes as nearly the same size and

shape as possible, from the same hill or similar hills. Cut one potato into four pieces and plant each piece in a hill; this will make four hills. Mark these four hills "Plat No. 1." Cut the next two potatoes lengthwise into halves; plant each half in a hill and mark these four "Plat No. 2." Plant the remaining four potatoes whole, each one in a hill, and mark these "Plat No. 3." Give the same care and cultivation to each plant and, when they have matured, dig all the potatoes carefully and weigh the yield from each plat and tabulate as follows:

	Amount of Seed Planted	No. Pounds of Yield	Net Profit
Plat No. 1	4 oz.		
Plat No. 2	8 oz.		
Plat No. 3	16 oz.		

4. See problems for Lesson 12.

LESSON LXXIX

TOMATOES

Growing popularity of tomatoes.—The tomato is one of our most popular vegetables. It is widely grown as a market crop, and is used for canning to a greater extent than any other vegetable. The demand for fresh fruit the year round, especially in large cities, has made the tomato a profitable forcing-house crop, and many experiments by the stations to determine best varieties, methods of culture, etc., have been reported.

Girls' tomato growing and canning clubs.—Aiken County, South Carolina, through the leadership of Miss Samuella Cromer, started the first Girls' Tomato Club

GIRLS' TOMATO CLUB

in this country. This movement is only a little over a year old and already there are over four thousand members of the clubs. South Carolina, North Carolina, Virginia, West Virginia, Tennessee, Mississippi, and Georgia have Girls' Tomato Clubs.

The clubs are carried on in this manner: Any girl between the ages of nine and twenty years, in the county organized may become a member. She must plant one-tenth of an acre in tomatoes, and do all of the work connected with her garden, except preparing the soil for her plants. Prizes are offered for the largest yield, the best display in glass jars, best essay on her garden work, largest and most perfect tomato, neatest and best collection of tomato recipes, etc. Canning parties are held at the homes of the girls, and the whole work becomes an inspiration to the entire community.

Some requirements in tomato culture.—A clay soil is preferred by some varieties of tomatoes, and a sandy soil by others. Deep preparation and plenty of manure will make good tomatoes on almost any kind of soil. Too much manure on light soil, however, may cause the plant to run to vine. Sow the seed in the hotbeds about the end of March, and transplant the plants into small pots when about two inches high. They should not be set out until the temperature is likely to stay above 60° F. All the rules of transplanting mentioned in Lesson 77 should be observed. Set the plants three feet apart in rows three and one-half feet apart. Thorough cultivation, loosening the soil and killing the weeds, is necessary until the plants begin to spread and cover the ground. The soil should then be drawn up to the plants in hills two or three inches high. A strawy mulch over the ground, or some support, as a trellis, is necessary to keep the fruit off the ground.

The fruit will begin to ripen in August and should be picked as fast as ripe. The plant will usually continue bearing until frost, and if full-sized green tomatoes are picked and placed on the cellar floor, they will usually ripen. Earliana, Eclipse, Acme, Ponderosa, Yellow Prince, and Best of All, are good varieties.

Practical Exercises

1 Experimenting in Tomato Culture

Procure enough tomato plants from the hot-bed or from any source available to set out a plot on the home grounds, two rods by one rod. Transplant and cultivate as directed above. When the vines begin to branch and blossom, divide your plot into three sections and treat each section as follows:

1. Mulch the ground about the plants with straw and allow them to fall without support.

2. Support the plants with some sort of trellis to which they are tied, and prune away most of the lower and side branches.

3. Allow the plants to fall unpruned and unsupported on the bare ground.

Pick the ripened tomatoes from each section all summer and keep a record of the quantity and quality of the yield from each. Report this experiment and the results to the school next autumn.

2. Organizing Girls' Tomato Clubs

Write to the Department of Agriculture at Washington, D. C., or to the State Agricultural College for plans and details for the organization of a Tomato Growing and Canning Club. Ask your teacher to help organize a Tomato Club in the school.

LESSON LXXX

PLANT LEAVES

Work of leaves.—The main object to be brought out in the study of this lesson is the great work that leaves have to do, and the important relations they sustain to the life of the plant.

1. Leaves spread out a great surface through which the plant takes in oxygen, necessary for its life and growth.

2. Through this expanded leaf-surface the carbon-dioxide gas of the air enters, and in the sunlight the green leaf makes plant food out of the carbon-dioxide and the minerals brought up in solution from the soil. As one result of this process in the leaf, oxygen is set free.

3. After the leaf has used all the food-material needed from the sap-solution brought up from the soil through the roots and stem, the excess of water is thrown off by the leaf. This is called transpiration.

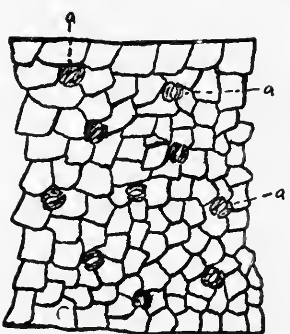


FIG. 87. MAGNIFIED SECTION OF UNDER SIDE OF LEAF SHOWING BREATHING PORES

A great amount of water is passed out of some plants in this way. In the corn plant about 275 pounds of water are passed through the plant for each pound of dry matter in the corn. In oats almost double this amount of water is handled by the plant. These are the three principal uses of the leaves to the plant.

Leaves make our food.—Plant food is manufactured in the leaves in the form of starch, is changed to sugar, and with other nitrogenous matter in solution, is sent to the various parts of the plant, there to be changed again into root, stem, leaf, or fruit. We ought surely to take our hats off to the leaves, for it is they that make possible all our grain, fruit, vegetable, and flower, all the wood and all the food we have, in a word all things useful and beautiful are made by the leaves.

Practical Exercises

1. Transpiration in the Leaf

Take a plant that is well started in a flower-pot, a piece of cardboard, and two glass tumblers large enough to cover the plant. Cut a slit in the cardboard and draw it around the plant. Seal the slit so that no moisture can come through it from below. Cover the plant with the glass, and allow the roots to extend into the water of the glass below. Moisture will collect on the inner surface of the glass. Where does it come from? Is all the moisture absorbed by the roots given off in this way? How could you find out? Why do plants need water?

2. Forms of Leaves

Collect and make drawings of seven different shaped leaves.

Leaves like the locust leaf are *compound.* Those like the oak are *simple.* Classify your leaves as to whether they are simple or compound.

LESSON LXXXI

THE FLOWER

Use of the flower.—However much the flowers serve to beautify the world and increase man's enjoyment, that is not their chief use. The fruit of the plant bears the seed, and the flower produces the fruit. That is the chief duty of the flower. Every plant that produces seed has flowers.

Structure of the flower.—Let us see what a flower is. Take for example a buttercup, cherry blossom, or the violet. You will find on the outside a row of green leaves enclosing the flower when it is still a bud. These

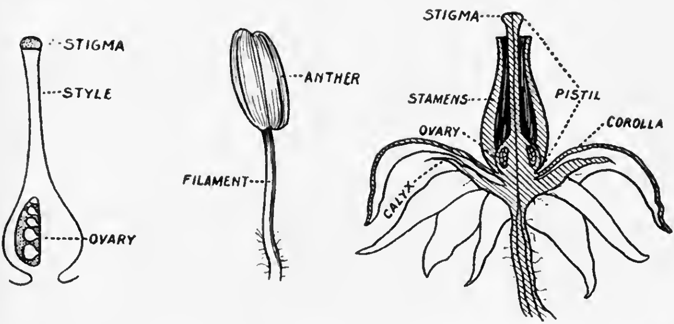


FIG. 88. A STAMEN A PISTIL VERTICAL SECTION OF TOMATO BLOSSOM

leaves are called *sepals*. Next on the inside is a row of colored leaves, or *petals*. Arranged inside of the petals are some threadlike parts, each with a knob on the end. These are the *stamens*. Examine one stamen closely. On the tip of its knob you should find, if the flower is fully opened, some fine grains of powder. This substance is called *pollen,* and the knob on the end in which the pollen is borne is called the *anther.* The pollen is very important to the flower. Without it there could be no seed. But there is another part to each flower that is of equal value. This part you will find in the center of the flower, inside the circle of stamens. It is called the *pistil.* The tip of the pistil is the *stigma.* The base of the pistil forms the *ovary.* If you carefully cut open this ovary, you will find in it very small unripe seed.

In the corn flower and many others, the stamens and pistils are separate on the same plant. In some plants these parts occur on separate individuals.

Now no plant can bear seeds unless the pollen of the stamen falls upon the stigma. The wind and the insects help to carry the pollen to the stigma.

Staminate and pistillate flowers.—Flowers that have both stamens and pistils are called perfect flowers. Those having only stamens are called stamenate flowers. Those having only pistils are called pistillate flowers. Some varieties of strawberries have individual plants that contain the stamenate flowers and other individuals, the pistillate flowers. In planting such varieties it is evident that both kind of flowers would have to be provided, otherwise the plants would produce no berries. In many plants, such as the clovers for example, the pollen will not grow into the pistil of the same flower, but the pistil must get its pollen from some other flower before the young seeds will develop. The seed of corn is often mixed because the wind or bees carry pollen from different varieties to the silks at the growing ear.

The tassel of the corn is the stamenate flower, and the silks, the pistillate flower.

Practical Exercises

1. The Structure of the Flower

Get specimens of three or four different kinds of flow- and fill out the following table from your observation of each flower:

Name of Flower	No. of Sepals	No. of Petals and color	No. of Stamens	No. of Pistils Seeds many or few
1.				
2.				
3.				
4.				

Make a drawing of each of the parts of the flower and of the whole flower.

LESSON LXXXII

PLANT STEMS

Purposes of stems.—In our studies of the parts of growing plants we shall learn something more about plant stems. As the root develops from the base of the caulicle in the embryo of the seed, the plumule, or first shoot, develops from the other end and becomes the main stem of the plant. Stems serve the plants three purposes: (1) They support the branches and hold the leaves up to the light. (2) They conduct the water and mineral food up from the ground to the leaves, and the starch and other manufactured food materials from the leaves down to the roots and other parts of the plant wherever needed. (3) They serve in some cases as storehouses for the reserve food of the plant.

Man has made the stems of plants serve him in other ways. They provide him with lumber, posts, poles, and fuel. They serve in many cases as food, and indirectly furnish materials both for food and clothing.

Stem structure.—Unlike the root, the stem is developed in sections, similar in a way to the stories of a building. Each section or story consists of one or more leaves attached to the farthest end of the section. The part of the stem to which the leaves are attached is called the *node,* and the part between the leaves is called the *internode.* The nodes are the points where the lateral buds are formed, and the internodes elongate causing the growth in length of the stem. The structure of the inside of stems will be seen in the practical exercises to follow.

Habits of growth.—Plants have stems that are erect, standing above ground, and strong enough to support all the leaves and branches. The stems of other plants are twining, or lie prostrate upon the ground. The stems of some plants are entirely underground, either condensed into short bulbs or running like rootstocks for a considerable length, bearing leaves above ground from their nodes. Still other plants are without stems, bearing their leaves from the root crowns.

Practical Exercises

1. Types of Stem Structure

Each pupil should have sections about six inches long, of corn-stalk and of a twig from a tree.

Compare the cross sections of the two stems. Note that in the corn-stalk the woody fibres are scattered irregularly through the pith, while in the tree stem the wood is arranged in circles around the pith. Make drawings of the cross sections to show this.

Cut the stems into longitudinal sections, and make drawings to show the arrangement of the wood and pith.

These two kinds of stems represent the two great groups of flowering plants having closed seed vessels—*monocotyledons* and *dicotyledons.* The corn stem belongs to the former, and the tree stem to the latter. The grasses, lilies, palms, etc., are monocotyledons, and the trees, most of the weeds and grains are dicotyledons.

2. Field Study of the Corn Plant

Go to the nearest corn field, and note your observations on the following points:

1. How many joints and how many blades have formed on the corn stems?

2. Would you prefer stalks with short or long internodes? Why?

3. Why do stalks grow tall and slender when planted too thickly?

4. If the ear has formed, count the number of nodes above and below it.

5. What height above the ground would you think best for the ear to be?

6. Note how the blade is attached to the stem.

7. Note the stem above the last node. It develops into the tassel.

3. Habits of Stem Growth

Fill out the table below with several examples of the kinds of stems indicated:

Stems on the Basis of Habit of Growth

Erect	Twining	Prostrate	Undergr'und	Condensed bulb stem	Stemless

1. What purposes do stems serve to the plant?

2. For what purposes do plant stems serve man?

3. Name the other parts of the plant attached to the stem.

JUNE

On the farm.—June is one of the busiest months of the year on the farm. The work is not so varied, but it is urgent and laborious. There are persistent, vigorously growing weeds to contend with, insects to combat, corn fields, truck patches, and gardens to cultivate, and clover and alfalfa to cut.

LESSON LXXXIII

WEEDS

Weeds, a great pest.—The farmer's life is a continual battle against the enemies of his crops. He must work hard to combat insect pests and plant-diseases, but harder still to eradicate the weeds. Any plant growing where the farmer does not want it might be considered a weed. Weeds are objectionable because they rob other plants of their food, moisture, and sunlight.

Classes of weeds.—Weeds may be divided into three classes—annuals, biennials, and perennials. Annuals are those plants that go to seed every year, and die, coming up from the seed year after year. Pigweed, wild mustard, and ragweed are examples of this class. To destroy such weeds, prevent them from going to seed. Biennials are plants that live for two years. They grow up from the seed one year and produce a heavy root. The next year they grow up from this root, produce seed and then die. To destroy this class of weeds, pull them up by the roots the first year or prevent them from seeding the second year. Burdock, bull thistle, and mullein belong to this class. Perennials are those plants that seed every year but whose roots live on from year to year. The only way to eradicate the perennials is to destroy them root and branch. These are the hardest of all to kill. The Canada thistle, ox-eye daisy, the fleabanes, sorrel, and common sour dock belong to this class. When such weeds are allowed to spread they soon take possession of the farm.

Practical Exercises

1. Study of Field Collections of Weeds

Gather six or seven different kinds of weeds—roots, stem, leaf, and all—and take them into the school room for study. Answer the following questions regarding each of the weeds you have collected:

Name of the Weed

1. Kinds of soil in which it thrives best.
2. Calculate number of seeds.
3. How are the seeds scattered?
4. When ripe?
5. At what time in the growing season do they germinate?
6. Does the young plant grow rapidly or slowly?
7. What kind of roots does the plant have?
8. When you cut it off does a new plant come from the same place?
9. Does plowing through a patch of weeds increase their number?

10. Does the weed have any natural check, such as birds, insects or live stock eating the foliage?

11. Weeds can be killed either by preventing the formation of seeds, or by preventing the growth of the foliage. Which of these methods is better suited to the weed in hand?

12. What garden or field crop does this weed injure? How does it injure it?

Write the names of twelve different kinds of weeds and classify as to whether they are annual, biennial, or perennial.

2. Spraying to Kill Weeds

Dissolve two pounds of iron sulphate (copperas) in a gallon of water, and spray over a patch of grass and weeds. Observe results after twenty-four hours and note which weeds are killed.

Free Bulletins, U. S. Dept. of Agriculture

Farmers' Bulletins

No. 28.—Weeds and How to Kill Them.
No. 188.—Weeds Used in Medicine.

Extracts

No. 133.—Birds as Weed Destroyers.

Problems

1. If a clean field produces 60 bu. of corn per acre and a weedy one only 35 bu. per acre, what is the loss caused by weeds with corn at 35 cents per bushel?

2. What would be the loss on a 20-acre field at the same rate?

3. For how many days' labor at $1 per day will an amount of money equal to this loss pay?

4. Suppose it required only four days' work to keep

an acre free from weeds, what would be the gain per acre?

5. What would be the gain on a 24-acre field?

6. Is the quality of the corn from a weedy field ever so good as that from a clean field? Why?

7. Suppose clean oats produce 65 bu. per acre and weedy oats produce only 48 bu. per acre, with oats at 30 cents per bushel, what is the loss from weeds? What is the loss on a 16-acre field?

8. Are oats grown in a weedy field as good in quality as clean grown oats? Explain.

9. Give several reasons for weedy oats. Can weeds in oats be easily destroyed after the oats are sown?

FIG. 89. WEED LESSON.
a, Amaranth; b, crab grass; c, rag weed; d, pigeon grass.

10. Will crop rotation prevent weeds in oats? What is a good crop for oats to follow? Why?

11. A yield of 300 bu. of potatoes per acre would be an excellent crop. The land would need to be well cul-

tivated and kept free from weeds to produce this. Suppose but 140 bu. are grown instead, what is the loss from lack of labor? At 25 cents per bushel what is the money value of this loss?

12. For how many days' labor at $1.25 per day will an amount of money equal to this loss pay?

13. Suppose only twelve days' extra labor were required to give the larger yield, how much would be gained?

FIG. 90. GRAIN WEEDING PLOTS

14. If the farmer did these extra twelve days' work himself, what would he get per day for his time?

LESSON LXXXIV

TRUCK CROPS

During the month of June the harvesting of truck crops again calls our attention to the vegetable garden.

On our forty-acre farm we are not specializing in truck gardening, and we shall have little for the market perhaps, but our tables will be abundantly supplied with new and fresh vegetables.

Profit in truck crops.—Vegetables grown for market are called truck crops. Many farmers in all sections of the country are finding "truck farming" more profitable than any other. Truck gardening combines well

FIG. 91. ONION HARVEST

with general farming, for it may bring money returns before and after the standard farm crops mature. Tomatoes, cabbage, strawberries, cantaloupes, onions, endive, beans, sweet corn, asparagus, peas, and beets have all been found profitable, and there should be larger developments in the trucking business in the future.

General requirements.—In order to obtain the earliest vegetables, and thus realize most profit in the trucking business, the soil should be light, warm and quick. Truck crops require heavy applications of fertilizers. Cabbage and tomatoes succeed best on lands that are rich in humus, hence it is best to practice rotation of crops and include a cover crop of cow peas or clover to turn under, or to apply annually an ample supply of barnyard manure. Low lands are usually richer in humus than uplands, and if properly drained, make the better sites for truck gardens.

Every truck crop demands special attention and treatment, and details cannot be given here. The following bulletins from the Department of Agriculture treat of special truck crops:

NOTE. The only practical suggestion to offer in connection with this lesson is to advise every boy and girl who reads it, seriously to try out some garden vegetable for the profit there is in growing and marketing it.

Free Bulletins, U. S. Dept. of Agriculture

Farmers' Bulletins

No. 35.—Potato Culture.
No. 354.—Onion Culture.
No. 52.—The Sugar Beet.
No. 60.—Methods of Curing Tobacco.
No. 82.—The Culture of Tobacco.
No. 83.—Tobacco Soils.
No. 120.—The Principal Insect Affecting the Tobacco Plant.
No. 129.—Sweet Potatoes.
No. 61.—Asparagus.
No. 94.—Cabbage.
No. 220.—Tomato.
No. 282.—Celery.
No. 359.—Canning Vegetables.

Problems

1. A sugar factory agrees to pay $4.50 per ton for all beets testing 14 per cent, or less, of sugar. They

also agree to give an additional 25 cents per ton for each additional 1 per cent of sugar or fraction thereof over 14 per cent, if the fraction exceeds one-half per cent. What is the price of beets testing 13.7 per cent? 14 per cent? 14.3 per cent? 14.7 per cent? 15 per cent? 15.2 per cent? 15.6 per cent? 15.8 per cent?

2. Mr. Smith's beets yield fourteen tons per acre and test 15 per cent. How much does he get per acre for his crop?

3. On two acres of ground Mr. Jones raises 73,680 pounds of beets which test 14.8 per cent. How much do his beets bring him in money per acre?

4. If Mr. Jones spends $56 worth of labor on his crop of beets, what is his net profit per acre?

5. How many onion plants will be required to set an acre in rows two feet apart, plants four inches apart in the row?

6. If a boy can set nine plants per minute, how long will it take him to set them?

7. If these onions average four ounces each, how many bushels are raised on an acre? If they average six ounces? Twelve ounces? One pound?

8. What is the value of the crop in each case, at 60 cents per bushel?

9. If it requires fifty days of a boy's time, worth 75 cents per day, to raise an acre of onions, what will be his profit on an acre of four-ounce onions?

LESSON LXXXV

THE VALUE OF BIRDS TO AGRICULTURE

Bird life.—We can not be long upon the farm in June without noting the joyous life of the birds. They are busy from dawn to dark, building their nests and feeding their nestlings. Nothing disturbs them except the heartless cat and the occasional thoughtless boy, who has not yet learned the great service the birds render to the farmer. The native birds are one of the nation's most valuable assets. If the birds were destroyed, in a very few years the insects would have multiplied to such an extent that our trees would be defoliated, and our crops destroyed. This is not fancy, but plain facts.

Birds and insects.—It has been found by observation and dissection that a Cuckoo consumes daily from 50 to 400 caterpillars, and that a Chickadee will eat from 200 to 500 insects or up to 4000 insect eggs. One hundred insects a day is a small estimate of the quantity consumed by insect eating birds, and most of our birds are insect eaters. Not only do they destroy great numbers of insects, but they eat great quantities of weed seeds as well. The State of Illinois loses annually about $20,000,000 by the ravages of insects.

It is the duty, and it should be the pleasure, of every citizen to do all in his power to protect these valuable birds, and to encourage them to remain about our homes.

Practical Exercises

1. Observational Studies of Birds About the Farm

Each pupil in the class should take a walk alone. along the lanes and about the fields and orchards at home. Take a note-book and pencil and walk quietly and unconcernedly looking among the trees, bushes, fences,

FIG. 92. BLACK-THROATED WARBLER

and on the ground for the birds. Prepare the following outline to guide you in your observations, and from which to make report to the school for this lesson:

Birds observed.
What the bird was doing.
What it eats.
Color.
Where it
nests.

FARMERS' FRIENDS

2. Bird Boxes

Each pupil should make a bird box, according to some design of his own choosing, and bring it to school to show the teacher and the rest of the class. Take the box home and put it up out of reach of the cat in some attractive place where the birds can build in it. It

FIG. 93. MARYLAND YELLOW-THROAT

would be well to make some bird boxes for the school yard also.

Problems

1. Suppose that the damage from insects in your state is 25c an acre. How much would that be for the whole state?

2. If there were three birds on every acre, how many birds would there be in this state?

3. If each bird eats 25 insects a day (a very low estimate), how many insects would be destroyed in this state during the months of June, July, and August?

4. If 120,000 insects fill a bushel basket, how many bushels of insects would the birds eat during the summer from the above estimate?

5. Suppose that one-fourth of the birds in this state, as calculated above, would eat one-fourth of an ounce of seed daily, how many pounds of weed seeds would our birds destroy in three months?

The forces that work against the increase of bird life are: man; the climatic elements; accidents; cats; other animals; birds of prey, and snakes. How can we help the birds in their struggle against these enemies? Each one of us can do something, and every time we save the life of one bird, we have not only done a kindness to the creatures we should love, but we have rendered service to the cause of agriculture. Have you read Longfellow's poem entitled, "The Birds of Killingworth"?

Reference: Farmers' Bulletin, No. 54.

LESSON LXXXVI

THE TOAD, THE FARMER'S FRIEND

The toad and insects.—In addition to the birds, about which we studied in the last lesson, the farmer has another valued friend in the common toad. All through the summer the toad is eating the harmful insects from our yards, gardens, truck-patches, and fields. The toad does more to rid the garden and field of noxious insects than any one species of bird, and he has solved the problem of insecticides better than man with all his bungling spray-machines.

The home of the toad.—The toad has a "homeing instinct," and should be placed in yards, gardens, and

Courtesy E. F. Bigelow, Sound Beach, Conn.
FIG. 94. THE TOAD IN HIS HOME

fields, and become one of our most valued domestic animals. A little stone house, containing a shallow jar of water will furnish an attractive home for the toad in the garden, and he will go forth at night like the lubber fiend, to do our tasks while we sleep.

The toad a harmless creature.—Laws should be passed preventing the small boy from killing all the toads he cares to. The toad is absolutely harmless, and the old wart superstition is mere "bosh," and its ugliness, so-called, becomes transformed into real beauty, when we see its great service in the economy of nature. The fact that the toad sometimes gets into wells, reflects on the thriftless methods of the man who leaves his wells open, rather than upon the thirst of the poor toad, which falls in, in its search for the water that the man should provide for it. In these days of increasing insect pests, it behooves us to encourage and protect all of the natural enemies of our plant destroyers, and a few toads in a garden will go far toward controlling the cut worms, caterpillars, and the leaf-eating beetles.

A plea for the toad.—The toad is an animal full of vital interest from its egg stage, through the tad-pole development, to the adult, and the horror and disgust with which this harmless beneficial friend is viewed by many boys and girls should be changed to intelligent sympathy and active appreciation in its behalf.

Practical Exercises

1. Watching the Toad Eat

The day before this lesson is to be given, the teacher, with the pupils' assistance, should have a box about a cubic foot in size, screened off on two opposite sides with common door-screening, and a little hinged door of some sort made, through which the toads and insects may be put into the box.

Place two toads in the box on the evening before the lesson, and they will be hungry enough to "show off" well for the class. Announce the plan beforehand, and ask the pupils to bring in flies, bugs, butterflies, caterpillars, worms, beetles, etc.

When the lesson is ready to begin, place the box before the class, put all the insects in with the toads, and watch them eat. Such an interesting sight the pupils seldom see. The insects disappear as if by magic, snapped in by the toad's long tongue with lightning rapidity. Have some pupil count how many insects the toad eats during the recitation time.

Place one toad in the glass tumbler, cover with a mosquito netting and pass it around among the pupils, so that all can see the beautiful eyes—"the fabled jewel" in the toad's head.

LESSON LXXXVII

CUTTING CLOVER AND ALFALFA

It is during the second year of our red clover field, and the third or fourth year of the alfalfa stand, and we must begin to harvest these crops this month.

Values of clover.—Next to alfalfa, red clover is one of the most valuable forage crops for stock feeding. Almost every farm animal is benefited by the feeding of red clover. Its merits in this respect are not fully appreciated as a farm crop. It is valuable as hay, as a soiling crop, and as a green manure crop; its roots render the soil open and porous, and richer in nitrogen.

Making clover hay.—Clover should be cut when free from moisture, and when about one-third of the blossoms have begun to turn brown. At this time the clover will make the most nutritious hay. The clover is cut and allowed to lie in the swath until almost dry, when it is raked into windrows, and allowed to dry more. Then the windrows are gathered into piles or hay-cocks. These may stand in the field a day or two or be hauled to the stack or barn at once. It should be the aim of the farmer to save all the leaves of the clover possible, for they contain much food material. Rains and dews are injurious to the crop while curing, quickly changing the color of the leaves to a dark brown, and soon de-

FIG. 95. ALFALFA

stroying the rich aroma from the oils which make clover so palatable and attractive. Red clover furnishes excellent pasture for stock of all kinds, but the result of this practice is usually the destruction of the plants.

Harvesting alfalfa.—Alfalfa is harvested for hay in a similar manner to clover. It is cut when about one-fifth of the heads are in blossom. As soon as cut new growth starts up, and in a few weeks it can be cut again for hay. Usually three or four crops can be cut from the same field in a season. The hay is cured in the same way as clover, but more care needs to be taken to save the leaves, as they drop off easily as soon as dry.

Problems

1. Ask some farmer how many tons of clover hay an acre should yield, and calculate the yield for ten acres. What price would the clover hay from ten acres bring if sold at the market rate?

2. Find the number of tons in a rick of clover hay, 25 feet long, 10 feet wide, and 40 feet over?

3. Find the number of tons in a mow, 40 feet long, 25 feet wide, and 12 feet high.

4. How many tons of hay will your father's barn on the farm at home hold?

NOTE. To find the number of tons of hay:

In mow. Multiply together the height, length and breadth in feet, and divide the product by 450 for timothy, and by 600 for clover hay.

In rick. Multiply the length by the breadth and that product by one half the difference between the breadth and the distance over. This will give cubic feet. Divide as above to find the number of tons.

References: Farmers' Bulletin, No. 278. Clover Farming, Wallace.

LESSON LXXXVIII

FIVE LINES OF AGRICULTURAL IMPROVEMENT

Out-line Review

Since June is one of the best months for many of the improvements suggested by the outline given below, this lesson is inserted at this point as a review outline. Pupils should study the following outline until they are able to reproduce it:

1. Seed Improvement

1. Selection for:
    a. Purity.
    b. Trueness to type.
    c. Viability.
    d. General vigor.
2. Testing for:
    a. Germination.
    b. Vigor of growth.
3. Plant breeding.

2. Live Stock Improvement

1. Use of pure breeds.
2. Proper care and feeding.

3. Soil Culture Improvement

1. Drainage.
2. Tillage.
3. Manuring.
4. Fertilizing.
5. Liming.
6. Crop rotation.

4. Checking the Waste

1. In fruit-growing by:
    a. Spraying.
    b. Pruning, tillage, etc.
2. In forests by:
    a. Checking fires.

b. More careful lumbering.

3. In field crops by:
   a. Use of good seed.
   b. Good cultivation.
4. In manures and fertilizers by:
   a. Spreading manures often or preventing its leaching away.
   b. Using only the fertilizers needed.
5. In live stock and feeding by:
   a. Having pure-bred stock.
   b. Intelligent care in handling.
   c. Feeding balanced rations of good standards and not buying patent medicines and feeds.
6. In human efforts by:
   a. Knowledge and practice of scientific agriculture.

5. Country Life Organizations

1. Boys' and girls' agricultural clubs.
2. The grange.
3. Consolidated schools.
4. Country churches.

JULY

On the farm.—This is the month of wheat harvest and hay-making. The orchard is to be sprayed again to check the second brood of codling moths and spread of various fruit rots. The catalpa grove and young orchard should be sown to cow peas or some other legume. Such succession crops as beans, cabbage, peas, lettuce, radishes, turnips, etc., may be planted in the garden this month.

LESSON LXXXIX

ROADS AND ROAD-MAKING

Perhaps the best time of the year to make roads and improve the old ones is in the spring season, but there are certain improvements which can profitably be made in July and August. Working the roads late in autumn or in winter is not advisable, because they will not get settled, and will remain bad all winter.

Good roads and country life.—Our life in the country will never be as attractive as it ought to be until we have good roads. Bad winter roads that keep the young people in their homes for many months, cause them to grow to dislike the country, and to join that throng of restless humanity moving steadily toward the cities. Will not the young people who love their country homes enter into this crusade for better roads?

All industrial interests are affected by the nature and condition of the country roads, over which the products of the farm are transported to market, but it is the farmer who suffers most from the inferior roads —which constitute so large a percentage of the road system of the United States. Over our country roads

FIG. 96. A BAD ROAD

there are annually hauled at least 250,000,000 tons. A system of better roads would reduce the cost of hauling this volume of freight one-half or two-thirds of what it now costs. Following are some of the values of good roads.

1. A direct saving in dollars and cents. How?
2. A saving of time.
3. Makes country life more desirable. How?

4. Makes school and church attendance more convenient.

5. More humane to horses.

6. Helps every industry of the city. Why?

As a part of the preparation of this lesson, each pupil should write a brief essay upon one of these topics.

FIG. 97. AN IMPROVED ROAD

Points in the Construction of a Good Road

1. A level road or gradual grade, whenever possible.

2. The road bed, highest in the middle and sloping to each side, having a fall of one inch to three or four feet.

3. Under-drains in wet places, and side-ditches

to carry off surface water should furnish the drainage necessary for good roads. Water, standing or running, in roads is the great destroyer of good roads.

4. The surface should be hard and smooth. A good surface is made by putting a layer of larger stones at the bottom, a layer of smaller stones next, and crushed stone or gravel as the top layer.

5. Ordinary earth roads can be improved by proper grading and drainage. The best time to do this is in the spring after the ground is settled.

6. Drains should be kept open, and all depressions filled.

Pupils should write a paragraph on one of these topics in their note-books.

Practical Exercises

1. Constructing a Road

For the second part of this lesson it might be possible at the school to construct a path from the school house to some desired point a few rods away, according to the best principles of road-making.

If some of the larger boys or some school patron would furnish a few loads of coarse stone, a few loads of gravel, a plow and a team for a few hours, an interesting and profitable demonstration of good road-making could be made at the school.

1. Select the line for the road or walk.

2. Measure off a space six feet wide, the entire length of the walk to be constructed, and mark it with stakes.

3. Plow up the whole area, turning it toward the

middle. Then with spades or a scraper, if the space is large, grade it up from the sides to the center, so that the center is about one inch higher than the level of the ground where it is not plowed.

4. Place a layer of coarse stones over this surface next, and a layer of gravel or finer stones over the coarser stones. Smooth it all over so that the walk gradually slopes from the center to the ditch left at the side by the plow's furrow.

5. The walk is now ready for use. The side ditch or drain should be kept open, and the roadbed properly graded.

References: Farmers' Bulletin, Nos. 136 and 338.

Problems

1. Find out how much tax your father pays for the roads of the county. What is the rate of road tax in your county or state?

2. Learn from some citizen or from your Road Commissioner his estimate of the cost of constructing a mile of gravel or crushed stone road in your section, and then determine what it would cost to build such a road on all the main lines of the school district.

LESSON XC

TIMOTHY HAY

Time for harvest.—Very soon after the wheat harvest is over the timothy hay will be ready for cutting. We have five acres on our farm, and we shall expect at least three tons per acre. Some farmers say that timothy hay should be cut just as it is coming into blossom, others say to wait until the blossoms have all fallen. We shall cut our hay when the blossoms are beginning to fall.

General requirements for meadow.—Timothy does well on rather heavy soils like clay and humus loams. It also does well on muck soils, but it is likely to become too coarse stemmed. The seed of timothy is usually sown

FIG. 98. TIMOTHY HAY AT WEST VIRGINIA EXPERIMENT STATION—FIVE TONS PER ACRE

in autumn with wheat or rye. After the grain is cut the timothy occupies the field, and the next year is cut for hay. It may be used several years for hay, especially if top dressed in the spring with stable manure. Timothy may be sown alone in the fall on well prepared land. A bushel of seed is used for about six acres of land. In practice timothy is often grown with red clover. A recent practice of many farmers is to sow both timothy and clover seed together late in the summer. When sown in this way, a fall crop of hay is secured the following season.

Meadow grasses.—Timothy hay is cut with a mower, allowed to cure in the swath, raked into windrows, and later into hay-cocks, from which to be stacked

FIG. 99. A HAYING SCENE

or stowed in the mow. Other good hay grasses are orchard grass, red top, millet, etc., and all these are enriched by the legumes in combination. The legumes in combination with the other hay grasses, help to maintain the meadow's fertility, and to bring it to a higher yield.

Problems

1. How much would the hay from our five-acre field bring if placed on the market at the prevailing price?

2. Ascertain how much stable manure should be spread upon our meadow as a top dressing after the hay is cut.

3. Write a list of the different grasses and legumes used as hay.

LESSON XCI

PASTURES

Pastures need attention.—While we are working with meadows and hay we shall try to learn something about pastures. It is well known that the ordinary pasture throughout the country receives very little attention and is of little value when compared with other farm lands. With proper seeding and care the pasture might be made as valuable as any other part of the farm. Mr. McClennan, of the New York States College farm, states that in several of the European countries land valued at from $2,000 to $3,000 per acre has been kept in pasture for generations and at a profit, because it is intelligently seeded and properly treated. It is entirely practical to re-seed pastures with any kind of grass desired without breaking up the soil or injuring the sod.

Grasses for pasture.—Good pasture land should be seeded with such variety of grasses as will supply plenty of food for the stock from early spring to late fall. Mr. McClennan gives the following grasses for permanent pasture: "A mixture of seed containing 4 pounds of orchard grass, 4 pounds of meadow fescue, 3 pounds of tall oat grass, 2 pounds of timothy, 2 pounds of alsike

FIG. 100. THE PASTURE

clover, and 2 pounds of white clover. Total, 24 pounds."

The purpose of combining all these grasses in one field is to have plants ripening at various periods throughout the season, and adapting themselves to varying soil conditions. The above mixture would not be suitable for meadow purposes, because none of the plants would develop and ripen together. In limestone regions the Kentucky blue grass furnishes a permanent and ideal pasture throughout the entire season. Mr. W. D. Zinn, of

Philippi, West Virginia, has been of great service to farmers of this country through his Pasture Clubs, organized for mutual helpfulness in the improvement of pastures.

Problems

1. How much seed would be needed to renew the pasture on our forty-acre farm, using the amount quoted above on each acre?

2. How many head of stock should we allow on our pasture, if in good average condition of growth?

3. Examine the pastures at home and report how much stable manure it will require to cover the bare and poor spots, at the rate of six tons per acre.

4. Make a list of the pasture grasses grown in your community.

References: Farmers' Bulletin, No. 66. Forage Crops Other Than Grasses.—Shaw. Elements of Agriculture.—Warren.

LESSON XCII

DRY FARMING

The problem.—At this season of the year the farmer's crops are most likely to suffer from dry weather. During the summer the plants are making heavy drafts upon the earth's moisture, and the hot, dry atmosphere is evaporating all the water and moisture exposed to it. In certain semi-arid sections of the country the farmers have met this problem of conserving moisture by a system known as "dry farming." It has been demonstrated that a certain amount of water is indispensable. To produce a single pound of dry substance in wheat, 1,200 pounds of water are necessary. It would, therefore, be impossible to produce a crop year after year on the same dry area. The question is not one of fertility of soil, but of conservation of moisture.

The conservation of moisture.—By the system of dry farming the solution of the problem consists in summer fallowing of the land, which means that the ground is plowed as deep as possible and left to rest and absorb all the rainfall it can. A person with a two-hundred acre farm would by this method use only one-half of his land at a time for crops and allow the other half to lie fallow. A crop every year on all the land would hopelessly dry up all the soil. In addition to the deep plowing and summer fallowing, a loose surface mulch must be kept over the fields to prevent the moisture from evaporating. In this way the twelve or thirteen inches of rainfall, characteristic of many semi-arid regions, is caught and held to supply the moisture for the crop of a single season.

Certain crops have been bred up to be adapted to the dry farming system, among which are the macaroni wheat, Turkestan alfalfa, dwarf Milo maize, and Swedish oats. At the present time wheat is the principal crop in dry farming.

Practical Exercises

1. See Exercise 5, Lesson 46.

2. How Moisture is Saved by the Dry Earth Produced by Frequent Shallow Cultivation.

Suspend a tin can from each end of a small stick fourteen to sixteen inches long and balance over a nail driven through a hole at the middle of the stick.

Fill one can full of moist soil and the other to within about one inch of the top with a portion of the same soil. Pour dry dust over the surface of the soil in the second can to the depth of about an inch. Adjust the amount of soil in the two cans so that the system exactly balances. Allow the apparatus to stand over night. The amount of water that must be added to one can to restore a balance represents the water that has been saved by the protective covering of dust—the dry earth mulch. Hold the bar horizontally while adding the water.

The effect of mulches of cut straw, leaves, or other material may be studied in the same way.

AUGUST

On the farm.—This is the month when the farmer may take a little vacation, and every farmer should leave his farm, if possible, for a short vacation at least once a year. There are plenty of things to do, however, in August, if the farmer wishes to find work. Perhaps he is planning to sow an alfalfa field, or he may have to break his wheat ground. If the weather is rainy he may have to dig his potatoes. He will probably sow a patch of turnips. There will be fence corners to mow and clean out. Perhaps he may have some melons or cucumbers or other truck to market. Of course he should help the housewife to pick blackberries, peaches or apples, for she is very busy at canning this month. The teacher and pupils will think of other work going on during August.

LESSON XCIII

ALFALFA

Essentials in growing alfalfa.—It is worth the trial for most farmers to begin the production of alfalfa. There are a few essentials in alfalfa culture that are required for success.

1. The seed bed must be in perfect "onion tilth."

2. The ground should be inoculated with the bacteria necessary to produce the root-nodules. This may be done

by sprinkling the soil of the field with soil from an old alfalfa or sweet clover field.

3. There must be plenty of lime in the soil.

4. Weeds must not be allowed to choke out the young alfalfa plant.

5. The ground must be well drained and have a porous sub-soil, for alfalfa has a long tap-root and must grow deep into the soil.

6. The seed must be pure and viable, and sown at the rate of 25 pounds per acre. With these conditions provided alfalfa may be grown much more widely than at present.

Practical Exercises

1. An Alfalfa Plot Test

If the required amount of land cannot be obtained on the school grounds, a farmer living near the school will probably be glad to furnish the land. Select the site in any plowed-up ground, lay out the following plats, each one rod square:

1	3 INOCULATION
LIME 2	LIME 4 INOCULATION

Drive stakes at each corner of each plat.

Sow about eight quarts of lime on plats 2 and 4, four quarts on each plat, which is equivalent to about twenty bushels on an acre. Obtain some soil from a place where alfalfa or sweet clover is growing, and scatter a few quarts of this on plats 3 and 4, being careful not to get it on the other plats. This is inoculating the soil with the bacteria of the alfalfa. Then sow a light seeding of oats or barley over all the plats, a little more than a quart is sufficient. Then sow about three-fourths of a pound of alfalfa over the four plats and rake it in. Be careful not to rake any of the soil from the inoculated plats into the others.

No further care need be given the plats until the barley or oats is headed out, when it should be mowed off above the tops of the alfalfa plants. The oats or barley should not be allowed to mature in the alfalfa. School may be closed before this experiment is finished; but the teacher should appoint a committee to study and report the observations of the summer, and all living near should be encouraged to watch the experiment. This is getting lessons from the real source and not from books alone.

Draw the plats in the agricultural note-books, and answer the following questions:

How soon does the barley or oats come up? The alfalfa? In six weeks observe the roots of the alfalfa in each plat. In which plats are swollen nodules found on the alfalfa roots? What is the effect of the lime and inoculation? Observe the difference in growth in the four plats.

The surest way to get alfalfa to grow on a poor soil is to manure the soil, cultivate it, and sow about August the 1st, applying lime and inoculation, if necessary.

This work may be carried on at the students' home if there are no plats for it near the school. The home work of these lessons is to be greatly encouraged.

References: Alfalfa Book.—Coburn. Farmers' Bulletin, No. 215.

LESSON XCIV

BUDDING FRUIT TREES

August is the month when young peach and apple trees are usually budded.

Purpose of budding.—Budding is such a simple and important farm operation that every boy and girl should know how to do it. Think of changing the little apple-trees in the orchard to any variety of apples you wish! This is exactly what budding is for. This change can be made on branches as small as lead pencils, or as large as the thumb. The nurseryman buds the little trees a few inches above the surface of the ground. The fruit grower top buds the little trees, two or three feet above the ground.

And when, above this apple-tree,
The winter stars are quivering bright
And winds go howling through the night,
Girls, whose young eyes o'erflow with mirth,
Shall peel its fruit by cottage-hearth,
And guests in prouder homes shall see,
Heaped with the grape of Cintra's vine

And golden orange of the line,
The fruit of the apple-tree.

—Bryant.

Practical Exercises

1. Budding the Peach

The class may go to a young orchard near the school for this lesson, or several branches of young trees may be brought into the schoolroom.

1. Choose the place for the bud. Make a horizontal

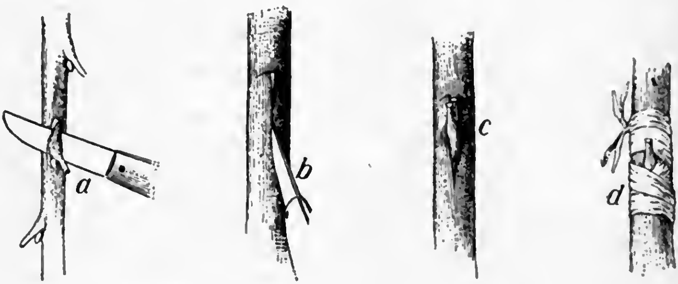


FIG. 101. BUDDING

cut across the stem, just through the bark. Then beginning in the middle of the horizontal cut, draw the knife straight down making a vertical cut. (See figure b). Twist the knife sidewise before drawing it out, in order to loosen the bark. The stock is now ready for the bud.

2. Take the buds from bearing trees of the variety you wish. Cut twigs that have grown this year. The leaves are still on them. At the base of each leaf, and between the leaf and the branch, you will find a little

bud. This is the bud to insert into the tree which has been prepared as above described.

3. Cut the leaf off about a quarter of an inch above the bud, thus leaving the leaf stock as a handle for the bud. The end buds should not be used. Beginning with a sharp knife below the bud, cut upwards just through the bark, beneath the bud and above it about half an inch. Be sure to cut through the bark, but not into the wood. (See figure a.)

4. Push the bud down into the cut made into the stock, using the leaf stalk as a handle. Be sure that the entire bud is shoved into the incision. If a piece of bark should project above, cut it off. (See figure c).

5. The bud is now ready for tying. Raffia is the best material to use, but ordinary string may be used. Begin below the bud and wrap the wound entirely, except where the bud is. Wrap it snugly and tightly, and then tie securely. (See figure d).

6. In two or three weeks the bud will have "stuck," and the string may then be removed. The bud will remain dormant during the winter and begin to grow the next spring.

References: Farmers' Bulletins, Nos. 157 and 218.

LESSON XCV

NO TWO PLANTS ALIKE

Variations and resemblance.—It is a common observation of everybody that no two things are exactly alike. This is especially true of plants. Plants like animals, produce offspring which resemble the parents very closely in many respects. If it were not for this resemblance to parents in plants, our crops would not come true to seed, and we could not depend upon fixing desired characteristics in improving the crop. On the other hand, it is a good thing that no two plants are exactly alike, for the variation might be an improvement over the parent plant, and thus enable the plant breeder to select points for improvement.

Practical Exercises

1. Variations in the Corn Plant

Select two corn plants that most nearly resemble each other, and note the following points in comparison:

1. Height of the plant.
2. Does it branch? How many secondary stems or suckers from one root?
3. Shade or color.
4. How many leaves?
5. Arrangement of leaves on the stem.
6. Measure length and breadth of six main leaves.
7. Number and position of ears. Color of silks.
8. Size of tassel, and number and size of its branches.
9. Stage of maturity or ripeness of the plant.
10. Has the plant grown symmetrically, or has it been crowded by other plants, or been obliged to struggle for light or room?
11. Note all the unusual marks or features.
12. Note the comparative vigor.

These points may be used with any two plants with slight modification.

(Adapted from Bailey in the Cornell Rural School Leaflet.)

Reference: Farmers' Bulletin, 229.

LESSON XCVI

THE WATER SUPPLY

We are likely to have little rainfall in August and our attention is often called to the quality as well as the quantity of our water supply.

Pure water.—There is nothing of more importance to the health, comfort, and convenience of a farm and household than an abundant supply of pure water. It is not easy to find absolutely pure water. Some of the impurities in drinking water are harmless; others are very injurious. The most dangerous impurities in water are the minute plant forms, called *bacteria*. One kind of bacteria occasionally found in drinking water, causes the typhoid fever. It is impossible to judge by the appearance or taste, whether water contains these dangerous bacteria. It may be perfectly clear and have the finest taste, and yet be unsafe to drink.

Sources of drinking water are: 1. Springs. Spring water is almost always pure if the spring is deep and a good distance from foul places, such as barnyards and open drains.

2. Lakes and reservoirs. Water supplied to cities is often taken from rivers and lakes, and purified to a certain extent and stored in reservoirs. If there is any doubt about the purity of the city water, people are advised to boil it in order to kill all the dangerous bacteria.

3. Wells. If wells are on a lower level than the barns or outhouses, they are likely to contain water with the dangerous bacteria in it. If any surface water can drain into the well it renders the water impure and unfit to drink. The land should not slope to the well from any house or barn, and the well cover should be perfectly tight to prevent animals from getting into it.

Good rules for drinking water.—1. If there is any doubt about the purity of drinking water it should be boiled.

2. Allow no standing water about the farm premises, for it may be the source of contamination for the drinking water.

3. Do not drink out of the cup at public drinking places, nor from the common cup or dipper often used in the schoolroom, for many disease germs are carried from one mouth to another, through the common drinking vessel. Pupils should have their own individual drinking cups.

4. Always have clean fresh water for the farm animals, for their health and growth depends as much on the water supply as does our own.

Practical Exercises

1. Simple Tests of Water

If this lesson is given in a school that has the material named, the following tests will prove interesting and valuable:

1. Test for animal or plant matter:

Fill a clean test-tube half full of the drinking water. Add a drop or two of concentrated sulphuric acid, and sufficient potassium permanganate solution to color the water. Heat gently to the boiling point. If the color changes to a brownish tint, it indicates the presence of organic matter.

2. Test for chlorides:

To a test-tube half full of water, add a few drops of nitric acid, and then a few drops of silver nitrate solution. If there is any cloudiness, it shows that the water had traces of chlorides in it.

3. Test for sulphates:

To a test-tube half full of water add a few drops of barium chloride solution. If there is a whitish precipitate, it indicates the presence of sulphates in the water.

4. Test for lime compounds:

To a test-tube half full of water add a few drops of fresh solution of ammonium oxalate. A white precipitate indicates the presence of calcium or lime compounds.

As a note-book record of this lesson, the pupils should write an essay on the Water Supply, bringing out the facts they have learned, and showing the attitude they have toward the subject.

LESSON XCVII

THE UNITED STATES WEATHER SERVICE

Farmers dependent upon weather.—There is no subject of more vital interest to the farmer than the weather. Especially is this true in the month of August. In the corn belt the condition of the weather either makes or mars the crop. As the rain falls "on the just and on the unjust,'' so does the dry weather come to both alike, and the farmer, to whatever class he may belong, is more dependent upon the state of the weather for success in his business, than perhaps upon any other force.

Weather reports.—The Department of Agriculture, through the Weather Service, has made provision for

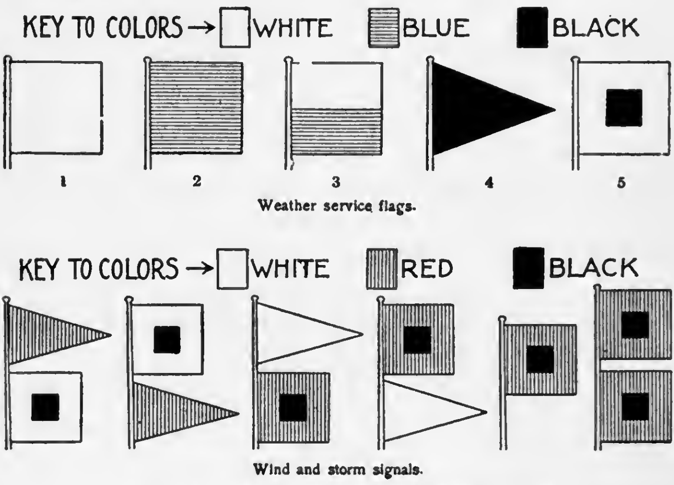


FIG. 102. UNITED STATES WEATHER SIGNALS

daily weather reports to all parts of the country. These reports are sent out by rural telephones, by bulletins carried by the rural mail service, by means of signal flags of certain designs and colors, and by steam whistles blown sufficiently strong to be heard some distance away. The flags used for this purpose are as follows:

No. 1. White flag indicates clear and fair weather.

No. 2. Blue flag indicates rain or snow.

No. 3. White and blue flag indicates local rain or snow.

No. 4. Black triangular flag is a temperature signal.

No. 5. White flag with black square in the center indicates that a cold wave is expected.

When No. 4 is placed above Nos. 1, 2, and 3, warmer weather is expected; when placed below these signals, colder weather is expected. A red flag with a black center indicates a storm of great violence. A red pennant signifies an easterly wind, while a white pennant indicates a westerly wind. When either of these pennants is placed above other flags, it signifies a northern wind, but when placed below, a southern wind is promised.

Practical Exercises

1. Keeping Weather Records

Make daily weather observations for one week and record your observations in the following table:

Date	Temperature	Moisture Conditions	Sky Aspect	Wind Direction

2. Study of the Weather Signals

Ask your rural carrier to expose the Weather Service Signals on his wagon, and keep a record each day of what the signals indicate. Note whether the report is correct or not.

Draw upon the blackboard of the school each day the flag shown by the weather report, which foretells the weather for the next twenty-four hours.

LESSON XCVIII

CONSERVATION OF NATURAL RESOURCES

Study needed.—A text-book in agriculture would fail in an essential duty if it did not call attention to the great need of the conservation of our natural resources. In a recent conference, Hon. Gifford Pinchot advised the preparation of text-books on conservation, and strongly urged that the problem be presented to the children of the public schools.

Americans wasteful.—We have been concerning ourselves about every other subject under the sun, while we ate, drank, and made merry over the abundance of our natural resources. As a nation we have wasted our substance by riotous living, and now we hear our President sounding the alarm by saying, that the question of the conservation of our natural resources is one of the most important problems before the American people.

The natural resources.—Disregarding the question of moral purposes, the prosperity of our people depends directly upon the energy and intelligence with which we use the *soil,* the *forests,* the *mines,* and the *waters* of the earth. From the sea, the mine, the forest, and the soil, must be gathered everything that can sustain the life of man. How stands the inventory of our property at the beginning of the twentieth century?

The sea and forests.—The sea furnishes 5 per cent of our food products. The forests are fast disappearing. We are consuming wood three times faster than the forests grow, and without reforestation, the present century will see the end of our timber.

The mines.—The mines of coal, oil, and gas are incapable of restoration. The wealth of these resources can be used only once. When fuel becomes scarce, as far as we can now foresee, man will suffer as he would if the air were gradually withdrawn. One has only casually to observe to note the great waste of coal, oil, and gas that is continually going on unchecked.

The soil.—Our greatest source of wealth is the land—the soil. How are we caring for it? The last census shows that the average annual product per acre of the whole country was $11.38, a little more than a respectable rental in some places, where the land is well cared for. We are robbing the soil in order to get the largest returns in the shortest time. We have done this in two ways—by single cropping and by neglect of fertilization. We need the intelligent treatment of smaller areas, raising the productivity to three or four times the present rate. Thirty-six per cent of our people live directly by agriculture, and the rest depend upon it. We shall have 200 million people here by 1950. How shall they be clothed and wherewithal shall they be fed?

Time was when the son of the farmer could go West, when his father's farm was run down, now all this is changed. The son of the farmer, if he follows his father's vocation, must make his living on his father's farm. This can be done, if the father exercises wisdom. No wise use of the soil exhausts its fertility.

Ignorance and selfishness.—And, finally, the greatest waste of resources is the loss that comes to all our material development, through ignorant minds and unskilled hands. It is the old curse of ignorance together with the primal sin of selfishness that has led to the waste of the world's substance.

LESSON XCIX

AGRICULTURE AND EDUCATION

Educational value.—The boys and girls who have been studying these pages and the plants and animals of the farm to which we have constantly referred them, may be sure that they have not been neglecting their education in this study of agriculture. We have seen that the science of agriculture deals not only with the common things and processes of everyday life in the country, but that it reaches out and touches all the great branches of science and learning. In all that goes to give one a modern education of culture, agriculture plays a large and efficient part.

Practical value.—Agriculture has also its practical value as a school subject, in that its study enables the farmer to gain larger profits in his business. This value may not be realized at once by the boys and girls in the public schools, but in the extension schools and in the short courses at the colleges of agriculture, the profitableness of studying agriculture is often concrete and immediate.

An actual saving of over $1,000 in horse feed resulted from the information gained by a prominent business man and farmer of Salem, Ore., in the winter short course at the Oregon Agricultural College. Last year he came himself to the college, and this year, being unable to attend, sent his ranch foreman. The knowledge gained in the course on feeding of horses alone netted him a saving of over $1,000 in his feed bills, and his animals are in finer condition, he says, than ever before. Here is another concrete illustration of the value of scientific agricultural information.

Moral value.—The study of agriculture in the school and on the farm cannot help but make us better men and women. The boys and girls who love and care for plants and animals, surely cannot think or do as evil things as those who do not care for them. There is so much to learn, so much suffering and inconvenience because of ignorance, and so much service to be done, that the world is looking to the boys and girls in the public schools, who are learning how to think and to do things, to render the greatest service for country life.

It remains for you, teachers and pupils, who love the country life and desire its best interests, in the spirit and intelligence with which you have pursued these lessons, to go forth as leaders, where leadership is so much needed—in the open country. Be leaders in the grange. Be leaders in boys' and girls' clubs. Be leaders in country school and church. Uphold and advance every movement that will bring larger measures of justice and education to the farmer and his family.

LESSON C

THE FARM HOME

Home industries.—Our lessons in agriculture would not do justice to rural life if we did not refer to the country home and its works and influence. The development of the material and industrial side of the home life has not kept pace with the progress of men's work on the outside. Many of the industries of the early homes have been wisely taken from them and given over to the factories and shops. Two industries yet remain—cooking and cleaning. These are not much further advanced in their development than they were a thousand years ago. The time may come—it is to be hoped that it will, when women of the home will be relieved from most of the drudgery of cleaning and cooking, and these industries be turned over to specialists who will do them better and cheaper than they are now done, and that the home may become a place of rest and culture for the lives within. It will be long years before such ideals can be realized in the country, yet much can be done in the country home to lighten the labors of the mother, and enlighten the members of the household.

Some conditions making for the betterment of the farm home:

1. Beautiful natural surroundings, as brought out in a former lesson.

2. Absolute cleanliness from cellar to garret.

3. The absence of all carpets, lace curtains, and

bric-a-brac, and their places supplied with smooth, hardwood finish of window and door casings; hardwood, waxed floors; and furniture of plain, uncarved, smooth type.

4. Few pictures, well selected, in plain, modest frames, placed upon walls of restful tints.

5. Good books, daily papers, magazines, and farm journals in the library.

6. Musical instruments and members of the family who can appreciate good music.

7. Ample, shady porches, screened doors and windows, and well ventilated rooms.

8. Pure, clean food, well prepared and cooked, and cool, clean kitchen and dining rooms in which to prepare and eat the meals.

9. A bathroom with hot and cold water supplied.

10. A telephone and rural free mail service.

11. All the labor-saving machines that can be afforded.

12. Good roads, good schools, good churches, good markets available, and good people to live in the homes.

A stronger and better country home!—That is what we want. That is what we must have. The "New Earth" that is coming, will bring its rural homes of good cheer, of culture and education. In these homes will be strong men, sensible women, and happy children. Love will be law and wisdom chief ruler, and the child that is born in them is sure of all that the highest thought can secure for him in body, soul and spirit.

This is the stronger home, and in that home must be seen all the graces and gentleness in thought and word that make the happy illumination which, on the inside of the house, correspond to morning sunlight outside, falling on quiet dewy fields. Out of such homes neither knaves in politics, nor tyrants in business competition can ever come. With such homes, the golden age already dawning as the new century opens hastens its steps.

And for the woman in that home:

"A woman, in so far as she beholdeth
 Her one Beloved's face;
A mother—with a great heart that enfoldeth
 The children of the race;
A body free and strong, with that high beauty
 That comes of perfect use is built thereof;
A mind where reason ruleth over duty,
 And justice reigns with love;
A self-poised, royal soul, brave, wise, and tender,
 No longer blind and dumb;
A human being of unknown splendor,
 Is she who is to come."

A GLIMPSE INTO A GOOD FARM HOME

APPENDIX NOTES

Suggestive List of Materials and Equipment Needed in Using This Book

1. Three boxes of soil, one each of clay, sand, and humus loam.
2. One dozen Mason pint fruit jars.
3. One dozen tumblers.
4. Four lamp chimneys.
5. Sach's plant food tablets.
6. Samples of commercial fertilizers.
7. One-half dozen wide-mouth bottles.
8. Germination test box.
9. A fifty-foot tape line.
10. Hoe, spade, rake, axe, etc.
11. One pint of formaldehyde.
12. One spray pump.
13. Five gallons of lime-sulphur spray material.
14. Resin, beeswax, and tallow or linseed oil.
15. A pruning knife and saw.
16. An insect cage.
17. A Babcock tester.
18. One dozen test tubes.
19. One pound of potassium cyanide (deadly poison).
20. Window boxes.
21. A set of economic seeds.
22. Kitchen scales, weighing to twenty-four pounds.
23. Vessels for dry measure.
24. Bricker's drainage apparatus.
25. Animals and plants easily supplied from the farms.

Cornell University Score-Card for Farms

		Standard Score	Students' Score
1.	Kind of Farming—		
	Adaptation as affecting value	3	
2.	Size—		
	As adapted to kind of farming to be used	2	
3.	Shape—		
	As affecting shape of fields	2	
	As affecting nearness of farmstead	3	
4.	Topography—		
	As affecting production	1	
	As affecting ease of cultivation	3	
	As affecting loss of soil fertility	2	
5.	Fertility—		
	Natural	15	
	Condition	5	
6.	Physical Properties—		
	As affecting economy of cultivation	1	
	As affecting number of days of labor	1	
	As affecting loss of soil fertility	2	
7.	Drainage—		
	Natural or artificial	5	
8.	Condition—		
	Freedom from stumps, stones, weeds, waste land, etc.	3	
9.	Climate—		
	As affecting production of live stock	3	
	As affecting number of days of labor	2	
10.	Healthfulness—		
	As an economic factor	5	
11.	Water-supply—		
	Running water and wells	5	
12.	Location—		
	Local markets	5	
	Neighbors	5	
	Shipping facilities	5	
	Roadways	5	
13.	Improvements—		
	Location of farmstead	3	
	House as adapted to farm needs	5	
	Other buildings as adapted to size of farm and kind of farming	5	
	Fences, character, condition, arrangement	2	
14.	Timber, orchards, vineyards, etc.	2	
	Total	100	

The above score card, worked out for the pupils' home farms, would make valuable lessons in Elementary Agriculture.

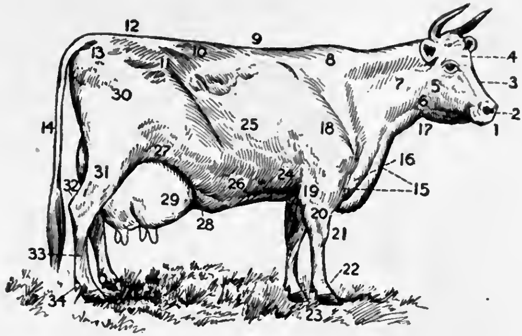


DIAGRAM OF COW

1, Muzzle; 2, Nostrils; 3, Face; 4, Fore-head; 5, Cheek; 6, Jaw; 7, Neck; 8, Withers; 9, Back; 10, Loin; 11, Pinbone; 12, Rump; 13, Hips; 14, Tail; 15, Chest; 16, Brisket; 17, Throat; 18, Shoulder; 19-20, Fore Arm; 21, Knee; 22, Pastern; 23, Foot; 24, Chest; 25, Ribs; 26, Belly; 27, Flank; 28, Milk Veins; 29, Udder; 30, Quarters; 31, Thigh; 32, Escutcheon; 33, Cannon; 34, Fetlock.

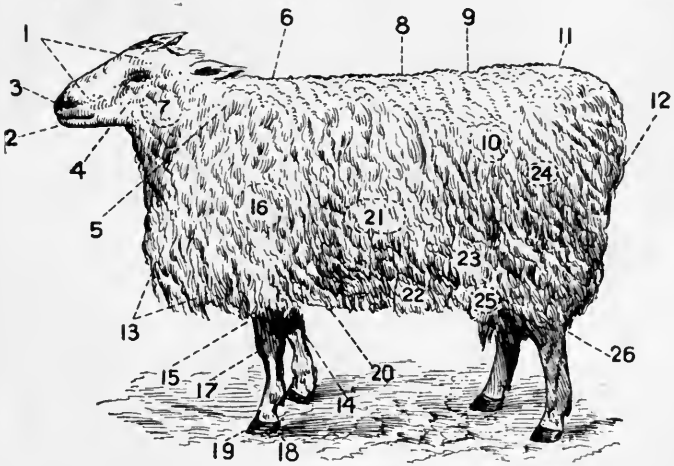
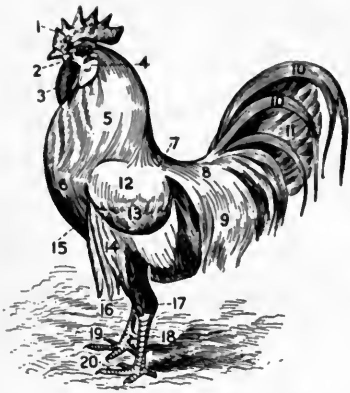


DIAGRAM OF SHEEP

1, Face; 2, Muzzle; 3, Nostrils; 4, Eye; 5, Neck; 6, Top of Shoulder; 7, Cheek; 8, Back; 9, Loin; 10, Twist; 11, Rump; 12, Dock; 13, Brisket; 14, Cannon; 15, Fore-leg; 16. Shoulder; 17, Knee; 18, Foot; 19, Toe; 20, Fore flank; 21, Ribs; 22, Belly; 23, Flank; 24, Hip; 26, Leg.



1, Comb.
2, Beak.
3, Wattles.
4, Lobes.
5, Neck.
6, Body and Fluff.
7, Back.
8-9, Tail Coverts.
10, Tail Primaries.
11, Tail Fluff.
12-13, Wing Coverts.
14, Wing Primaries.
15, Breast.
16, Thigh.
17, Heel.
18, Tarsus.
19, Spur.
20, Toes.

DIAGRAM OF CHICKEN

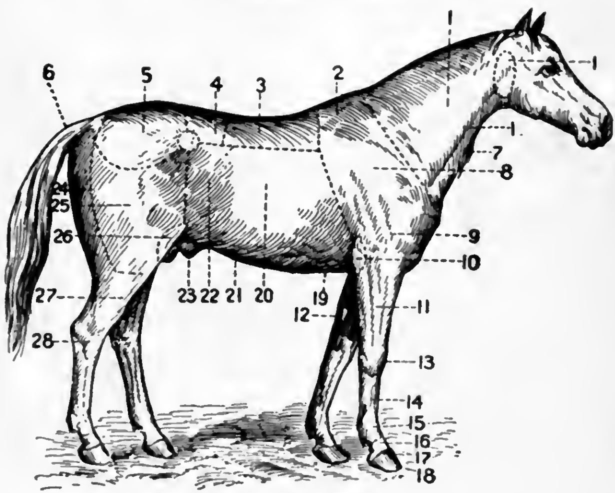


DIAGRAM OF HORSE

1, Neck. 2, Withers; 3, Back; 4, Loin; 5, Hip; 6, Dock; 7, Throat; 8, Shoulder; 9, Breast; 10, Fore-arm; 11, Arm; 12, Wart (x); 13, Knee; 14, Cannon-bone; 15, Fetlock; 16, Pastern; 17, Hoof; 18, Toe; 19, Chest; 20, Ribs; 21, Belly; 22, Flanks; 24, Gaskin; 25, Quarters; 26, Stifle; 27, Thigh; 28, Hocks.

INDEX