A MANUAL

—FOR—

Laboratory and Field Studies

—IN—

AGRICULTURE

—BY—

JOHN M. LECATO, A. B., A. M.
Head of the Department of Biology and Agriculture, Marshall College
STATE NORMAL SCHOOL
HUNTINGTON, WEST VIRGINIA

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PREFACE

The aim of this manual is to give the beginner in Agriculture something concrete to build upon besides the ordinary text-book work, which amounts to little unless the student can demonstrate the principles set forth in the book for himself. My object is to make Agriculture a live subject instead of a lifeless one, which is too often forced upon unwilling ears.

The work is planned for a one year's course, consisting of three hours of recitation and four hours of laboratory work per week. A large number of the exercises are based upon Farmers' Bulletins purposely, rather than text-books, since the Bulletins are available to all, while suitable reference books are next to impossible to procure in many of our schools. I have also kept in mind the fact that many schools cannot afford expensive apparatus, and have arranged the exercises accordingly. The entire equipment for a section of twelve can be purchased for $100.00 or less.

I wish to express my appreciation to Professor W. H. Franklin, who has read the manuscript critically; to Professor W. A. Adamson, who criticised the chemistry part of the manual; and to Miss Mary Donaldson, my associate, who tried out the Tree Key. Above all I wish to thank my wife, Esther Virginia LeCato, without whose help this manual could not have been brought to completion.

J. M. LeCATO,
Marshall College, Huntington, W. Va.

June 10, 1915.

EQUIPMENT

Each student should provide himself with the following equipment:

1. A text-book.
2. A copy of this manual.
3. One 4H drawing pencil.
4. Two Manilla folders for laboratory records.
5. Other equipment will be furnished by the school.

DIRECTIONS FOR LABORATORY WORK.

1. The laboratory work is an essential part of the course and the final grade is largely determined by the attitude of the student in the laboratory and the results accomplished.

2. Accuracy of statement is essential in writing up an exercise. Express the facts correctly. The writings must be in ink and must be legible.

3. Drawings should be carefully made with a 4H drawing pencil. Drawings made or inked with a fountain pen cannot be accepted. Grading will be upon neatness, accuracy and clearness.

4. The student is held responsible for any exercise or part of exercise missed by absence. Arrange for making up back work within a week after returning to the class. Credit is not given for exercises worked outside the laboratory.

5. The records of each laboratory exercise will be collected at the close of the laboratory period. No reports will be accepted after the time limit set by the instructor.

6. Do not mark or deface the laboratory tables or other furniture of the laboratory. Injury to a microscope or other apparatus, caused by careless usage or abuse, or lost parts, are charged against the student. If an instrument is out of order, or if you do not understand anything about it, report to the instructor at once.

FORESTRY.

A key to the common forest trees of West Virginia.

A Leaves linear, flat or awl shaped; cone-bearing; usually evergreen ..... Conifers
- B Leaves needle-like or flattened, single or in clusters.
  - C Leaves in clusters.
    - D Leaves and cones more than two inches long, evergreen ..... Pine (Pinus)
    - DD Leaves and cones two inches or less in length, deciduous ..... Larch (Larix)
  - CC Leaves not in clusters.
    - D Leaves stalked, cones ¾-inch long ..... Hemlock (Tsuga)
    - DD Leaves not stalked.
      - E Leaves flattened, soft; cones 2-4 inches long, erect ..... Fir (Abies)
      - EE Leaves 4-sided, harsh; cones 3-6 inches long, pendent ..... Spruce (Picea)
- BB Leaves scale-like.
  - C Branches flattened; fruit a cone ..... Arborvitae or White Cedar (Thuja)
  - CC Branches not flattened; fruit a small blue berry ..... Red Cedar (Juniperus)

AA Leaves broad and flat, not evergreen.
- B Leaves and buds alternately or spirally arranged.
  - C Leaves simple.
    - D Margin of leaves toothed, saw-toothed or lobed.
      - E Branches thorny ..... Hawthorn (Crataegus)
      - EE Branches not thorny.
        - F Leaves symmetrical at base.
          - G Leaves not lobed, but coarsely toothed on edges.
            - H Leaves elongate.
              - I Leaves 3-5 inches long, shiny beneath. Spray fine; bark steel grey; fruit a small bur ..... Beech (Fagus)
              - II Leaves 4-8 inches long.
                - J Fruit a large bur; bark brownish, vertically furrowed ..... Chestnut (Castanea)
                - JJ Fruit an acorn; buds and leaves clustered on end of twig ..... Chestnut Oak (Quercus)
            - HH Leaves rounded; buds scaly, often sticky; bark light colored ..... Poplar (Populus)

GG Leaves not lobed but finely serrate.
H Leaf-blades more than three times as long as broad.....Willow (Salix)
HH Leaf-blades not three times as long as broad.
I Bark smooth; trunk fluted.....Water Beech (Carpinus)
II Bark not smooth.
J Bark stringy, grey brown.....Ironwood (Ostrya)
JJ Bark coming off in angular black flakes; twigs bitter.....Wild Cherry (Prunus)
JJJ Bark coming off in thin rolls.....Birch (Betula)
GGG Leaves lobed.
H Lobes with prickly points.....Scarlet, Red, Black and Pin Oaks (Quercus)
HH Lobes without prickly points.
I Leaves of two kinds on tree, lobed and not lobed.
J Leaves thin, glabrous, twigs spicy, aromatic.....Sassafras (Sassafras)
JJ Leaves thicker, pubescent; twigs exuding milky juice when cut.....Mulberry (Morus)
II Leaves similar.
J Leaves truncate on top.....Tulip Tree (Liriodendron)
JJ Leaves not truncate, deeply lobed at base.....White Oak (Quercus)
JJJ Leaves more or less triangular, or star-shaped.
K Bark peeling, white; fruit a smooth ball.....Sycamore (Platanus)
KK Bark not peeling; fruit a spiny ball.....Sweet Gum (Liquidamber)
FF Leaves not symmetrical.
G Leaves doubly serrate; fruit a samara; tree vase-shaped in open.....Elm (Ulmus)
GG Leaves singly serrate.
H Leaves as long as broad, heart-shaped; fruit nut-like, hanging in clusters.....Basswood (Tilia)
HH Leaves longer than broad, ovate lanceolate; fruit a dark purple drupe.....Hackberry (Celtis)
DD Leaf margins smooth, not lobed.
E Leaves ovate to lanceolate; fruit a drupe.....Black Gum (Nyssa)
EE Leaves lanceolate, petioles pubescent; fruit a berry.....Persimmon (Diospyros)
EEE Leaves rounded; fruit a pod.....Redbud (Cercis)
CC Leaves compound.
D Twigs or branches armed.
E Twigs armed; leaflets not serrate.....Black Locust (Robinia)
EE Twigs unarmed; trunk and large branches armed; leaflets serrate.....Honey Locust (Gleditsia)
DD Twigs or branches unarmed.
E Leaflets entire except at base. Leaves large, exuding milky, evil-smelling juice when broken.....Tree of Heaven (Ailanthus)
EE Leaflets serrate.
F Leaflets more than 2½ inches broad; twigs compact.....Hickory (Carya)
FF Leaflets less than 2½ inches broad; pith of twigs chambered.....Walnut (Juglans)
BB Leaves and buds oppositely arranged or whorled.
C Leaves simple.
D Leaves lobed.....Maple (Acer)
DD Leaves not lobed.
E Leaves serrate.....Nannyberry (Viburnum)
EE Leaves entire.
F Leaves 3-5 inches long, spray fine.....Dogwood (Cornus)
FF Leaves 5-12 inches long, often whorled; fruit long cylindrical capsule.....Catalpa (Catalpa)
CC Leaves compound.
D Leaves digitately compound.....Horsechestnut or Buckeye (Aesculus)
DD Leaves pinnately compound.
E Leaflets 3-5, samaras paired.....Box Elder (Acer)
EE Leaflets 5-11, samaras not paired.....Ash (Fraxinus)

GLOSSARY OF TERMS USED IN FORESTRY.

Acute—Sharp-pointed.
Alburnum—The sapwood.
Annual—Yearly.
Berry—A thin-rind juicy fruit, usually with more than one seed.
Blade—The broad part of a leaf.
Compound—Having more than one leaflet.
Deciduous—Not persistent. Applied to leaves falling in autumn.
Digitate—Applied to a compound leaf in which all the leaflets radiate from the top of the petiole.
Drupe—A single seeded fleshy fruit.
Duramen—The heart wood.
Fluted—Not round, angular.
Glabrous—Without hair of any kind.
Internode—The space between two nodes.
Lanceolate—Applied to leaves broadest at base and tapering to apex.
Lateral—Coming from the side.
Latent—Appearing late or dormant.
Leaf Scar—Scar left by last year's leaf.
Lenticles—Small breathing pores that appear as dots upon the branches.
Linear—Applied to a leaf which is many times longer than broad, as that of the pine.
Netted—Veins running into each other.
Node—The point on a stem from which a leaf develops.
Obovate—Broader at tip than at base.
Obtuse—Blunt or rounded.
Ovate—Rounded at both ends.
Pendent—Hanging.
Petiole—The stem of a leaf.
Pinnate—Applied to a compound leaf where the leaflets are arranged on each side of a common petiole.
Pome—An apple-like fruit.
Pubescent—Downy or hairy.
Samara—A dry fruit with a wing-like appendage, as that of the maple.
Serrate—Toothed.
Spray—The twigs at the end of a branch.
Stipule—A leaf-like organ at the base of a petiole.
Symmetrical—Having both sides exactly alike.
Terminal—End.
Truncate—Cut off.

EXERCISE 1. LEAVES: Make an outline drawing of three of the leaves furnished you. Identify and label the following parts: Blade, veins, petiole (stem), and stipules (if present). Describe each leaf, using such of the following terms as applicable. If you do not know the meaning of these terms consult glossary above.

BLADE: Simple or compound.
VENATION: Parallel, netted, palmate, pinnate.
GENERAL FORM: Linear, oblong, lanceolate, oval, ovate, obovate.
APEX: Acute, obtuse, truncate.
MARGIN: Entire, serrate, dentate, sinuate, lobed.
COMPOUND LEAVES: Pinnately compound, bi-pinnately compound, palmately compound.
PETIOLES: Round, flat.

EXERCISE 2. STEMS: Study the branch of the basswood or some other common tree. Identify and locate all of the following features present: Node, internode, leaf scars, stipular scars, lateral buds, terminal buds, branch scars, lateral bud scar, terminal bud scars, lenticles, latent buds, and annual rings. Draw and label carefully the features noted.

EXERCISE 3. FRUITS: Study the fruits of the following trees: Maple, Elm, Walnut, Chestnut, Ash, Apple, Sweet Gum, Sycamore, Persimmon, Black Gum, Basswood, Locust. Write a description of each of the above fruits, using such of the following terms as applicable: Samara, pome, nut, pod, berry, drupe.

EXERCISE 4. FIELD TRIP: Object to study trees. Each student should provide himself with an old magazine for collecting leaves, a small box for collecting fruits, and a cheap notebook for taking notes. Do not try to write a detailed description of the tree in the field, but see that you have the following points before leaving each tree: (1) common name, (2) branch system, (3) form of leaf, (4) shape of tree as a whole, (5) kind and color of bark, (6) fruit, (if present).

Return to the laboratory and fill in the following table:

(Over)

EXERCISE 4.—Continued.

NAME OF TREE	No. of Species Found	Branch System	Form of Leaf	Shape of Tree	BARK		Fruit
					Color	Texture	

EXERCISE 5. Classify fifteen of the common trees of this locality according to the outline below:

Common Name	Genus	Branch System	Leaves			Fruit
			Simple or Compound	Form	Venation	

EXERCISE 6. Identification by Means of Key. Identify by means of the key the three trees selected. Write down the steps as you go, but do not put anything down until you are reasonably sure you are correct.

EXERCISE 7. Identification by Means of Key. Identify as many species as possible. Have the identification of each species approved before youstart to identify another one.

EXERCISE 8. The Study of Sections of Oak Wood. Examine a cross section of a young oak tree. Note three regions: (1) the heart, wood, duramen; (2) the sap wood, the alburnum; (3) the bark. Do you note any difference in color in the three? If so, what? Which of the three is the hardest? What special function does each of these regions perform? Notice concentric rings from the pith outward. How many are there in your specimen? Are all of them the same distance apart? If not, why are some closer together than others? Why are these rings called annual rings? Notice the pith rays running across the rings. Are all of them the same length? How can you account for the difference in length? What work do the pith rays do? Draw a surface view of the section, showing all parts studied.

EXERCISE 9. The Study of Sections of Wood. Study cubes of oak wood furnished you. Picture in your mind how it was cut. Identify all markings. Locate the following sections: (1) transverse, (2) radial longitudinal (cut parallel to rays), (3) tangential longitudinal (cut at right angles to rays). Describe the appearance of the pith rays in each. Draw a diagram showing how quarter sawn boards are cut. What is the advantage of quarter sawing over flat sawing? Which is the most saving of lumber? Why is quarter sawn wood so high priced? Examine some furniture. How can you tell which has been flat sawn and which quarter sawn?

EXERCISE 10. Microscopic Sections of Wood. Examine the sections given you with the low power of the microscope or with a hand lens. Is it a cross or longitudinal section? How can you tell the difference?

Note in the center of the stem the pith, made up of thin-walled clear cells. Just outside the pith note the wood or xylem. Can you see large openings in the wood? These are the tracheal vessels. Their use is to take water and minerals from the roots to the leaves. Is there any regularity in their distribution? Notice between the tracheae the wood fibres, small cells with thick walls. On the outer edge of the xylem note a ring of thin-walled brick-shaped cells, the *cambium*. This is the dividing line between the bark and the wood. It is the growing region of the stem. All of the tissue on the outside of the cambium layer is known as the *phloem*. How many different kinds of tissue do you see?

Do all of the cell walls in this region have the same thickness? On the very outside of the phloem note a single layer of cells called the epidermis. Note the *pith* rays running from the pith outward.

EXERCISE 11. The Estimation of the Number of Board Feet per Acre. Count all trees in a circular area of 118 feet in diameter (¼ acre); measure several trees and select one as nearly the average as possible. How many 16 feet logs may be cut from it? Estimate the diameter of the tree inside of the bark at top and bottom; then add these figures and divide the result by 2. Square this number, then subtract 60, multiply by 8; this gives the number of board feet in a 16 foot log. Multiply the number of board feet by the number of 16 foot logs found in the average tree. This will give you the number of board feet found in the average tree; then multiply this number by the number of trees found in one-fourth of an acre and you will get the number of board feet in this area.

REFERENCES ON FORESTRY AND RELATED SUBJECTS.

Selected from Farmers' Bulletins.

Bulletin No. 99.—Insect Enemies of Shade Trees.
Bulletin No. 134.—Tree Planting on Rural School Grounds.
Bulletin No. 173.—Primer of Forestry, Part I.
Bulletin No. 113.—The Apple and How to Grow It.
Bulletin No. 181.—Pruning.
Bulletin No. 358.—Primer of Forestry, Part II.
Bulletin No. 467.—The Control of the Chestnut-bark Disease.
Bulletin No. 482.—The Pear and How to Grow It.
Bulletin No. 491.—The Profitable Management of the Small Apple Orchard on the General Farm.
Bulletin No. 492.—The More Important Insect and Fungous Enemies of the Apple.
Bulletin No. 582.—The Use of Chestnut Timber Killed by the Bark Disease.
Bulletin No. 600.—An Outfit for Boring Taprooted Stumps for Blasting.
Bulletin No. 622.—Basket Willow Culture.
Bulletin No. 631.—Growing Peaches.
Bulletin No. 632.—Growing Peaches.
Bulletin No. 633.—Growing Peaches.

SECTION II.—SOILS.

EXERCISE 12. The Study of Soil Particles. Examine samples of gravel, sand, peat, clay, loam, and silt. Do you note any difference in size of particles? Take some of each and rub between thumb and forefinger. Which has the smallest particles? Take very small samples of each soil and put them on a

slide. Examine with the hand lens or with the compound microscope. Are all of the grains the same size, color, and texture? If not, what are the chief differences? Which has the most decayed plant matter in it? Is the amount of decayed plant matter and the color associated in any way? Describe each soil and draw several particles of each. If one particle is five times larger than another, denote size by 5X. Denote the smallest by X.

EXERCISE 13. THE STUDY OF SOIL PARTICLES. Fill five jars half full of water, then put into No. 1 four spoonfuls of sand; into No. 2, clay; into No. 3, silt; into No. 4, loam. Shake each thoroughly for two minutes, then set aside. Which became clear first? Has the time of settling any relation to the size of particles?

EXERCISE 14. CLAY AND SANDY SOILS. Clay is called a heavy soil, and sand a light soil. Fill two cans of equal weight, one with clay and the other with sand; pack both down and weigh. What results? Take a shallow pan and fill it three-quarters full of clay. Take another and fill it three-quarters full of sand. Put half a pint of water on each, then work both with a stick. Which works the easier? Put both away until the next laboratory period. Describe the appearance of both. Would you advise a farmer to plow just after a rain? Do the terms heavy and light refer to the actual weight of soils or to the ease or difficulty of cultivation?

EXERCISE 15. THE POROSITY OF SOILS AND THEIR CAPACITY TO HOLD RAINFALL. Fill five soil tubes with different kinds of soils. Compact each tube by jarring it lightly upon the table, then weigh. Pour water into each tube just rapidly enough to keep the surface soil covered. Time the interval until the first drop appears in the receptacle. Stop pouring water into the tube at once, but put a piece of rubber cloth or waxed paper over the top of the tube to prevent evaporation. Weigh each tube as soon as it stops dripping. Figure out per cent. of gain in each case. This represents the soil's water holding capacity. Make several practical applications of the principles brought out in this experiment.

EXERCISE 16. THE ABILITY OF SOILS TO TAKE MOISTURE FROM LOWER LEVELS. Set up this experiment exactly as in Exercise No. XIV., but this time immerse the soil tubes into jars of water. Record the time it takes the water to reach the surface of each soil. Upon what physical action does the rise of the water in the tube depend? Discuss this action thoroughly and give its practical bearing in farming.

EXERCISE 17. THE EFFECT OF A MULCH. Take three pans and fill them nearly full of loam. Wet the soil in each thoroughly, but do not have an excess of water. Press the soil in one pan down; leave the second just as it is; and put a layer of sand over the third. Weigh the three and set aside until the next laboratory period, then re-weigh. Record results. What is a mulch? Would you advise a farmer to cultivate frequently during a drought? Give reasons for your answer.

EXERCISE 18. THE EFFECT OF LIME ON CLAY AND SANDY SOILS. Take two quart cans and fill each three-quarters full of clay; add three spoonfuls of lime to one, wet both with an excess of water and stir until the clay and the lime are thoroughly mixed. Examine both after several days and see which is the more easily crumbled. Why the difference? What do you mean by a well flocculated soil? Repeat this experiment with sand. What differences do you note in the effect of lime on each soil?

EXERCISE 19. THE PER CENT OF AIR IN SOILS. Put 250 cc. of sand, clay, silt, loam, and humus in five different beakers. Pour water into each beaker from a graduate until it reaches the surface of each soil. The volume of water required to wet the different soils is approximately the volume of air in each soil. Find the percentage of air in each soil. Can you see any reason why seeds often fail to come up in marshy soils?

EXERCISE 20. THE ACTION OF FROST ON CLAY. Take a pint of clay and mix it thoroughly with water and work it into a ball; bake it for twenty minutes, moisten it and then set it out in the open for several nights during freezing weather. Make another ball of clay the same way, but do not let it freeze. Examine both after three days. Describe the appearance of each. From the results of this experiment do you think fall plowing of clay land advisable? Can you give any other advantages in fall plowing?

EXERCISE 21. THE EFFECT OF COLOR ON THE TEMPERATURE OF SOIL. Fill a shallow box full of sand which has been darkened with lampblack; fill another with sand that has been whitened with lime; fill a third with sand and do not change its color. Lay each box flat upon the ground and insert the bulb of a thermometer about half inch under the surfaces of each. Record the temperature hourly of each on a sunny day. Other things being equal, what color of soil would you try to get if you were growing early vegetables. Give reasons for your answer.

EXERCISE 22. THE EFFECT OF DRAINAGE ON THE TEMPERATURE OF SOIL. Take two quart cans and fill both with the same kind of soil. Wet the soil of each thoroughly, but drain one can by punching holes in its bottom. Insert the bulb of a thermometer half inch under the surface of each soil and set them in the sunlight, and record hourly temperatures. Which of these soils could be worked earliest in the spring, and which would keep crops growing the longest in the fall?

EXERCISE 23. THE EFFECT OF EXPOSURE TO THE SUN ON THE TEMPERATURE OF SOIL. Fill three boxes about four inches deep with the same kind of soil and set them out on a sunny day. Place one level, the second inclined to the south, and the third inclined to the north at the same angle. Insert the bulb of a thermometer about one inch under the surface of each and record the hourly temperatures. Which is the warmer, a flat field, one that slopes to the north, or one that slopes to the south? Which do you think would be the driest by April 15th?

EXERCISE 24. SOIL AND SUBSOIL. Take a spade or soil auger and collect the soil and subsoil from several nearby fields. Note carefully the color of each. To what is the dark color in the surface soil due? How far down does it extend? Which soil is the more compact? Which contains the most moisture?

EXERCISE 25. THE PRODUCTIVITY OF SOIL AND SUBSOIL. Take two flower pots, fill one with soil and the other with subsoil. Plant several grains of wheat or some other grain in each. Record the growth of each for three weeks. Why did the wheat grow better in one spot than in the other? What effect upon the fertility of the field has the rapid washing away of the surface soil?

EXERCISE 26. THE RELATIVE AMOUNT OF WATER AND ORGANIC MATTER IN THE SOIL AND SUBSOIL. Take 20 grams of soil and put it into a crucible which has already been weighed. Put the soil in an oven and heat for one hour at 110 degrees. Re-weigh. This drives all of the water out of the soil. Burn this same soil in a crucible or iron bowl for one hour then weigh again. This removes the humus. Repeat this experiment with the subsoil. Using the above data, fill in the following table. Fill in second column with data taken from another student.

	Soil	Subsoil	Soil	Subsoil
Weight of crucible				
Weight of crucible plus soil				
Weight of soil	20	20	20	20
Weight of both when dry				
Per cent. of H^2O				
Weight of both after burning				
Per cent. of organic matter				
Per cent. of mineral matter				

EXERCISE 27. METHODS OF TESTING THE ACIDITY OR ALKALINITY OF SOIL. Take two soils, one of which is known to be slightly acid or alkaline, put a blue piece of litmus paper in each. What results? Repeat, using pink litmus. Are your results the same? If pink paper turns blue, the soil is said to be alkaline or sweet. If, however, the pink paper remains pink, the soil is acid or sour. Next, take a little lime and put it into the can which is acid. Test again and record your results. The lime neutralizes or destroys the acidity of the soil. Any excess of lime above that necessary to do this makes the soil alkaline. Do you know any reason why clover will not grow on acid soil? Does sheep sorrel show the presence of acidity or alkalinity in soil? What is the best remedy for acid soils?

(NOTE TO TEACHER)—If acid and alkaline soils cannot be collected in your locality you can make the soil acid by adding a little diluted sulphuric acid; alkaline by adding a diluted solution of potassium hydroxide.

EXERCISE 28. FIELD TRIP. OBJECT, TO STUDY SOILS IN THIS LOCALITY. Each student should bring with him a rough note book and several pieces of litmus paper. Note the general lay of the land. Would you class the land as hilly, level or rolling? Are the streams rapid or slow flowing? What use is made of the steep hillsides? What is done to prevent them from washing? Do the crops vary in any way with the exposure? Why are the valleys generally fertile? Is the soil clay, sand, or loam? Is it sweet or sour? (Test with litmus paper.) What crops are grown on each soil?

EXERCISE 29. FERTILIZERS. Examine samples of several well-known fertilizers. Note especially color, size of particles, odor. Put a small bit of each in a test tube and soak it in water for one hour. Which is the most soluble? Which the least? Which of the fertilizers do you thing would be the most quickly available for the plant? What elements are supplied in each fertilizer? What three elements are usually lacking in soil? What one element may be supplied by growing leguminous crops?

REFERENCES ON SOILS AND RELATED SUBJECTS.

Selected from Farmers' Bulletins.

Bulletin No. 77.—The Liming of Soils.
Bulletin No. 138.—Irrigation in Field and Garden.
Bulletin No. 245.—Renovation of Worn-out Soils.
Bulletin No. 263.—Practical Information for Beginners in Irrigation.
Bulletin No. 266.—Management of Soils to Conserve Moisture.
Bulletin No. 371.—Drainage of Irrigated Lands.
Bulletin No. 373.—Irrigation of Alfalfa.
Bulletin No. 404.—Irrigation of Orchards.
Bulletin No. 406.—Soil Conservation.
Bulletin No. 421.—Control of Blowing Soils.
Bulletin No. 494.—Lawns and Lawn Soils.
Bulletin No. 524.—Tile Drainage on the Farm.

SECTION III.—THE PLANT.

EXERCISE 30. A SEED-BEARING PLANT. Study a common plant of your neighborhood. Give its common name. Note four chief regions, (1) Root, (2) Stem, (3) Leaf, (4) Flower. What is the chief work of each of these parts? How is each part especially adapted to do this work?

(a) THE ROOT: Would you classify this root as fibrous or fleshy? Shallow or deep-rooted? Are the branch roots given off according to any system? Why are some roots highly prized by man and animals? Name three roots eaten by man.

(b) THE STEM: Is this stem woody or herbaceous? Climbing or upright? Are the branches given off according to any system? What? The place where a bud or leaf is given off is called a *node*, the region between two nodes is called an *internode*. How many nodes are there on this plant?

(c) THE LEAF: Are the leaves simple or compound? What is their shape? Is the veining netted, parallel or palmate?

(d) THE FLOWER: Identify the following parts: (1) Sepals, (2) Petals, (3) Stamens, (4) Pistil. How many sepals has this flower? What is their color? Their use? The sepals taken collectively is called the *calyx*. Count the number of petals. Why are they colored? Do flowers that bloom at night have brightly colored petals or are they mostly white? Can you give any reasons for the difference? The petals taken collectively are called the *Corolla*. How many *stamens* has this plant? Note that each is made up of a long slender stalk-like part, the filament, and an enlarged part, the anther. The anther is filled with a yellow dust, the pollen. Examine some of the pollen under a hand lens or a microscope. What is its shape? Its use? In the center of the flower locate the pistil or pistils. It is made up of three parts: The *ovary* is the large bulbous part at the bottom of the pistil. Cut a cross section of it. How many compartments is it divided into? What are in these compartments? Arising from the ovary note a slender portion, the *style*. What are its functions? Describe the *stigma* at the top of the style. Why is it broad and flattened? Draw a complete plant, labeling parts noted. Also draw a flower, showing its parts.

EXERCISE 31. THE ABSORPTION OF WATER FROM THE SOIL. Take two flower pots and put the same amount of soil in each; plant three grains of corn in one; water each pot daily with the same amount of water until the corn in the one is at least three inches tall. Weigh both pots, then quickly tie a rubber cloth or a piece of waxed paper around each, leaving only room for the corn to protrude through. Let each pot stand for one week, remove the paper and re-weigh. What percentage of its weight did each lose? What conclusions do you draw from this experiment?

EXERCISE 32. OSMOSIS. Take a piece of bladder or animal membrane and tie it over the end of a thistle tube; now fill the tube with a solution of water and molasses; immerse the tube into pure water and record the height of the liquid in the tube daily. What is osmosis? Why is this experiment given? Compare this apparatus with a cell.

EXERCISE 33. THE EFFECT OF SOLUTIONS OF DIFFERENT STRENGTH ON ROOTS. Take several radish seedlings, put one in distilled water, another in water the volume of which is one-fifth molasses, and a third in a solution which is one-fifteenth molasses. Examine each at the end of twenty minutes. Are the seedlings changed? How? Explain fully. Why should farmers avoid putting strong fertilizers near tender seedlings? Why is a salt put on meat to preserve it?

EXERCISE 34. PLANTS GET FOOD MATERIAL FROM THE EARTH. Take two quarts of sand and burn it until all of the humus has been completely burned out. Now make a soil solution by mixing two quarts of rich soil taken from beneath a manure heap with six quarts of distilled or rain water; stir thoroughly and drain off this water. Next, plant two grains of corn in each pot of the humus free soil, water one with rain or distilled water and the other with the soil solution. Water as needed and record the growth of the corn in each pot for four weeks. Is the difference in the seed planted or is it due to some other reason?

EXERCISE 35. PLANTS GIVE OFF MOISTURE. Take a plant that has several well developed leaves on it. Select a piece of cardboard the size of the pot or a little larger and cut a slit in it large enough to go around the plant. Seal the slit with wax or tallow so no moisture can escape from the pot below. Cover the plant with a tumbler and set in a warm sunny place. Note the number of minutes before moisture will be condensed on the inner surface of the glass. If a square inch of leaf surface gives off half gram of water per hour, how much water will be given off in a day (12 hours) by an oak which has 600,000 leaves, each leaf averaging eight square inches of surface?

EXERCISE 36. PLANTS MANUFACTURE FOOD ONLY IN THE PRESENCE OF SUNLIGHT. Take some common plant, as the geranium, and put it in the sunlight for a day. At the same time take another plant and put it in a dark room or cover it with something that excludes all of the light. Toward evening pick some of the leaves from each plant and boil them in alcohol, (this removes the green coloring matter of the leaf). Lay these leaves on a white plate and cover them with iodine. If there is any starch in the leaves it will turn black or bluish in color. What two lessons do you learn from this experiment?

EXERCISE 37. CARBON AND CARBON DIOXIDE. Take a piece of green wood and burn it in a test tube where only a small amount of air can get to it. Keep burning it until all gas and smoke is given off. What have you left? Give its color and any other noticeable characteristics. Soak it in water for half an hour. Does it dissolve? Pour some weak acid upon it, what results? Do you think a plant could take any of this substance in through its roots? Why not?

Now, take a piece of this same substance and hold it over a flame. Does it burn readily? Where does it go since there are no ashes left? What do we mean when we say a substance is oxidized? How do plants get their carbon? The gas formed by the burning of carbon is called carbon dioxide. Its presence may be detected with lime water. Take a tube of lime water and blow your breath into it several times. If a whitish film comes to the surface of the lime water it indicates the presence of carbon dioxide. Why are growing plants often recommended for sickrooms?

EXERCISE 38. THE LOCATION OF THE GROWING REGION OF A ROOT. Take several vigorous corn seedlings which have been germinated in a moist chamber. Mark each at intervals of one-quarter inch from tip of root to grain, either with waterproof ink or by tying pieces of dark cotton around the root. (Do not injure the root or expose it too long to the dry air of the room.) Examine at the end of two days. Why is it especially harmful to cut the tips off growing roots?

EXERCISE 39. THE DISSOLVING ACTION OF ROOTS. Take a piece of smooth marble about the size of a cigar box and one-quarter inch in thickness; put it into the box, cover it with humus, and plant corn in the box. At the end of three weeks pull up the corn and carefully wash the dirt off the stone. Can you see traces of the roots etched in the stone? Does this experiment help you to understand why plants can grow in cloddy and rocky soil?

EXERCISE 40. FUNGI. Take a piece of bread and dampen it, then expose it to the air of the laboratory for a few minutes. Observe every three days. By the end of a week there should be a cobwebby growth over the surface of the bread. What is the common name for this substance? Two kinds of fungi are likely to appear, a green one with fan-like heads, (Penicillium), and a gray or blackish one with globular heads, (Rhizopus). Are these plants *parasites* or *saprophytes?* Compare them with the green plant just studied.

The black heads of the gray fungus are fruiting bodies. Notice that within each head is a number of spherical bodies, the *spores*. Spores differ from seed by the fact that seeds are never formed without the union of the male germ with the egg, while spores are without sex, and may reproduce the plant without uniting with another spore. How did the spores get to the bread? What is your opinion concerning their numbers? Draw a filament of one of these fungi and show several fruiting heads.

EXERCISE 41. BACTERIA. Take several lima beans and place them in lukewarm water for forty-eight hours. At the end of this time note a film on the surface of the water; put some of this substance on a clean slide and observe under a microscope. Three different types of bacteria should be present:

(1) a round form, (2) a rod-like form, (3) a cork-screw form. Notice their methods of locomotion. Have they legs? Bacteria reproduce by simply dividing into two parts. Do you see any doing this? Draw the forms noted. If a single bacterium divides once every fifteen minutes, how many descendents will it have at the end of twelve hours?

EXERCISE 42. Bacteria on Legumes. Dig up a clover plant or some other legume and wash its roots carefully. Do you see small tubercles on the roots? Are they more abundant on the main or branch roots? About how many are there to the linear inch? What causes them? Why do farmers lime fields that are to be planted in leguminous crops? What element do leguminous crops bring to the soil? Name four other leguminous crops planted in this locality.

SECTION IV. PROPAGATION OF PLANTS.

EXERCISE 43. The Corn Kernel. Examine the corn kernel carefully. What difference do you note between the two broad sides? On the upper surface observe the scar left by the silk. Now examine a soaked grain. How many seed coats has it? Remove the seed coats and locate the "germ" or embryo. What per cent. of the whole grain does the embryo comprise? Surrounding the embryo note a white substance, the starchy *endosperm*. What is its use? Surrounding the starchy endosperm note an extremely hard substance, the horny endosperm.

Carefully remove the embryo; the part nearest the top of the kernel is called the *plumule*, the part nearest the tip is called the *radicle*. What does each of these parts form?

EXERCISE 44. The Bean. Compare a soaked with a dry lima bean. Which is the larger? Note the external markings. The scar in the center is called the *hilum*. What caused it? Near the hilum locate a small opening, the *micropyle*. It is the place where the *pollen* entered to fertilize the bean. Can you think of any other use it may have?

Remove the seed coats. How many has this seed? Within the seed coats note two fleshy parts, the *cotyledons*. Between the cotyledons locate the plumule. The part below the plumule is called the *hypocotyl*. What is its function? Make two drawings (1) showing the hilum and micropyl, (2) a half bean showing cotyledon, plumule, and hypocotyl in their proper positions. Write a description of a bean, comparing it with a corn kernel.

EXERCISE 45. The Corn Seedling. Identify in the seedling all parts studied in the mature kernel. Select a series showing different stages of growth. Draw. Carefully describe the changes which have taken place. What disposition is being made of the endosperm? Compare the growth of plumule and radicle.

EXERCISE 46. The Bean Seedling. Locate in a drawing all parts studied in the mature bean seed and describe the changes that have taken place during germination. Trace the process of germination step by step from its beginning until the first leaves are fully opened. What structures do you find that were not present in the mature seed?

EXERCISE 47. Yellow Lupine. Seect ten good lupine seeds and put them into a glass of water. Examine at the end of three days. How many have swelled? What does swelling indicate? Stick half of these not swelled with a pin and set aside for two days. How many have germinated by this time? Why didn't all of them germinate at once? Why did all of those stuck germinate? Is it an advantage or disadvantage to the plant to have seeds germinating at different times? Give reasons. Why is it clover will not all come up the first year?

EXERCISE 48. Factors Necessary for Germination: Air, Moisture, Heat. Take four good corn kernels and put them into a bottle of water that has been recently boiled, but not hot. (Why boil the water?) Now pour slowly some kerosene on the surface of the water. What does this do? Observe and record any changes in the grain.

Take four good corn kernels and plant them in some perfectly dry earth. Observe at the end of a week. Have they germinated? Why not? Take four good corn kernels and plant them in some moist soil that has been kept in a refrigerator for at least six hours. Replace them in the refrigerator and observe at the end of a week. Have they germinated? What three factors are necessary for germination?

EXERCISE 49. GERMINATION TABLE. Plant seeds of at least fifteen different plants. Label each pot, putting name of seed and date planted. Fill in the following table:

KIND OF SEED	No. of Days to Appear	Seed Forced Above Ground	Seed Remaining Below Ground	No. of Seed Leaves

EXERCISE 50. Propagation by Spores. Take some of the spores of the black mould found on bread and put it on various parts of a cut sweet potato. Keep the potato moist and in a warm dark place for a few days. In three or four days note the young whitish growth of mould on the inoculated parts. Take another sweet potato and cut the same away but do not inoculate it. Compare results.

EXERCISE 51. Propagation by Stems. The Irish Potato. Identify the proximal or attached end of the potato and the "eyes". What are the "eyes"? Are they arranged according to any system? If so, what is the system? At which end of the potato are they more abundant? Judging from position and relation to the stem, are there rudimentary leaves on the potato? Does the potato in any way serve the function of a root? Is it a root or a stem? Give all evidences for your conclusion. Draw, showing all points studied.

Make a cross-section of the potato and examine the cut surface for different regions of tissue. What different regions do you find?

Examine a thin section of the potato under a microscope. What are the grains and what is their relation to the cell of the potato? Study the structure of a single starch grain under the high power of the microscope. Draw. Trace the food material stored in the cells of a potato from its manufacture in the leaves of the plant to its consumption in the development of a shoot of next season. What is the function of the potato tuber? Explain the absence of seeds in some varieties of potatoes.

Compare a potato with the skin intact with one from which it has been removed for twenty-four hours. What is the function of the skin? Observe the *lenticels* in the skin. Should potatoes be stored in a very dry atmosphere? Should they be allowed to sprout in storage? Explain. If sprouts are removed will others appear?

Cut a potato into several pieces, some with eyes and others without eyes. Plant those with eyes in one flower pot and those without eyes in another pot. Compare at the end of ten days.

EXERCISE 52. Propagation by Roots. The Sweet Potato. Examine sweet potatoes which have started to grow. Do you find anything that corresponds to the "eyes" of the Irish potato? Is there any system in the arrangement of the small roots and the shoots which have started to grow? If so, what is that arrangement? Which end of the potato bears the majority of the new shoots? Does this depend on which end of the potato is uppermost while it is germinating? How do you explain this? From what kind of buds do the new shoots arise? What relation exists between the new roots and the new shoots? Of what advantage is this in the propagation of the plants? Draw, showing above points.

Is the sweet potato a root or a stem? State clearly the distinction between root and stem. What is the principal function of the sweet potato? How does this compare with the tuber of the Irish potato? How are sweet potatoes propagated?

EXERCISE 53. Propagation by Cuttings. (a) Soft cuttings. Select a vigorous shoot from a geranium, rose, begonia, tomato, or sweet potato, and divide it up into parts having two or more nodes; trim the leaves to about half of their surface. Why do this? Insert the cutting in moist sand about half of its length. Dig up a cutting every five days. How long is it before the first roots are formed?

(b) Hard cuttings. Select shoots of dormant mature wood of last season's growth from grape and willow. Divide the shoot in pieces from four to six inches long, so as to include two or more buds. These may be planted at once in moist, well-packed sand, or kept over winter in the cellar and planted the following spring.

EXERCISE 54. Propagation by Budding. Select a bud stick which has plump, well-matured buds on it. Pare off the buds by cutting a shield-shaped incision around each bud, leaving a small bit of the wood tissue on the bud. Cut the leaf blade off below the bud, but leave the petiole on to form a handle for the bud.

Now, select a good healthy seedling which is at least as large as an ordinary pencil. Make a T-shaped incision in the seedling about two inches above the ground. Loosen the bark on both sides of the incision and insert the bud (using the leaf petiole as a handle) until the cut surface of the bud comes in contact with the cut surface of the stock. Tie the bud firmly in place with raffia or worsted string, but see that the string does not press against the bud itself. At the end of two weeks examine the bud. If it is dried and shriveled, the seedling should be re-budded. In either case cut the binding string. Why? The operation is now complete until the following spring; then cut off the seedling just above the bud. Why is this necessary?

The more successful fruit growers always bud on the north side of the seedling. Can you give any reason for this practice? Name five trees that can be budded successfully.

EXERCISE 55. The Making of Grafting Wax. Weigh out 10 grams of resin, 5 grams of beeswax and 2½ grams of tallow or linseed oil. Melt these three ingredients together until each is thoroughly liquified, then pour the liquid into cold water. Grease your hands with tallow and begin to pull the wax as soon as it becomes cold enough to handle; keep working and pulling it until it becomes tough and straw-colored.

EXERCISE 56. Propagation by Grafting. Cut off a branch one to two inches in diameter, being careful not to loosen the bark from the stub. Split the end of the stub with a grafting tool, then insert a wedge in the cleft to keep it open while the scion is being inserted. The scion should always be of mature last season's growth, and should contain several buds. The lower end of the scion, which is to be placed into the cleft, should be cut into the shape of a wedge, with the outer edge thicker. The scion should be so cut that the lowest bud comes just to the top of the wedge. It is often advisable to put two scions opposite each other on the same stock. This will double your chance of success and the weaker may be cut off if both live. After the scion is securely adjusted, grafting wax should be put on all exposed places. Why is this necessary? To make the stock and scion unite, what tissues must come together? What name is given to this particular kind of grafting?

REFERENCES ON PLANT PROPAGATION.

Selected from Farmers' Bulletins.

Bulletin No. 157.—The Propagation of Plants.
Bulletin No. 181.—Pruning.
Bulletin No. 204.—The Cultivation of Mushrooms.

SECTION V. PLANT DISEASES.

EXERCISE 57. Fire Blight of Apple and Pear. Examine diseased and healthy twigs. Note the character of the bark of each. Is the line of disease demarcation sharp or not? Cut the twigs crosswise. Do you note discolorations of any kind? How far down the twig do they extend? In what tissue do they extend the fartherest? Is this much farther than the external indication of the disease? How will this knowledge help you in controlling this disease? Can you ascertain the point of infection? Why are the twigs bearing blossoms infected more often than others? If the disease attacks a branch it produces cankers. How do you suppose the branch became infected? How deep is the canker? What do you think will be its ultimate effect upon the branch? This disease is caused by Bacillus amylovorous, a bacterium. It cannot be killed by spraying, but its numbers can be greatly reduced by cuting out the affected parts. These parts should be burned and the wound sterilized with formalin. Why is this necessary?

EXERCISE 58. Cedar and Apple Rust. How does this disease affect the cedar? Describe the cedar apple, giving its size, color, location on twig, etc. Cut the apple open and locate the spores. Contrast the appearance of this disease on the cedar with its appearance on the apple. Is there any way of telling it is the same disease? Scrape some of the diseased spots on the apple leaf and examine them under the microscope. Describe the spores.

The life history of this disease is as follows:

The disease lives over winter on the cedar tree, forming cedar apples; the following spring the cedar apple gives off a number of reddish yellow spores, called teleutospores. These blow from the cedar to the young leaves of the apple; there they germinate and produce the discolored places on the apple leaf. The fungus lives all summer on the apple. In the fall it produces rounded spores called uredospores; these are blown to the cedar, where they infect it, causing the cedar apple. What is one obvious method of controlling this disease? Draw a cedar apple and a diseased leaf.

EXERCISE 59. Brown Rot of Peach and Plum. Examine some fruit affected with this disease. What are its superficial characteristics? Does it affect the twigs or leaves or only the fruit? Scrape off some of the small tufts found on the outside of the fruit and examine it under the microscope. What are they made up of? Examine some of the old mummies found clinging to the trees. What has become of their tissue? Soak one in water and examine part of it under the microscope. Do you see spores? Is it advisable to destroy the old mummies? Why? One remedy for this disease is to spray with strong Bordeaux mixture in the winter. What makes this effective? Another remedy is to spray with self-boiled lime sulphur in the summer. Why is this effective? Why not use strong Bordeaux mixture all of the time?

EXERCISE 60. Oat Smut. Examine affected heads. What parts does it attack? What is the black sooty mass made up of? Examine some under the microscope. What shape are the spores? Is this disease of any importance in your community? How do you think it is spread? One of the standard remedies for this disease is to soak the seed for ten minutes in one pint of formalin diluted with thirty gallons of water, or about 1 cc. of formalin to 240 cc. of water. To see if the formalin lowers the vitality of the seed, perform the following experiment, using twenty seed in each test: Give per cent. of germination.

Per cent. of germination.

Soaked in water ten minutes .....
Soaked in formalin solution ten minutes.....
Soaked in formalin solution twenty minutes.....
Soaked in formalin solution thirty minutes.....
Soaked in double amount of formalin for ten minutes.....

EXERCISE 61. PLANT DISEASE TABLE. Tabulate the five most common diseases in your neighborhood, using the following table as a guide:

NAME OF DISEASE	CAUSE		Name of Plant Affected	Part of Plant Affected	Remedy
	Bacteria	Fungi			

EXERCISE 62. THE PREPARATION OF *Bordeaux* MIXTURE. The formula for ordinary Bordeaux mixture is 5 pounds of bluestone (copper sulphate), 5 pounds of lime and 50 gallons of water. This is too great a quantity to be made in the laboratory. It may be made by dissolving half pound of bluestone in two pounds of water. At the same time slake half pound of lime in two pounds of water. Strain the lime and water through cheese cloth and fill with water up to the 2½-pound mark. Now pour the bluestone into the lime water and mix well. The object is to get just enough lime to combine with the copper sulphate but an excess of lime does no harm. Pour some of the solution into a cup, then blow your breath on it. If there is an excess of lime present your breath will cause a flaky film to form on the surface. If no film is formed, more lime is needed. An excess of copper sulphate can be told by testing with a shiny nail or a bit of shiny iron. Put the nail into the solution; if there is an excess of copper sulphate the nail will become coated with a rusy film.

SECTION VI. INSECTS.

EXERCISE 63. THE GRASSHOPPER, A TYPICAL CHEWING INSECT. Locate the following main divisions of the body: (1) Head, (2) Thorax, (3) Abdomen. Locate the following organs and tell upon which divisions they are situated, their use and number: Legs, Wings, Spiracles, Antennae, Mouth, Eyes, both simple and compound, and Auditory organs. The mouth parts consist of the following structures, and must be worked out with extreme care: The *labrum*, or upper lip, is the hinged flap-like piece attached to the front of the head. It nearly covers the other mouth parts. Just beneath the labrum locate two thick short pieces, the *mandibles* or jaws. Note tooth-like projections on the inner surface of the jaws. What are they for? Directly beneath the mandibles is a second pair of jaws, the *maxillae*. Notice attached to each maxilla there is a five-jointed antenna-like organ, the palpa. These are used as feelers and tasters. Forming the under part of the mouth we have the *labium* or under lip. Note that it also has two *palpa* but these consist of only four segments. Carefully dissect these parts out, place them in their natural order and draw them 5X. What kind of spray would you use to kill an insect that has mouth parts like the grasshopper?

EXERCISE 64. THE SQUASH BUG, A TYPICAL SUCKING INSECT. Can you locate the same divisions of the body and organs on this insect as you did on the grasshopper? How do this insect's wings differ from those of the grasshopper? Why are the insects belonging to this group often called the half wings? The mouth parts are much harder than those of the grasshopper to work out, and require some patience, but with a little effort may be discerned. The upper lip (labrum) is a sharp pointed, triangular unsegmented piece that fits over the groove in the under lip. The under lip (labium) is a long four-jointed tube-like organ that sticks out far beyond the head. The mandibles and maxillae resemble each other so closely that it is difficult to distinguish them apart. There is one pair of each and they are long, hair-like organs with sharp points on the end. These organs are used to pierce the tissue of the plant and to start the flow of sap so it may be readily sucked up. What kind of spray would you use to destroy this insect? Would Paris green kill them? Why not?

EXERCISE 65. THE LIFE HISTORY OF AN INSECT AS ILLUSTRATED BY THE CABBAGE BUTTERFLY. Collect some cabbage caterpillars. What color are they? Are they smooth or hairy? How many true legs do they have? Have they biting or sucking mouth parts? Feed them fresh moist cabbage leaves every morning. At the end of ten days, and perhaps before if the worms are large, they will change into a *chrysalis*. Does the chrysalis resemble the caterpillar? How does it differ? Are there any points of likeness between the two. Keep the chrysalis for another ten days, at the end of which time it should turn into a white butterfly. How does the butterfly differ from the caterpillar and chrysalis? The butterfly is the adult stage of this insect and will not undergo any more transformations. Its work is to lay eggs, which hatch into caterpillars. Do butterflies and moths do any damage in the adult stage? Have the adults biting mouth parts? What kind of spray would you recommend to kill caterpillars?

NOTE TO TEACHER: The various stages may be collected in the summer and kept in a four per cent. formalin solution if they cannot be procured when wanted, but it is best to use fresh specimens whenever possible.

EXERCISE 66. THE SAN JOSE SCALE. Examine trees in an orchard infested with this pest. Note the appearance on both large branches and small twigs. Do you note any difference in appearance? Take some of the scale to the laboratory and study it under the hand lens. Find three forms: (1) The adult female. These are brown to grayish in color, with a prominent nipple-like projection in the center. (2) The Male. These resemble the females very much but the nipple is at one end instead of in the center. The winged males are hard to procure and if not found should be studied from drawings, but wherever possible study the specimen itself. (3) The half grown stage, known as the "nigger" stage, can be recognized by its carbon black color and its size. Carefully remove the external scale from the insect itself. What is its color? Shape? Examine under the hand lens or low power of the microscope. Has it legs, wings, eyes, or antennae? Locate its sucking apparatus. Where is it located? Make drawings of the different stages and the insect with the scale removed.

EXERCISE 67. INSECT PEST TABLE. Tabulate ten destructive insects of your locality, using this table as a guide:

NAME OF INSECT	MOUTH PARTS		Plant Affected	DAMAGE DONE AS		Control
	Biting	Sucking		Larvae	Adult	

EXERCISE 68. THE PREPARATION OF LIME SULPHUR. The common formula for lime sulphur is twenty pounds of lime, fifteen pounds of sulphur, and fifty gallons of water. It may be made in the laboratory as follows: Slake 25 grams of lime in 200 cc. of water, then add 40 grams of flowers of sulphur. Shake vigorously for five minutes, then pour into an open vessel and heat for 45 minutes; stir occasionally to prevent the liquid from boiling over. Let stand for fifteen minutes then notice color, density and odor of the solution. Is there any sediment? What is its character? Now test with the Baume hydrometer for its specific gravity. To use as a winter spray for the scale dilute as follows:

Reading of Hydrometer in Degrees Baume	Number of Gallons of Water to One Gallon of the Concentrate
35	9
34	8¾
33	8¼
32	8
31	7½
30	7¼
29	6¾
28	6½
27	6
26	5¾
25	5¼
24	5
23	4½
22	4¼
21	3¾
20	3½
19	3¼
18	3
17	2¾
16	2½
15	2¼
14	2

EXERCISE 69. THE PREPARATION OF KEROSENE EMULSION, A CONTACT INSECTICIDE. The formula for making this insecticide is as follows: Hard soap, ½ pound (finely shaved); hot water, 1 gallon, (soft); Kerosene, 2 gallons. Dilute with 50 gallons of water. This insecticide may be made in the laboratory by dissolving 1 gram of soap in 16 cc. of boiling water; after the soap has dissolved add 30 cc. of kerosene. Now shake the liquid thoroughly until the solution is emulsified. What is its color now? Do you see any particles of free kerosene? This solution is too strong to be put on tender plants and should be diluted with 500-600 cc. of water. This preparation is very effective against plant lice of various kinds. How does it kill them?

EXERCISE 70. PURITY TEST FOR PARIS GREEN. Paris green is often diluted with other materials which do no harm to insects, but cost the farmer a great deal of money. Collect samples of Paris green from several local dealers. Bring some of it to the laboratory and weigh out 1 gram. Put it into a breaker and add 25 cc. of ammonia of water. Stir vigorously for five minutes, then let it stand for ten. Is the solution a clear dark blue or is it murky-looking? Is there a solid residue left? Murkiness and a solid residue indicate impurities.

REFERENCES ON PLANT DISEASES, FUNGICIDES AND RELATED SUBJECTS.

Selected from Farmers' Bulletins.

Bulletin No. 221.—Fungous Diseases of the Cranberry.
Bulletin No. 243.—Fungicides and their Use in Preventing Diseases of Fruits.
Bulletin No. 284.—Insect and Fungous Enemies of the Grape.
Bulletin No. 345.—Some Common Disinfectants.
Bulletin No. 440.—Spraying Peaches for the Control of Brown Rot, Scab, and Curculio.
Bulletin No. 467.—Chestnut-bark Disease.
Bulletin No. 476.—The Dying of Pine in the Southern States.
Bulletin No. 488.—Diseases of Cabbage and Related Crops.
Bulletin No. 489.—Two Dangerous Imported Plant Diseases.
Bulletin No. 492.—The Fungous Enemies of the Apple.
Bulletin No. 507.—The Smuts of Wheat, Oats, Barley and Corn.
Bulletin No. 544.—Potato-tuber Diseases.
Bulletin No. 555.—Cotton Anthracnose.
Bulletin No. 618.—Leaf Spot, a Disease of the Sugar Beet.
Bulletin No. 625.—Cotton Wilt.

REFERENCES ON INSECTS AND INSECTICIDES.

Selected from Farmers' Bulletins.

Bulletin No. 99.—Insect Enemies of Shade Trees.
Bulletin No. 120.—Insects Affecting Tobacco.
Bulletin No. 127.—Important Insecticides.
Bulletin No. 172.—Scale Insects and Mites on Citrus Trees.
Bulletin No. 178.—Insects Injurious in Cranberry Culture.
Bulletin No. 264.—The Brown Tail Moth.
Bulletin No. 275.—The Gypsy Moth.
Bulletin No. 442.—The Treatment of Bee Diseases.
uBlletin No. 444.—Remedies and Preventatives Against Mosquitoes.
Bulletin No. 447.—Bees.
Bulletin No. 450.—Some Facts About Malaria.
Bulletin No. 453.—Danger of Spread of the Gypsy and Brown-tail Moths.
Bulletin No. 456.—Our Grosbeaks and their Value to Agriculture.
Bulletin No. 459.—House Flies.
Bulletin No. 478.—How to Prevent Typhoid Fever.
Bulletin No. 500.—Control of the Boll Weevil.
Bulletin No. 503.—Comb Honey.
Bulletin No. 506.—Food of Well-known Birds.
Bulletin No. 512.—The Boll Weevil Problem.
Bulletin No. 540.—The Stable Fly.
Bulletin No. 543.—White Grubs.
Bulletin No. 547.—The Yellow Fever Mosquito.
Bulletin No. 557.—The Potato Tuber Moth.
Bulletin No. 564.—The Gypsy and the Brown-tail Moths.
Bulletin No. 593.—Arsenate of Lead as an Insecticide.
Bulletin No. 606.—Collection and Preservation of Insects for Class Use.
Bulletin No. 626.—The Carpet Beetle.
Bulletin No. 630.—Common Birds Useful to the Farmer.

EXERCISE 71. THE RECOGNITION OF VEGETABLE SEED. Examine seed of 25 of our common vegetables. Classify them according to the following table:

NAME	SHAPE Spherical Flat Oblong	SURFACE Smooth Rough Angular	COLOR Light Medium Dark	SIZE Small Medium Large

EXERCISE 72. THE CLASSIFICATION OF VEGETABLES. Classify the vegetables grown in your locality according to the following table:

NAME	Root	Bulb	Tuber	Foliage	Stem	Fruit

EXERCISE 73. THE MARKETING OF VEGETABLES. Visit several local stores or markets to see how vegetables are sold. Before leaving each store see that you have the following points: (1) Note how the vegetables are packed and displayed. (2) Price. (3) Whether home or foreign grown. (4) Variety. (5) Quality. Hand in a written report of this trip tomorrow.

EXERCISE 74. PLANTING OF STUDENT GARDENS. Suggest a planting for the plots on page 25, keeping in mind that in every garden we should have (1) variety; (2) a succession of vegetables; (3) spring and fall crops.

STUDENT GARDEN, MARSHALL COLLEGE

Huntington, West Virginia

118 ft.

59 ft.

1	2	3	4	5	6	7	8	9	10	21
Walk 3 ft. Wide										
11	12	13	14	15	16	17	18	19	20	22

PLOTS 1—20 Students Plots 10x28 ft. 1-2 ft. between plots.

PLOTS 21—22 Instructor's Demonstration Plots, 12x28 ft.

EXERCISE 75. PLANTING TABLE. Fill in the following table for our common vegetables:

NAME	Part Planted	Date of Planting in Open	PLANTING DISTANCE		Days to Maturity
			Rows	Plants in Rows	

EXERCISE 76. Home Garden. Draw a plan of your ideal home garden, size 50 by 100 feet. Lay it off in beds and rows and show what plants you would have in it on June 1st.

REFERENCES ON VEGETABLE GARDENING AND RELATED SUBJECTS.

Selected from Farmers' Bulletins.

Bulletin No. 61.—Asparagus Culture.

Bulletin No. 62.—Marketing Farm Produce.

Bulletin No. 121.—Beans, Peas and Other Legumes as Food.

Bulletin No. 154.—The Home Garden.

Bulletin No. 185.—Beautifying the Home Grounds.

Bulletin No. 213.—Raspberries.

Bulletin No. 218.—The School Garden.

Bulletin No. 220.—Tomatoes.

Bulletin No. 224.—Canadian Field Peas.

Bulletin No. 232.—Okra.

Bulletin No. 254.—Cucumbers.

Bulletin No. 255.—The Home Vegetable Garden.

Bulletin No. 256.—Preparation of Vegetables for the Table.

Bulletin No. 282.—Celery.

Bulletin No. 289.—Beans.

Bulletin No. 324.—Sweet Potatoes.

Bulletin No. 354—Onion Culture.

Bulletin No. 359.—Canning Vegetables in the Home.

Bulletin No. 407.—The Potato as a Truck Crop.

Bulletin No. 433.—Cabbage.

Bulletin No. 434.—The Home Production of Onion Seed and Sets.

Bulletin No. 460.—Frames as a Factor in Truck Growing.

Bulletin No. 521.—Canning Tomatoes.

Bulletin No. 548.—Marketing Sweet Potatoes.

EXERCISE 77. POTATOES. Examine samples of several local varieties. Are the seed home or foreign grown? What are the advantages of foreign grown over home grown seed? Make a detailed study of the samples, using the outline below as a guide:

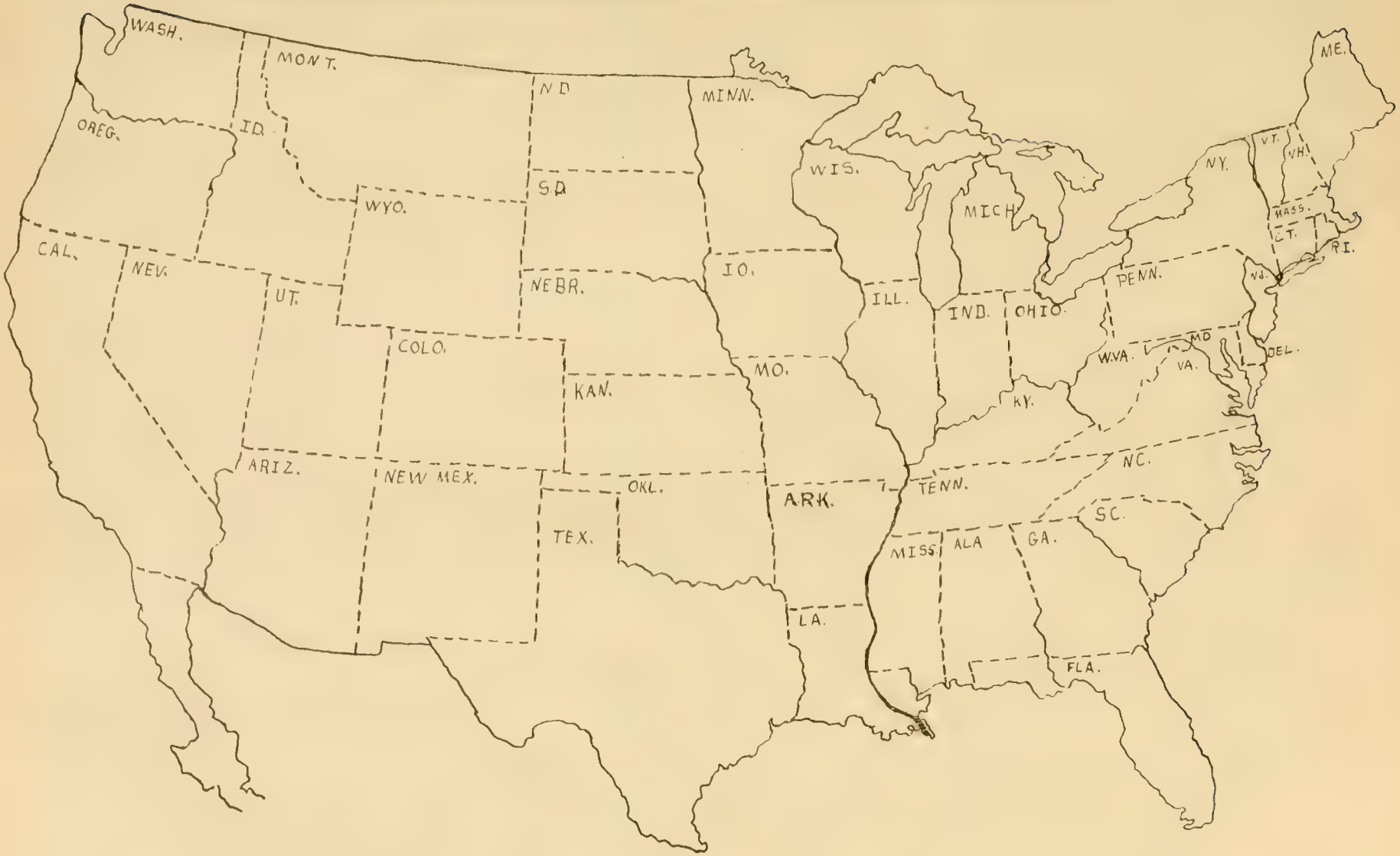
VARIETY	Color	Average Weight	Shape	EYES				Condition
				Many	Few	Deep	Shallow	

EXERCISE 78. Amount of Waste in Different Varieties of Potatoes. Weigh and pare three potatoes of about the same size of each variety, being careful not to take off more paring than is necessary. Re-weigh. What per cent. did each variety lose in paring? What variety would be the cheapest for home consumption?

EXERCISE 79. The Distribution of Potatoes in the United States. Use the data below, selected from United States Year Book, 1913. Show the distribution of potatoes by putting one dot for every 100,000 bushels on the map on the next page.

State	*Bushels*	*State*	*Bushels*
Maine	28,160,000	Missouri	3,230,000
New Hampshire	2,074,000	North Dakota	5,100,000
Vermont	3,175,000	South Dakota	4,680,000
Massachusetts	2,835,000	Nebraska	5,664,000
Rhode Island	650,000	Kansas	2,920,000
Connecticut	2,208,000	Kentucky	2,450,000
New York	26,640,000	Tennessee	2,432,000
New Jersey	8,930,000	Alabama	1,512,000
Pennsylvania	23,320,000	Mississippi	960,000
Delaware	957,000	Louisiana	1,750,000
Maryland	3,741,000	Texas	2,340,000
Virginia	9,870,000	Oklahoma	1,920,000
West Virginia	3,984,000	Arkansas	1,800,000
North Carolina	2,400,000	Montana	5,040,000
South Carolina	800,000	Wyoming	1,680,000
Georgia	972,000	Colorado	9,200,000
Florida	912,000	New Mexico	612,000
Ohio	10,240,000	Arizona	75,000
Indiana	3,975,000	Utah	3,600,000
Illinois	5,750,000	Nevada	1,760,000
Michigan	33,600,000	Idaho	5,780,000
Wisconsin	32,155,000	Washington	7,380,000
Minnesota	30,250,000	Oregon	6,750,000
Iowa	7,200,000	California	8,092,000

Map showing the distribution of potatoes in the United States. One dot equals 100,000 bushels.



EXERCISE 80. CORN. Study ears of as many types and varieties of corn as are represented locally. Fill in the following table for each variety studied:

VARIETY NAME						
Weight of 10 grains						
Length of 10 grains						
Width of 10 grains						
Shape { Wedge, Spherical, Conical }						
Shape of Top { Rounded, Flat, Dented }						
Color						
Length of Ear						
Length of Cob						
Circumference of Ear						
Circumference of Cob						
Color of Cob						

COMMENT

SCORE CARD

CORN

Scale of Points.		*Ear No.*				
1. Trueness to Type	10					
2. Maturity and Market Condition	10					
3. Shape of Ear	10					
4. Length of Ear	10					
5. Circumference of Ear	5					
6. Shape of Kernel	5					
7. Uniformity of Kernel—Color—Size	10					
8. Character of Germ	10					
9. Butts	5					
10. Tips	5					
11. Straightness of Rows	5					
12. Space between Rows	5					
13. Size of Cob	10					

Totals.....

VARIETY STANDARDS.

Recognized Varieties.

Yellow	*Length*	*Circumference*
Reid's Yellow Dent	10 to 10½	7¼ to 7½
Leaming	10 to 10½	7½ to 7¾
Legal Tender	10 to 10½	7¼ to 7½
White		
Boone County White	10½ to 11	7½ to 7¾
St. Charles White	10 to 10½	7¼ to 7½
Other Varieties.		
Yellow		
Cartner	9 to 9½	7¼ to 7½
St. Charles Yellow	10½ to 11	7¼ to 7¾
White		
Silvermine	9 to 9½	7 to 7¼
Johnson Co. White	10½ to 11	7½ to 7¾

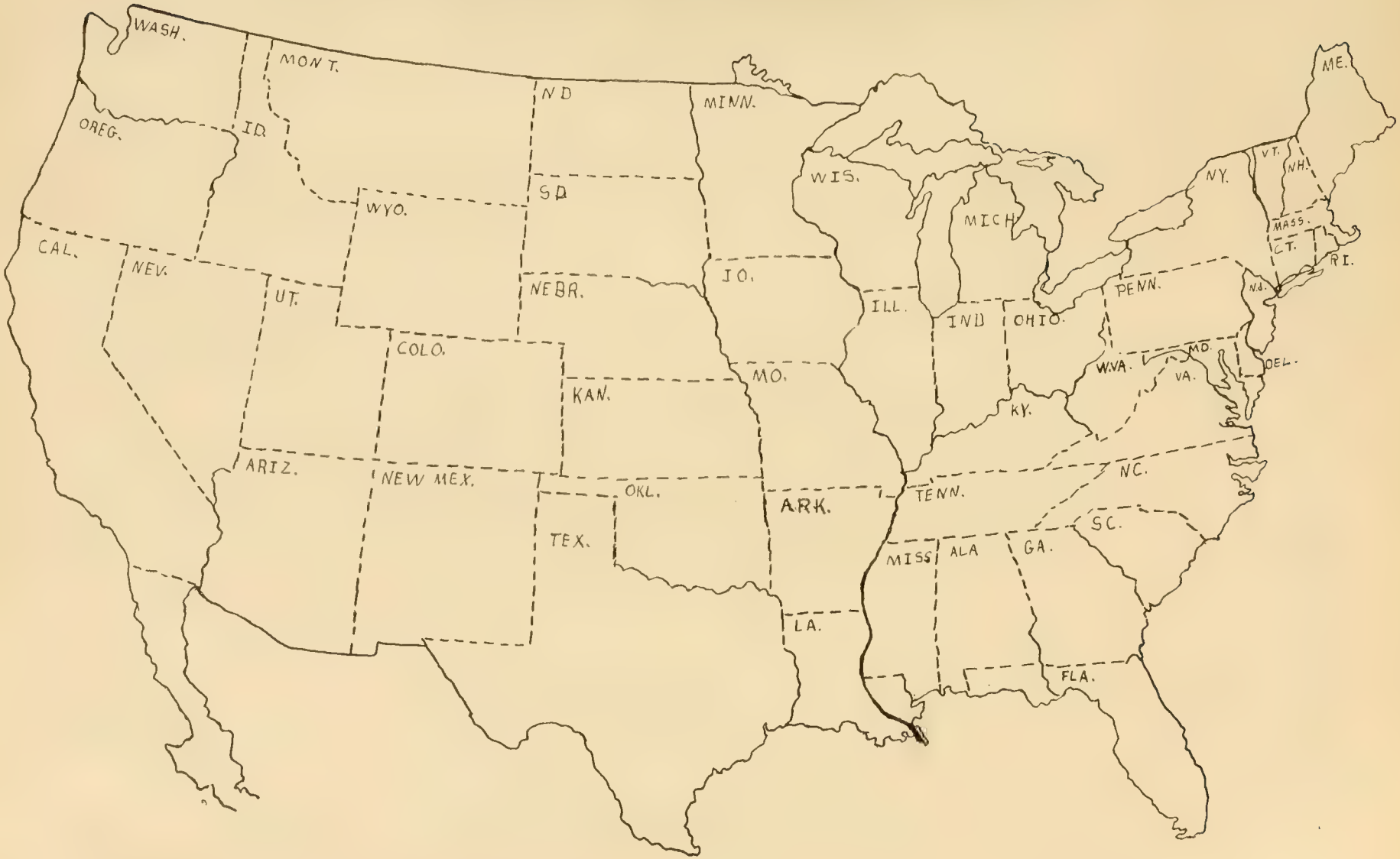
Varieties Judged. 1.
2.

EXERCISE 82. SEED TESTER. A seed tester may be made by sawing off the top of an old box four inches from the bottom. Put two inches of thoroughly wet sawdust or sand in the box. Cover this with a piece of white muslin which has been marked off in 2-inch squares. Number the squares from 1 up; then take six kernels from the ear to be tested, two from the butt, two from the tip and two from the middle of the ear. Put these kernels in square No. 1 and number the ear 1. Why do this? Put the kernels from as many ears as are to be tested in their respective places. Now cover the tester with several thicknesses of cloth or blotting paper. Wet thoroughly every other day for eight days. On the ninth day examine; if some of the kernels are not well germinated wait another three days and examine again. Figure out percentage of perfect germination. Tell another way you could make a seed tester at your home. Give two reasons why all seed should be tested before planting.

EXERCISE 83. THE DISTRIBUTION OF CORN IN THE UNITED STATES. Use the data below, selected from United States Year Book, 1913. Show the distribution of corn by putting one dot for every 100,000 bushels on the map on the next page.

State		*State*	
Maine	608,000	Missouri	129,062,000
New Hampshire	814,000	North Dakota	10,800,000
Vermont	1,665,000	South Dakota	67,320,000
Massachusetts	1,944,000	Nebraska	114,150,000
Rhode Island	402,000	Kansas	23,424,000
Connecticut	2,348,000	Kentucky	74,825,000
New York	15,020,000	Tennessee	68,675,000
New Jersey	10,862,000	Alabama	55,360,000
Pennsylvania	57,057,000	Mississippi	63,000,000
Delaware	6,206,000	Louisiana	41,800,000
Maryland	22,110,000	Texas	163,200,000
Virginia	51,480,000	Oklahoma	52,250,000
North Carolina	55,282,000	Arkansas	47,025,000
South Carolina	38,512,000	Montana	882,000
West Virginia	22,692,000	Wyoming	493,000
Georgia	63,023,000	Colorado	6,300,000
Florida	10,125,000	New Mexico	1,572,000
Ohio	146,250,000	Arizona	476,000
Indiana	176,400,000	Utah	340,000
Illinois	282,150,000	Nevada	34,000
Michigan	56,112,000	Idaho	448,000
Wisconsin	66,825,000	Washington	952,000
Minnesota	96,000,000	Oregon	598,000
Iowa	338,300,000	California	1,815,000

Map showing the distribution of corn in the United States. One dot equals 100,000 bushels.



EXERCISE 84. WHEAT. Select several local varities of wheat. Study them carefully and record your observations in the following form:

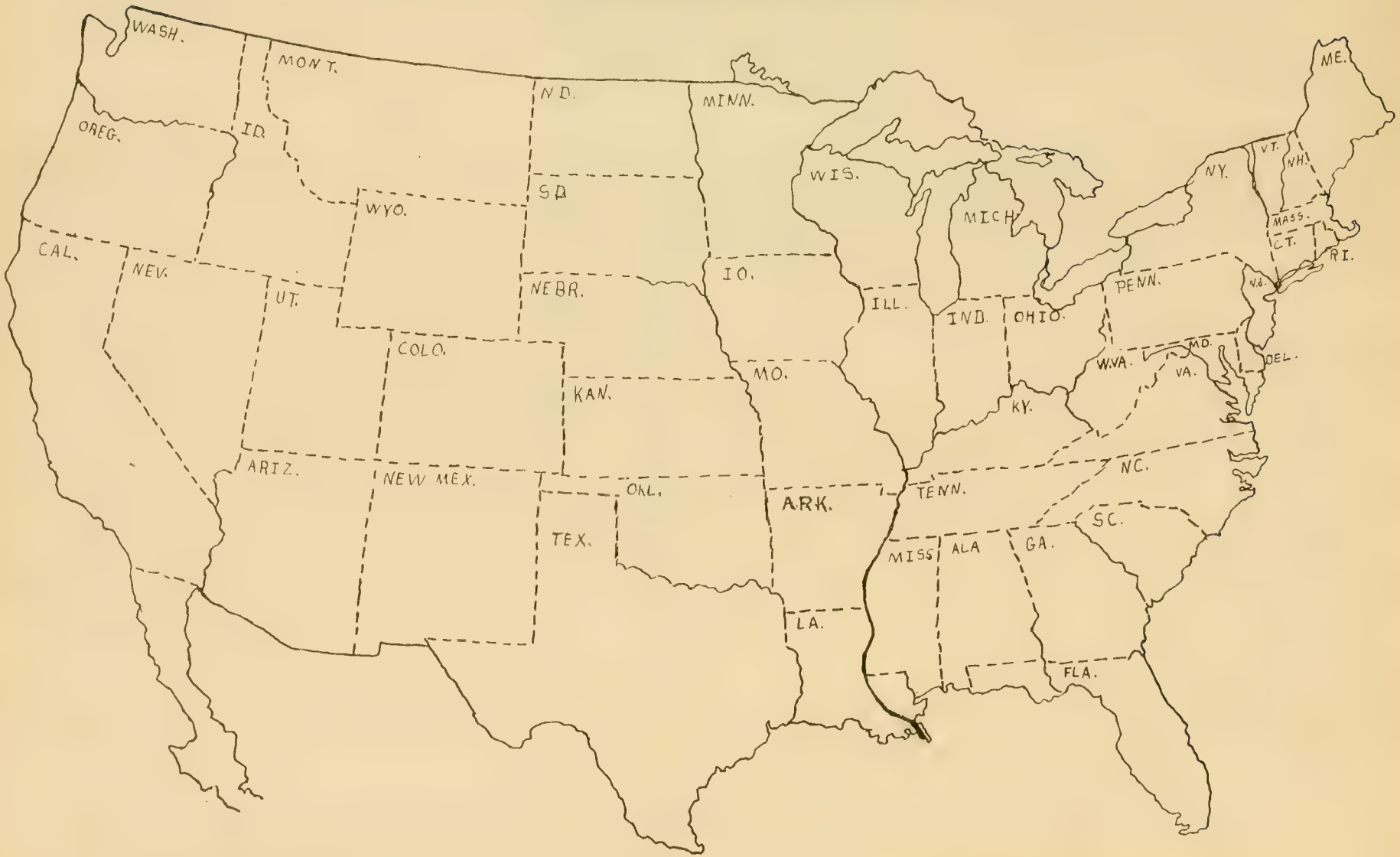
Variety				
Lgth. of Culm to Spike				
Spike				
a. Length				
b. Shape				
c. Color				
d. Bearded				
e. Beardless				
Length of Beards				
Arrangement of Glumes				
No. kernels to Spike				
Kernels				
a. Color				
b. Shape				
c. Hardness				
d. Weight of 100				

EXERCISE 85. The Distribution of Wheat in the United States. Use the data below, selected from United States Year Book, 1913. Show the distribution of wheat by putting one dot for every 500,000 bushels on the map on the next page.

State.		*State.*	
Maine	76,000	South Dakota	33,975,000
Vermont	24,000	Nebraska	62,325,000
New York	6,800,000	Kansas	86,983,000
New Jersey	1,408,000	Kentucky	9,860,000
Pennsylvania	21,862,000	Tennessee	8,400,000
Delaware	1,638,000	Alabama	374,000
Maryland	8,113,000	Mississippi	14,000
Virginia	10,608,000	Texas	13,650,000
West Virginia	3,055,000	Oklahoma	17,500,000
North Carolina	7,078,000	Arkansas	1,313,000
South Carolina	972,000	Montana	20,673,000
Georgia	1,708,000	Wyoming	2,250,000
Ohio	35,100,000	Colorado	9,680,000
Indiana	39,775,000	New Mexico	1,221,000
Illinois	41,888,000	Arizona	928,000
Michigan	12,776,000	Utah	6,420,000
Wisconsin	3,665,000	Nevada	1,081,000
Minnesota	68,040,000	Idaho	14,094,000
Iowa	16,395,000	Washington	53,300,000
Missouri	39,586,000	Oregon	15,717,000
North Dakota	78,855,000	California	4,200,000

EXERCISE 86. Comparison of Oats, Rye, And Barley. Compare these three cereals as to (1) method of growth, (2) length and shape of blades, (3) culm, (4) head, (5) grain. Which of these three cereals is grown the most abundantly in your locality? What is each used for?

Map showing the distribution of wheat in the United States. One dot equals 500,000 bushels.



REFERENCES ON FIELD CROPS AND RELATED SUBJECTS.

Selected from Farmers' Bulletins.

Bulletin No. 81.—Corn Culture in the South.
Bulletin No. 139.—Emmer.
Bulletin No. 229.—The Production of Good Seed Corn.
Bulletin No. 249.—Cereal Breakfast Foods.
Bulletin No. 253.—The Germination of Seed Corn.
Bulletin No. 272.—A Successful Hog and Seed Corn Farm.
Bulletin No. 292.—Potatoes and Other Root Crops as Food.
Bulletin No. 298.—Food Value of Corn.
Bulletin No. 303.—Corn Harvesting Machinery.
Bulletin No. 313.—Harvesting and Storing Corn.
Bulletin No. 343.—Cultivation of Tobacco in Kentucky.
Bulletin No. 365.—Farm Management in Northern Potato-growing Sections.
Bulletin No. 395.—Sixty Day Oats.
Bulletin No. 399.—Irrigation of Grain.
Bulletin No. 400.—A More Profitable Corn-planting Method.
Bulletin No. 414.—Corn Cultivation.
Bulletin No. 415.—Seed Corn.
Bulletin No. 420.—Oats; Distribution and Uses.
Bulletin No. 424.—Oats; Growing the Crop.
Bulletin No. 427.—Barley Culture.
Bulletin No. 428.—Testing Farm Seeds in the Home.
Bulletin No. 436.—Winter Oats.
Bulletin No. 443.—Barley; Growing the Crop.
Bulletin No. 448.—Better Grain-sorghum Crops.
Bulletin No. 466.—Winter Emmer.
Bulletin No. 501.—Cotton Improvement.
Bulletin No. 518.—Winter Barley.
Bulletin No. 523.—Tobacco Curing.
Bulletin No. 534.—Durum Wheat.
Bulletin No. 537.—How to Grow an Acre of Corn.
Bulletin No. 546.—How to Manage a Corn Crop in Kentucky and West Virginia.
Bulletin No. 552.—Kaffir as a Grain Crop.
Bulletin No. 553.—Popcorn.
Bulletin No. 554.—Popcorn for the Market.
Bulletin No. 565.—Corn Meal.
Bulletin No. 601.—A New Method of Cotton Culture.

SECTION IX. FORAGE AND PASTURE CROPS.

EXERCISE 87. THE GRASSES. The following eight grasses are the most common in the United States. If, however, others not given here are grown more commonly in your locality, substitute them. Timothy, Red top, Kentucky Blue Grass, Meadow foxtail, Orchard grass, Meadow fescue, Smooth brome grass, Crab grass. Study each grass carefully, then record your observations in the following form:

VARIETY				
1. Culm				
a. Length				
b. Erect				
c. Decumbent				
d. Strong				
e. Medium				
f. Slender				
g. Furrowed				
h. Foliage { Abundant / Scanty				
2. Leaf Blade				
a. Length				
b. Width				
c. Midrib { Prominent / Medium / Indistinct				
d. Open, folded				
3. Flowering head				
a. Color				
b. Length				
c. Open				
d. Compressed				
4. Use { Hay / Pasture				
5. Annual				
6. Perennial				

EXERCISE 87.—Continued.

Variety				
1. Culm				
a. Length				
b. Erect				
c. Decumbent				
d. Strong				
e. Medium				
f. Slender				
g. Furrowed				
h. Foliage { Abundant / Scanty				
2. Leaf Blade				
a. Length				
b. Width				
c. Midrib { Prominent / Medium / Indistinct				
d. Open, folded				
3. Flowering head				
a. Color				
b. Length				
c. Open				
d. Compressed				
4. Use { Hay / Pasture				
5. Annual				
6. Perennial				

EXERCISE 88. THE IDENTIFICATION OF GRASS SEED. Study carefully pure samples of the grasses given in Exercise 87. Some grass seed are naked like the kernels of wheat, in which case it is called a *caryopsis*. Other seed are covered with husks, (technically the glumes) as the oat. In the latter case we speak of the "flowering glume" rather than the seed itself, which the glume covers. Another important character of grass seed is the *rachilla*, which is the stalk to which the seed are attached on a double seeded spikelet. There is no rachilla on a single seeded spikelet. First locate the flowering glume, the rachilla and a caryopsis, then fill out the table below.

1. VARIETY					
Caryopsis					
a. Length					
b. Shape					
2. Flowering Glume					
a. Length					
b. Blunt or pointed					
c. Straight or curved					
d. Awned or awnless					
e. Color					
f. Smooth, hairy					
3. Rachilla					
a. Present or absent					
b. Long, short					
c. Slender, broad					
d. Smooth, hairy					
4. Weight of 100 seed					
5. Important means of identification					

EXERCISE 88.—Continued.

1. Variety					
Caryopsis					
a. Length					
b. Shape					
2. Flowering Glume					
a. Length					
b. Blunt or pointed					
c. Straight or curved					
d. Awned or awnless					
e. Color					
f. Smooth, hairy					
3. Rachilla					
a. Present or absent					
b. Long, short					
c. Slender, broad					
d. Smooth, hairy					
4. Weight of 100 seed					
5. Important means of identification					

EXERCISE 89. THE LEGUMES. The following legumes are the most common in the United States, but substitutions should be made if any of the eight legumes listed here are not grown locally: Alfalfa, Red Clover, Alsike Clover, Crimson Clover, Sweet Clover, Cowpeas, Hairy Vetch, Black Medic. Study each carefully and sketch a leaflet of each. Record your observations in the form below:

VARIETY					
1. Leaves					
a. Arrangement					
b. No. of leaflets					
c. Palmate or pinnate					
d. Smooth or hairy					
e. Edges entire or serrate					
2. Stems					
a. Height					
b. Circumference at base					
c. Erect or trailing					
d. Round or square					
e. Smooth or hairy					
3. Flowers					
a. Color					
b. Borne in a raceme, umbel or head					

EXERCISE 89.—Continued.

Variety					
1. Leaves					
a. Arrangement					
b. No. of leaflets					
c. Palmate or pinnate					
d. Smooth or hairy					
e. Edges entire or serrate					
2. Stems					
a. Height					
b. Circumference at base					
c. Erect or trailing					
d. Round or square					
e. Smooth or hairy					
3. Flowers					
a. Color					
b. Borne in a raceme, umbel or head					

EXERCISE 90. THE IDENTIFICATION OF LEGUME SEED. Compare an alfalfa seed to that of the bean studied in a previous exercise. What are the points of likeness and difference? Study carefully pure samples of the Legume seed given in Exercise 87, but before filling out the form below be sure that you know the location of both radicle and hilum in each seed.

SEED				
1. Shape, view from largest diameter				
a. Spherical				
b. Oval				
c. Kidney				
d. Elliptical				
2. Shape, view from smallest diameter				
a. Round				
b. Oval				
c. Flat				
3. Length, largest diam.				
4. Color				
a. Orange				
b. Yellowish brown				
c. Dark Olive Green				
d. Black				
e. Yellow				
f. Reddish				
g. Red				
h. Green				
5. Hilum				
a. Round				
b. Oval				
c. Elongate				
6. Radicle				
a. Tip prominent				
b. Tip not prominent				

EXERCISE 90.—Continued.

Seed					
1. Shape, view from largest diameter					
a. Spherical					
b. Oval					
c. Kidney					
d. Elliptical					
2. Shape, view from smallest diameter					
a. Round					
b. Oval					
c. Flat					
3. Length, largest diam.					
4. Color					
a. Orange					
b. Yellowish brown					
c. Dark Olive Green					
d. Black					
e. Yellow					
f. Reddish					
g. Red					
h. Green					
5. Hilum					
a. Round					
b. Oval					
c. Elongate					
6. Radicle					
a. Tip prominent					
b. Tip not prominent					

EXERCISE 91. THE DETECTION OF ADULTERANTS IN GRASS AND LEGUME SEED. Take several samples of commercial seed and examine them carefully. Pick out all sticks, chaff and seed of any plant other than that given on the label. What per cent. of the weight is pure seed? Look up in some good seed catalogue the price of these seed per bushel and figure out how much the farmer loses on every five bushels of these seed bought. Give some reasons why it seldom pays to buy cheap, low-grade seed.

EXERCISE 92. WEEDS. Collect ten of the worst weeds of your neighborhood. Look up their native home and scientific name in a good Botany.

WEED	Scientific Name	Native Home	Annual or Perennial	Means of Ditsribution

SECTION X.—FARM ANIMALS.

EXERCISE 93. HORSES. Horses are of two types, Draft and Harness. As the name indicates the draft horse is bred to draw heavy loads, while the harness horse is bred for speed and endurance. Name three breeds of each and compare one breed of draft horses with one breed of harness horses, using the following form as a guide:

	DRAFT	HARNESS
Form { Massive / Rangy		
Muscled { Heavy / Light		
Legs { Massive / Slender		
Underline { High / Low		
Weight		
Height		
Neck { Comparative / Thickness		
Head—Size		
Shoulders { Heavy / Light		

EXERCISE 94. CATTLE. Cattle are bred in the United States for two purposes, beef and dairy. Each type has reached a high state of perfection and should not be confounded one with another. Name three breeds of beef cattle and three dairy breeds. Which breed of each is the most popular in your locality? Reasons. Make out a table as in Exercise 93 on horses, and compare the two types in as many respects as you can.

EXERCISE 95. SHEEP. Sheep are of two general types, mutton and wool. The wool type is represented by the Rambouillet, while the Southdown may be taken as the mutton type. Contrast these two breeds in as many respects as possible.

EXERCISE 96. SWINE. Among swine we have two chief types; namely, the bacon type and the lard type. The types are divided into several breeds, all of which are readily distinguished by certain characters. Select the four chief breeds in your locality and record their characteristics in the following form:

BREED					
1. Bacon or Lard					
2. Color					
a. Red					
b. Black					
c. White					
3. Markings					
4. Face					
a. Dished					
b. Straight					
5. Ears					
a. Erect					
b. Drooping					
6. Form					
a. Blocky					
b. Rangy					
7. Legs					
a. Long					
b. Short					
8. Length of Body					
9. Width					

EXERCISE 97. POULTRY. There are two common types of chickens, the meat type and the egg type. The meat type, as the name indicates, is grown for its superior quality of meat. The egg breeds are much smaller than the meat breeds, and are raised especially for the great number of eggs they lay. Name four breeds of chickens found in your locality. Record the characteristics of each breed in the following form:

BREED				
Body { Plump / Rangy				
Disposition { Nervous / Sluggish				
Legs { Feathered / Not				
Eggs				
a. Large				
b. Small				
c. White				
d. Brownish				
e. Great production				
f. Small production				
Comb { Large / Small				

EXERCISE 98. A Rough Analysis of Milk. Take some fresh milk, shake it well, then put a drop of it on a slide and examine it. Note especially the number and size of the fat globules. Also look for any impurities in the milk, as manure, dirt, hair, etc. Now examine a drop of skimmed milk. How do the two differ?

Place one pint of pure milk in a quart jar and heat to 70F., then shake until lumps of butter collect. Now strain the milk through cheese cloth several times. The milk that runs through is called milk serum. Set the milk serum in a warm place for twelve hours until it has turned to clabber. Now put the clabber into a cheese cloth bag and squeeze it. The watery liquid which runs out is whey. The white solid remaining in the bag is curd or casein.

EXERCISE 99. The Babcock Test for Fat in Milk. Each student should bring a sample of milk from home or his local dairyman to be tested. The test is made as follows:

(1) Measure 17.6 cc. of milk with the pipette into the test bottle. (2) Shake this sample, being careful not to spill a drop. (3) Add 17.5 cc. of commercial sulphuric acid whose sp. gr. is 1.83. (4) Place the test bottles into the tester and whirl five minutes at the rate of 1000 revolutions per minute. (5) Now add enough hot water to the test bottle to bring its contents up to the shoulder. (6) whirl two minutes more. (7) Fill the bottles with water to near the top of the graduations. (8) Whirl again for two minutes. (9) Read the fat. The distance between two large divisions represents per cent.

EXERCISE 100. The Pasteurization of Milk. Take five test tubes and wash them thoroughly in boiling water. Fill each half full of milk, then stopper with a cotton plug. Heat a pan of water to 150F. and put the test tubes of milk into it. (Keep the water hot by adding more hot water as needed.) Remove a test tube at intervals of five minutes. Cool the samples as taken from the hot water to a temperature of 70F. then set aside at room temperature. Examine each sample carefully every day for five days. Compare with a tube of milk that was not pasteurized. What can you say as to the value of the pasteurization of milk? What is the difference between pasteurization and sterilization? What causes milk to sour?