A LABORATORY MANUAL

IN GENERAL HIGH SCHOOL AGRICULTURE

A THESIS

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STOTTLAR ARNOLD

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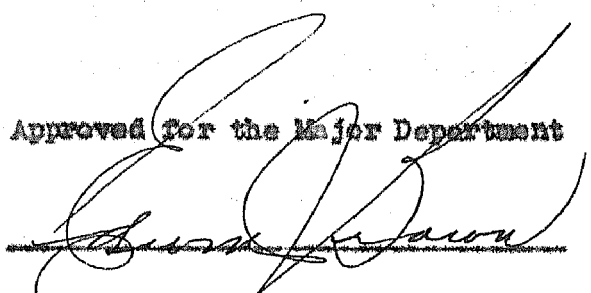

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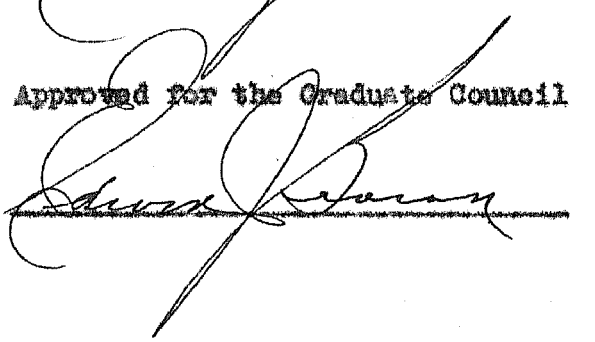

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A. S. A.

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INTRODUCTION

INTRODUCTION

In recent years there has been developing a tendency to neglect the teaching of non-vocational agriculture, or, if it is taught, to teach it as a more or less academic subject and to totally neglect the laboratory side of the study of agriculture. Schools also have been guilty of offering agriculture merely to satisfy a certification requirement for normal training students. They have considered the subject simply as another one of the normal training requirements, and have failed to understand that class demonstrations and experiments in so functional a subject as agriculture are absolutely essential. However, in a study conducted in Iowa, Jerdman[1] found that the majority of high school superintendents in that state were in favor of offering general agriculture, and wanted more time for it.

Why is it, then, that many Kansas schools unable to finance vocational agriculture make little or no effort to present a course in agriculture that leads to a clear understanding of America's most vital industry? It is a widely accepted fact of everyday observation, supported by recent governmental investigation, that the standard of life among rural people generally in the United States is quite inferior to that of the

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[1] Casper M. Jerdman, "The Status of General Agriculture in Iowa Public Schools," (unpublished thesis, Iowa State College, 1930), p. 33.

average classes of the towns and cities. Farmers as a group seem to have less income per worker, less wealth, less education, poorer houses, fewer luxuries, less leisure, fewer home conveniences, less recreation, less art and usually less culture than city people. The standard of living among rural people, as a whole, is considered to be lower than it should be.

The farm situation in this country is a puzzling one, filled with both surprises and contradictions. On one hand, we have giant capacity to produce foods and fibers, enough to provide a fine standard of living for all our people. On the other hand, most of the six million thrifty, industrious farmers who save and slave to produce this standard for us, cannot get a living for themselves doing it.

Most of our farms are large enough to support farm families of from four to five people. The climatic conditions usually are favorable. Most of the soil is sufficiently fertile. The farmers know enough; they have a general knowledge of scientific farming. A great farm machine technology has been developed with startling advances. Yet, by and large, the farmers of the United States are able to eke out a very meagre living.

Young folks, whether town or country born, whether boys or girls, like to and should study agriculture of a general or appreciative type. If the last few years have taught us anything, they have taught us the need of a mutual understanding between city people and the farmers, and a recognition of the interdependence of town and country. Agriculture as a way of life, and the problems and points of view of farmers, need to

be understood and appreciated by every citizen. The exercises included in this thesis attempt to present some of the ideas that need to be understood by the non-farming citizenry and consumers of the United States.

Reasons for the Study

Educational leaders in the United States, who have been forced by recent events to compare our education with that of other nations, have become aware of the defects in our system. With the passing of the Smith-Hughes law, the teacher trainers, supervisors, and other leaders in agricultural education have been, for the past sixteen years, devoting their energies almost exclusively to the improvement of secondary agricultural education in those departments which are federally aided, or vocational agriculture departments. Too little attention has been given to the schools without agriculture of the federally subsidized type, although such schools far outnumber the others and certainly are entitled to better instruction in agriculture and rural life. Of the 674 high schools in Kansas recognized by the State Department of Education,[2] only 142 had vocational agriculture departments in 1938. In the study of Jerdman,[3] it was found that Iowa, with 991 high schools, had in 1938 only 111 schools offering vocational agriculture. However, 690 schools offered some kind

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[2] W. T. Markham, Kansas Educational Directory, (Topeka: State Printing Plant, 1937), pp. 21-55.

[3] Jerdman, op. cit., p. 33.

of agriculture. In a report[4] completed in 1932, it was shown that of the 4,513 schools offering vocational agriculture to 143,979 pupils, this number represents less than one-fifth of the schools of the United States and less than three per cent of the high school population.

One difficulty in giving a course in agriculture which will bring out its proper values, arises from the fact that teachers are not available who can teach it properly. Crawford[5] found that the most important limiting factor in the success of a general agriculture course was the teacher. Our agricultural colleges teach production in their subject matter courses, and the tendency is for the graduate to do the same thing. This is not what boys and girls want who are not going to farm. They want to be taught, not how to farm, but how to live with and for farmers. Another difficulty is that the teacher requirements for general agriculture are usually low, and teachers trained in a general science course are assigned the class in agriculture because it falls within their line of work. If the teacher is city reared and not interested in agriculture, the course suffers.

This manual of laboratory exercises has been written with the idea of setting up certain exercises that will give the pupil a certain understanding of agriculture, without going so far as to demand production. The completion of projects is not always feasible when the instructor teaches a full schedule and cannot spare time for supervision necessary for adequate guidance, so all project work has been avoided. Work with charts and pic-

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[4] Sixteenth Annual Report of the Federal Board of Vocational Education, (Washington, 1932), p. 67.

[5] George E. Crawford, "General Agriculture in the High Schools of Iowa," (unpublished thesis, Iowa State College, 1925), p. 26.

tures has been suggested to complete certain exercises.

Laboratory manuals written recently are intended for the vocational agriculture group. The teacher of general agriculture has had no choice but to use them and work out his own salvation. Because of the large number of schools without vocational agriculture, it was clear that a manual of this kind would have a use and for that reason it was written.

Review of the Literature

Due somewhat to the emphasis placed on agriculture for production, namely vocational agriculture, few articles in strictly general agriculture have been published recently. In a recent article by Leohner,[6] he emphasized the need for a general agriculture course by saying, "Some phase of agriculture should be presented as an orientation course for its cultural value." He presents a course divided into fourteen units devised to give an understanding to pupils in a large high school in Seattle. In an article by Byran,[7] there are listed ten objectives of a general agriculture course, as set up by the course of study for Iowa. He indicated that the course should be

> ". . . a study of the essentials of the relationship that exists between town and country; of the interdependence of these two important members of every community; of the proper attitude of each group toward each other; and of their mutual obligations to cooperate with and help each other."[8]

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[6] H. J. Leohner, "Units on Agriculture for Every High School," Clearing House, 11:365-8, February, 1937.

[7] H. M. Byran, "Teaching General Agriculture," Agriculture Education, 6:69-71, November, 1933.

[8] Ibid., p. 69.

No textbooks have appeared in recent years that deal with the field of general agriculture. The textbook[9] in use in Kansas at the present time carries a copyright date of 1931, and is a revision of a book that originally appeared in 1924.

Sources of Data and Method of Procedure

Textbook catalogs of the major book companies were examined in order to find what books had recently been published in the field of general agriculture. Letters were also written to several companies, and the reply of most of them was that they did not handle books in that field.

The number of exercises was purposely limited to a small number in order to give a teacher enough time to plan field trips to supplement the laboratory work. All exercises were written to be used with the simplest apparatus. Most apparatus called for in this manual can be constructed by the pupils and the teacher by using materials available at home. Chemicals will be the only items necessary for a monetary outlay.

The available textbooks of agriculture and laboratory manuals were examined for content and arrangement of subject matter. This manual was intended for use in Kansas, so the textbook in use in Kansas was chosen as an outline to follow. In general subject matter, the outline is practically the same, and is divided into much the same divisions.

Subject matter was taken from recent farm journals and government and state publications and pamphlet material published by firms handling

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[9] Waldo Ernest Grimes and Edwin Lee Holton, Modern Agriculture, (Boston: Ginn and Company, 1931), pp. 632.

agricultural commodities.

Validation

In organization, the manual follows closely the Kansas textbook in agriculture and also the state course of study in agriculture. The number of exercises has been rather arbitrarily set at fifty. This will allow the pupil sufficient time to complete all exercises without hurry and will allow the teacher to plan sufficient field trips to properly supplement any course in agriculture.

The subject matter has been secured largely from bulletins of several state experiment stations and from the United States Department of Agriculture bulletins, and also from state and government yearbooks.

All material in this book has been checked by C. F. Gladfelter, Instructor of Agriculture, Kansas State Teachers College, Emporia, Kansas, for proper presentation and content.

The Organization of the Remainder of the Thesis

It would be possible to divide a study of this type into any of several divisions. In an effort to include all study of similar nature in the same division and thus get a simple organization, the main body has been divided into only four major divisions, as follows: (1) Exercises in Plant Production, (2) Exercises in Soils and Fertilizers, (3) Exercises in Live Stock Production, and (4) Exercises in Farm Business. The presentation throughout for each individual exercise is uniform and consistent.

PART II

EXERCISES IN PLANT PRODUCTION

EXERCISE 1

OSMOSIS, THE PLANT METHOD OF GETTING FOOD

Osmosis is the passing of a fluid through a semi-permeable membrane from an area of less density to one of greater density. In this process, the solution diffuses through the membrane and causes the solution of greatest density to rise. This process goes on through the walls of the root hairs and in this manner the plant is able to take up the necessary mineral salts dissolved in water. The plant obtains its food in a very weak solution and therefore the sap of the plant does not need to be so very dense.

In the process called exosmosis, the cell sap flows away from the plant into the soil. The same thing happens to a plant immersed in a salt solution, causing the plant to die. A sugar solution will also cause a plant to die. Some plants adapted to live in salt marshes are able to obtain food from a quite dense outside solution.

Object. To show how a plant secures food.

Materials. Thistle tube; large bottle or vessel; sugar solution or syrup; animal membrane. The animal membrane is probably best secured by using a large bologna peeling.

Procedure. Fill the thistle tube with a dense solution of syrup or sugar and color it with a drop of ink, iodine, or methylene blue. Tie securely the membrane over the mouth of the tube. Immerse the membrane in a beaker of water and fasten the tube vertically with a ringstand.

Lengthen the tube by joining glass tubing together with short lengths of rubber hose. The tube should be at least six feet in length. Record the results each hour for several hours. This passage of liquid through the membrane into the tube causing the colored solution to rise is osmosis.

Cut a potato into some cylindrical pieces with a cork borer or cut into cubes of equal size, and weigh. Place one cube in plain water in a small beaker. Place one cube of equal size into the same amount of water and add one or two spoonfuls of salt. Do the same with sugar. Twenty-four hours later, dry each piece of potato on blotting-paper and weigh carefully.

Height of Liquid in Tube in Inches

1st hr.	2nd hr.	3rd hr.	5th hr.	8th hr.	12th hr.	24th hr.

Weight of Potato

	Cube 1	Cube 2	Cube 3
Before			
After			

Discussion.

1. Explain the bleeding of grapevines pruned too late in spring.

2. What causes weeds cut late in the evening to liberate quantities of water through the cut off stems?

3. Explain why ripe fruits, such as watermelons, apples, peaches, grapes, etc., often burst following a rain. Would the green fruit be similarly affected? Why?

EXERCISE 2

GROWING PLANTS WITHOUT SOIL

It should be recalled by the student of agriculture that growing plants without soil is not new. This method has been under development for years and has not been released to the public until recently, when later developments seemed to indicate that the amateur and market gardener would be able to use this method. So much depends upon the skill of the user and the experience of the user, no grower can expect superior results at the first trial.

Object. To grow plants in a chemical solution without the use of soil.

Materials. Chemicals as called for; containers or boxes of sand; one pint milk bottle; and one five gallon bottle.

Procedure. To make a five gallon quantity of solution, use:

one teaspoonful of 16 or 20 per cent super phosphate
one-half teaspoonful of sodium nitrate (Old style Chilean)
one-half teaspoonful of Emejo (magnesium sulphate compound) or
one and one-half teaspoonfuls of Epsom salts
one-half teaspoonful of muriate of potash (potassium chloride).

Dissolve separately each of the above in one pint of water. Strain out any insoluble material that may be present, particularly in superphosphate. The four single salt solutions are then poured together and clear water added to make up the five gallon solution. As plants grow and become well-established, the solution should be strengthened by doubling the amounts in the different salt solutions.

To start plants in pure sand, there should be at least four inches of sand in a box five inches high. Surplus solution should drain away quickly. For young seedlings, a weaker solution may be used. After the young plants, which are grown in these nutrient solutions, attain good transplanting size they are best changed to a cold frame in which commonly prepared soil is used.

Another solution, commonly known as the Shive solution, consists of the following:

24.50 grams potassium acid sulphate

12.28 grams magnesium sulphate

36.98 grams calcium nitrate.

Add each of the above to one liter of distilled water and bottle separately. To use, take 5 cc. of each of the stock solutions, mix together and add clear water to make one quart of solution. Put one rusty nail in the bottom of the jar holding the plant.

Other solutions which have been used are:

A. 1½ teaspoonfuls 16 per cent superphosphate

¼ teaspoonful potassium nitrate

1 tablespoon calcium nitrate

⅓ tablespoon magnesium sulphate

1/8 tablespoon ammonium sulphate--only if leaf tips turn yellow.

B. 1 gram potassium nitrate

1 gram potassium phosphate

1 gram magnesium sulphate

4 grams calcium nitrate

10 grams copperas

1 gallon water

C.	oz. per 100 gal.	10 gal.
Magnesium sulphate	1.75	.175
Monocalcium phosphate, food	3.625	.3625
Potassium nitrate	5.9365	.59365
Ammonium sulphate	5.625	.5625
Calcium nitrate	10.85	1.085

Seeds can be planted on cheesecloth or muslin tied over the top of a quart jar and allowed to sag slightly. Some support is necessary to prevent the plant falling out of the jar. Probably the best method of supporting the plant in the laboratory is to fill a pot or jar with sterile sand and allow the roots to anchor the plant. Keep the solution at a constant level by adding fresh solution as needed. For experimental purposes, a control plant in dirt should be grown if at all possible.

EXERCISE 3

THE SOIL, THE SOURCE OF GREEN PLANTS

The soil as a basis of all living things is of utmost significance to the farmer, and the student of agriculture needs to develop the concept of soil importance. The mature seed contains only enough stored food for development of the embryo and during the period of growth necessary for establishment of the young plant. After this short period of establishment, the plant must secure its food from other sources, one of the most important being the soil.

Object. To demonstrate the importance of soil in plant growth.

Materials. Flower pots or thoroughly cleansed quart oil cans; clean, fine sand; powdered rock; humus; garden loam and clay soil; seed of beans or peas or other suitable garden seed.

Procedure. The number of pots depends upon the wishes of the instructor or student doing the experiment. A very good comparison can be had by using six cans with the following materials: thoroughly washed sand, sand as it comes from the sand pit, rock crushed very fine, garden loam, clay, and humus. Fill each pot or can to within an inch of the top with one of the above materials, and plant a few seeds. Keep all cans in the same place and treat exactly alike. Water when necessary. Record results at end of first week and for about two weeks thereafter.

Record of Plant Growth

	1st week		2nd week		3rd week		Size in
	Good	Poor	Good	Poor	Good	Poor	in. 3rd wk.
Garden loam							
Clay							
Crushed rock							
Washed sand							
Ordinary sand							
Humus							

Discussion.

1. Which material made the best plant growth? What reasons can you give for the results? Which of the materials would you use to construct a good soil?

2. Look up in some gardening book and list here their suggestions

as to what makes a good soil.

3. Which pot seemed to require the most water? Why?

EXERCISE 4

GREEN PLANTS AS FOOD FOR ANIMALS

All living things need food. A plant as well as an animal may starve to death. By being able to secure raw materials from the soil and combining them through a process called photosynthesis, the plant is able to manufacture food from raw materials. The animal is unable to manufacture food, so it must depend upon green plants for all food. Then through the process of decay, organic materials from animals are added to the soil and the cycle starts over again.

Object. To find what food compounds are found in some plant and animal substances.

Materials. Various food substances, such as oatmeal; bread; potatoes; apples; cheese; meat; grapes; raisins; white or hardboiled egg; corn; peanut; cooked beans; crackers, cornmeal, etc. Iodine; Fehling's solution; strong nitric acid; ammonia; ether.

Procedure. Starch. To test for the presence of starch, make a paste of the substance to be tested and add a few drops of the iodine solution. The dark brown color indicates the presence of starch.

Grape sugar. Place a small amount of the substance to be tested in a test tube of water. Distilled water is best, but tap water will do.

Add to this an equal amount of No. I and No. II Fehling's solution. Heat gently. If grape sugar is present, the color will change from the deep blue color to a brick red. The red color is an indication of the amount of grape sugar.

Protein. Place some hard boiled white of an egg in a test tube. Add a few drops of strong nitric acid. Heat gently, pour off the acid and then rinse the egg with water. Pour off water. Add a few drops of ammonia. The yellow color after the addition of acid, and the deep orange after the ammonia is added, indicates the presence of protein. Test other substances available.

Water. To get an idea of the amount of water in a plant sample, weigh out a 50 gram sample of green material, then dry in the sun for a few days, or in an oven for an hour or so at 212° F. Reweigh. The loss is water.

Fats. Lay the substance to be tested on brown paper. Crush and lay in an oven for a few moments, or smear it over the paper by hand. If much fat is present, a grease spot which is translucent will appear. Or fats may be extracted with ether. Cover some corn meal with ether and stir for one minute. Pour off the ether and dry. The remaining substance is fat. White gasoline may be substituted for ether.

Record results.

Food Materials in Plants

Substance Tested	Starch			Grape Sugar			Fats			Protein		
	High	Med.	Low	High	Med.	Low	High	Med.	Low	High	Med.	Low
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												

Discussion.

1. For what bodily use does the animal put each food substance?

2. What is the difference between organic and inorganic food?

3. Why is corn a good food to feed for fattening animals?

4. Would beans or soybeans or corn be best for growing stock?

5. Study the labels of some of the commercial feeds, such as bran, linseed oil meal, shorts, cottonseed meal, gluten meal, etc. What is the most abundant food substance? Does the formula vary with the purpose for which the food is advocated?

EXERCISE 5

A STUDY OF THE CORN PLANT

The corn plant is one of the most important food plants of the world and is of American origin. It is so specialized and dependent upon man's care that it is not found wild anywhere and cannot exist except under cultivation.

Object. To study the corn plant in order to learn how it grows and why it is so important.

Materials. Corn field or green stalks of corn with roots; or preserved stalk; immature corn seedlings about two weeks old grown in cans or pots.

Procedure. If a field trip can be taken, it is by far the best method of studying the growing corn plant. Examine the standing stalk and measure its height. Is the height fairly uniform throughout the field? What are the chief parts of the corn plant? Are the staminate and pistillate flowers located as on other crop plants such as the legumes? What advantage is this to the corn plant? How far apart are the joints and how does this construction give strength? Dig up a plant and examine the roots. What kind of root system does it have? Why do some of the roots form above ground? Do they aid in supplying food?

Where are the leaves fastened on? How? Does the leaf give support to the stem? Calculate the leaf surface of an average sized leaf. How

much per plant? Observe how water is prevented from passing into the sheath by the ligules or the rain guard.

Discussion.

1. List the products made from corn.

2. Why does not the corn plant compete with weeds successfully?

EXERCISE 6

A STUDY OF THE CORN EAR KERNEL

The kernel is the important part of the ear of corn. In general, the type of the kernel determines the value of the corn, and in selecting seed corn for Kansas conditions it is quite important that a type be chosen which is adapted to the conditions of soil and climate under which the crop is to be grown. With the advent of hybrid seed, most farmers are apt not to pay enough attention to proper seed selection.

Object. To study corn kernels to learn the desirable characteristics and to develop skill in judging seed corn.

Materials. Score card; several ears of corn; knife; scales and rulers or calipers.

Procedure. 1. Read the textbook discussion of proper seed corn type and also the bulletin, "Selecting Seed Corn in Kansas," and the score card. Then choose eight or ten type ears and compare and classify the kernels of the ears as to uniformity in shape, size and color; in thickness, depth and width. Select the type of kernel best suited to bottom lands and the type best suited to upland and dry seasons. Compare the germs as

to size and plumpness. (Corn several seasons old will have shrunken germs, therefore only new corn should be used.)

2. Choose an ear of the type selected and shell all butt and tip kernels of undesirable type in one pile and the good kernels into another pile; weigh each separately and determine the percentage of desirable kernels. Do the same with one of the off type ears, and record the results. Now weigh the cobs and determine the per cent of shelled corn per ear.

Record Middle Kernel Measurements in Inches

Ear	Length	Width	Thickness	Germs Good or Poor
1				
2				
3				
4				
5				
6				
7				
8				

Per Cent of Shelled Corn

Ear	Total Weight	Corn Weight	Cob Weight	% Corn
Good				
Poor				

Discussion.

1. Problem: Determine the increase in yield per acre of proper

type corn over improper type. Use tables. Use actual market price and get results in dollars and cents.

2. What kind of an ear will shell the greatest per cent of corn?

3. How may size and shape of kernel influence stand of corn? Yield of corn? How and why should grading be practiced?

4. How does season affect the type of kernel?

EXERCISE 7

THE ESSENTIALS OF CORN JUDGING

The student should have a well-defined idea of what constitutes a good ear of corn. This can be gotten only by the intensive study of the corn ear, through the use of a score card. To be a good judge requires time and practice.

Object. To get an understanding of what constitutes superiority in ears of corn by means of examination.

Materials. Two or three ears of corn for each pupil; one or two good ten-ear samples of corn; tape measure or flexible rulers. A knife and magnifying glass are also helpful.

Procedure. Read textbook material in regard to what constitutes a good ear of corn and read the scorecard carefully in order to get the different items well fixed in mind. Take one of the ears and score it, making your decisions carefully. In a like manner, score the other two or three ears. Discuss the results with your instructor. Then, on a new

score sheet, score the ten-ear sample and select the best ear in the sample. Be sure you can give reasons for your decisions in scoring off for deficiencies.

Discussion.

1. What points on the score card are most important? Why?

2. If one bushel of seed will plant seven acres of corn, how much can a farmer afford to pay for seed corn? Is $7.00 per bushel too much?

3. If properly selected seed will produce five bushels an acre more than ordinary seed, how much time can a farmer afford to spend selecting and growing seed at current labor and corn prices?

Score Card for Corn

Conformity to type and breed characteristics:		
1.	Uniformity of type	10
2.	Shape of ears	10
3.	Length of ears	10
4.	Circumference	5
5.	Purity of kernel and cob	10
Maturity and market condition:		
6.	Maturity	5
7.	Market condition	5
Yielding qualities and vitality:		
8.	Character of germ	10
9.	Kernels (a) shape	5
	(b) uniformity	5
10.	Butts	5
11.	Tips	5
12.	Space between kernels	5
13.	Size of cob	10
	Total points	100

HOW TO APPLY THE POINTS OF THE SCORE CARD[1]

1. Uniformity of Type (10). For each ear differing in shape, color, or indentation from the variety cut 1 to 10 points.

2. Shape of Ear (10). Ears should be as nearly cylindrical as possible. These characteristics indicate a high per cent of corn to the cob and kernels of uniform shape.

3. Length of Ear (10). For white, yellow and other corn in the Central States, 10 to 11 inches. Cut one point.

4. Circumference (5). Should be 7 to 7 3/4 at a point taken one-third distance from butt to tip.

5. Purity-Kernel (5). White in white corn; yellow in yellow varieties; any color in mixed varieties. Mixture in yellow corn shown on caps-in white corn on sides. Cut $\frac{1}{2}$ point for each kernel showing off-color. Ten kernels disqualify.

Purity-Cob (5). White in white corn; red in yellow; either color in mixed. Off color in cob disqualifies the ear.

6. Maturity (5). Ear should be well matured, heavy, dry, and the kernels bright and firm. For loose ears cut $\frac{1}{2}$ point.

7. Market condition (5). Ears should be free from injury or decayed spots. Ears showing rottenness should be cut severely. Twenty-five or more rotten kernels shall disqualify.

8. Character of the Germ (10). Most important in seed selection. Germs should be full, smooth, bright, not blistered, shriveled or discolored in any way. Embryo should be fresh and oily, yellowish white in color. If germ is dead or nearly so score zero. This point is important in seed selection.

9. Kernel-Shape (5). Slightly wedge shaped but not pointed, with straight edges. Length should be about $1\frac{1}{2}$ times as great as its greatest width. Thickness about 1/6th of an inch.

10. Kernels-Uniformity (5). Kernels should be of the same size and shape. Butt, body, and tip kernels nearly uniform.

11. Butts (5). Should be well rounded out, with regular rows of deep kernels, solidly and evenly compacted around a clean cup-shaped cavity, Butts never should be pinched, enlarged or flattened. Cut $\frac{1}{2}$ point if defective.

12. Tips (5). Should be covered to end of cob with deep kernels arranged in straight rows. The ideal tip is covered but if kernels are deep and regular to end of cob no cut need be made. Shoe-peg and shot-shaped kernels objectionable. Cut $\frac{1}{2}$ point.

13. Space (5). There should be no open space between the kernels in the row, either at the crown or at the cob.

14. Size of the Cob (10). Medium in size with diameter about twice the depth of the kernel. Too large a cob gives a low per cent of corn, while a small cob does not give a large yield per acre. Most standards call for 88 per cent of corn to cob.

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[1] John H. Gehrs and J. A. James, One Hundred Exercises in Agriculture, (New York: The Macmillan Company, 1916), pp. 32.

EXERCISE 8

SELECTING SEED CORN IN THE FIELD

After the preliminary work of scoring and judging corn both as individual ears and ten-ear samples, the pupil is ready to go into the field and select seed corn from the standing stalk. This is the practical application of the things learned by intensive study of corn ear characteristics. So much depends upon the position of the ear in the field as to whether it is good seed or not. The height of the ear from the ground, the way the ear hangs, the number of stalks in the hill are all to be considered. The method some farmers use to select seed corn by throwing good looking ears in a box on the wagon is much better than selecting corn from the crib in the spring when ready to plant. However, for the best seed corn and increased yields, select from the field.

Object. To learn how to select seed corn from the field.

Materials. A bag or gunny sack; notebook; score card; corn field.

Procedure. Each pupil should select at least ten ears according to the directions given on the score card. Take the ears to the classroom and score them as ten-ear samples. Compare the best ten-ear sample closely with the other samples in order to get a better idea of good ear characteristics. Only by constant practice can the sense of good ear characteristics be developed. Save the samples by storing in some suitable place for seed corn testing in early spring.

Discussion:

1. How many farmers in your neighborhood regularly select seed from the field? Why do not more do so?

2. Do any farmers contemplate selecting seed from hybrid corn? Can you tell them why this will not give satisfaction?

EXERCISE 9

TESTING SEED CORN

It takes good seed to produce a good stand of corn. Only by a germination test made before the seed is planted can one tell whether seed is alive and vigorous or dead. By spending a few evenings in February or March testing seed corn, the farmer may be able to save much valuable time by not having to replant in April. Only by a germination test can the proportion of live seeds be known.

Object. To determine the viability of seed corn and determine the percentage of yield.

Materials. Muslin cloth; heavy pencil or red marking pencil; rubber bands; bucket or container.

Procedure. Since the rag doll is so universally used and so adaptable, it will be the only method described here. Use a strip of muslin about two feet long and from twelve to eighteen inches wide. Mark this into convenient squares about three inches each way. With a cloth eighteen inches wide, leave six inches on each side and two inches at each end to fold over after placing the kernels on the cloth. This will make two rows of squares two inches by three inches and will test twenty ears. Dampen the cloth, lay it on the table and put six kernels from each ear in each square. Select two kernels each from the bottom end,

middle, and tip of ear. Lay the germs all one way and pointing upward. Be sure to number the ears to correspond with the squares or place them in order in an undisturbed place. Now lay the flaps over and roll up gently. Put a rubber band around each end. Soak for ten to fifteen minutes in warm water and put away in a warm place where they will not dry out. Examine in three days and again at five days and discard all ears not showing strong growth. It is better to be severe in judgment and not err on the side of leniency.

Record of Rag Doll Test
Sample 1

Ear Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
No. of Dead Kernels																				
No. of Live Kernels																				

Sample 2

Ear Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
No. of Dead Kernels																				
No. of Live Kernels																				

Discussion. "Does it pay to test seed corn?" is a question for any agriculture student to ask. The question can be answered! If an ear of corn has 800 kernels, and each kernel produces one stalk, and each stalk one ear, or one hundred ears to the bushel, an ear of corn will yield eight bushels of corn. The value of eight bushels at fifty cents per bushel is four dollars. So it is apparent that the rejection of one bad ear by testing means an increase in value of the corn crop by four dollars. The cost of labor can be easily determined. The ordinary farmhand can

test 350 to 400 ears a day. If of these seventy-five per cent have perfect germination, the cost of labor is one dollar and fifty cents per day and the cost of the rag doll seed tester material is fifty cents, the cost per acre for testing will not exceed ten to twenty cents. Three hundred ears will plant about twenty acres--one bushel about seven or eight acres. A general rule is to calculate an average of six pounds of shelled corn per acre. One pound of shelled corn has about twelve hundred kernels.

1. At the present price of corn and labor, determine the saving by testing corn if eighty acres are planted and the corn is only ninety-three per cent viable. Use information above or teacher can supply data, or pupil can supply own secured by actual home experience.

2. If corn is planted 3½ feet apart in the row and three kernels are dropped in a hill how long a row will an average ear plant? What would be the loss at present market prices if the ear failed to germinate?

EXERCISE 10

A STUDY OF THE WHEAT PLANT

In the study of the wheat plant in the school laboratory, wheat plants near maturity should be dug out of the ground with roots preserved as completely as possible. After they are properly dried they should be kept in vermin-proof receptacles. Head in flower may be preserved in formalin.

Object. To gain a better understanding of the structure and the relationship of the parts of a wheat plant.

Materials. Wheat seedlings; heads and mature plants; ruler.

Procedure. Describe the root system of the wheat plant. Is it fibrous, fleshly or tap-rooted? How do the lengths of the roots compare with the length of the stalk? Is wheat a deep or shallow rooted plant as compared with clover or corn? How many stems come from a single crown? This habit, known as stooling, materially increases the yield. Count the number of grains in one head and determine the number that may come from one plant. Examine one of the stems and notice that it is composed of sections. Note that the stems are hollow except at the joints. Compare a dry, mature stalk and a green one and explain how sap passes through the stem. Examine the head that is in flower and note that the spikelet consists of a number of flowers enclosed in the glumes. Find the essential organs of the flower.

Discussion.

1. Pollination in wheat is close while in corn it is open. What would you say about the chance of different varieties mixing in adjoining fields?

2. How do we secure new varieties of wheat? Read about the origin of Blackhull, Chiefkan, etc.

EXERCISE 11

THE PROPERTIES OF WHEAT WHICH AFFECT ITS PRICE

The physical properties of wheat have a great deal to do with its milling qualities, and price is based on milling qualities and freedom from disease. The miller is interested in color, hardness, protein or test weight, gluten content, and texture of wheat. These qualities determine flour yield.

Object. To study wheat and flour samples in order to determine seed and food value of hard and soft wheats.

Materials. Several samples of hard and soft wheats; several samples of different kinds of flour made from soft and hard wheat; beakers and scales.

Procedure. Select wheat kernels from the various samples showing variations in texture and color. Find some that are hard, vitreous and translucent. Select some that are dull and others that are glossy. Determine hardness with the fingernail. The harder wheats have the higher gluten content in general. The dark colored and amber wheats have a high gluten content. Gluten content may depend upon soil and weather conditions.

To find the gluten content of flour, take 50 grams of each kind of flour, add water, and knead into a tough, consistent dough. Wash the dough with warm water until all starch has been removed and water remains clear. Let the dough dry three to four days, or dry in a warming oven, but do not burn. Divide dry dough weight by flour weight to find percentage.

Varieties of flour	Weight of flour	Weight of dry dough	Per cent Gluten

Discussion.

1. For what purpose is hard wheat flour used? Soft wheat flour?

2. Is there any basis for the belief some women have that certain brands of flour are of low value?

3. Which flour costs more? Which wheat brings the best price?

A trip through a local flour mill should be arranged under the supervision of the teacher. Also, samples of different grades of flour should be secured. Information can be secured by writing to the Washburn-Crosby, and the Pillsbury Mills at Minneapolis, Minnesota.

EXERCISE 12

SCORING AND JUDGING WHEAT SAMPLES

The purpose for which it is to be used and quality determines the value of wheat. It is to the advantage of every student of agriculture to be able to recognize value in wheat. Wheat may be sound and still be of little value as food or feed for livestock.

Object. To learn to judge wheat by means of a score card.

Materials. Samples of wheat of various grades, in jars; wheat tester, if available; plates for examination.

Procedure. The first step is a thorough study of the score card in order to learn what is meant by the various points of the score sheet. Pour some of the sample into a plate and examine carefully. Be sure not to get the samples mixed.

Score Card for Wheat Samples

Points	Value	Samples					
		1	2	3	1	2	3
1. Soundness	20						
2. Weight per bu.	15						
3. Hardness	15						
4. Size and plumpness	15						
5. Per cent of foreign matter	15						
6. Uniformity	10						
7. Purity	10						
Total	100						

To compare wheat samples in order to determine which is best, carefully examine each sample of the group. Allow five points to each sample scoring first in any certain point, three for second place, and one to the sample scoring third. Add the results to get the total. Do this for several groups of three samples each until familiar with the procedure.

Card for Judging Wheat Samples

Points		Samples					
		1	2	3	1	2	3
Soundness	(10)						
Weight per bushel	(15)						
Hardness	(15)						
Size and plumpness	(15)						
Per cent foreign matter	(15)						
Uniformity	(10)						
Smut or disease	(5)						
Mustiness	(5)						
Color of kernel	(10)						
Total	100						
Rank							

Discussion.

1. What is the difference between soundness and mustiness and smut?

2. Does the size of grain indicate quality in wheat?

3. What is stack and bin burning? What causes it?

4. What is garlicky wheat? How would garlicky wheat be liked by the miller? The housewife?

5. What is "sample grade" of wheat?

(If it is desired to score oats and barley, an adaption of the forms given here or the score card may be used.)

EXPLANATION OF THE SCORE CARD[2]

1. Soundness (20).--The sample should be free from all broken, sprouted, smutty, or musty kernels. The bran should not be cracked, blistered, weathered, or streaked. Separate these from the sample and estimate the per cent. Cut one point for each per cent present.

2. Weight per bushel (15).--A good wheat sample should weigh sixty (60) pounds per bushel. Deduct two points for each pound below the standard.

3. Hardness (15).--The grains should be hard and horny. Hardness is determined by cutting a number of grains in cross section. If the majority show white and starchy, give a rather low score.

4. Size and plumpness of kernel (15).--The size of the kernel is important both from the farmers' and millers' standpoint. The kernels should be large, plump, and well filled; the crease narrow and deep; the cheeks well rounded. Cut one point for each 2 per cent of small or shriveled kernels found.

5. Per cent of foreign matter (15).--The sample should be free from all weed seed, dirt, and other foreign matter. Cut one point for each weed seed found, and according to judgment for other foreign matter.

6. Uniformity (10).--To secure full score the kernels in the sample should be characteristic of the variety, similar in shape, and practically of the same size.

7. Color and Purity (10).--The kernels should be clean and bright in color, characteristic of the variety. If the sample contains kernels different in shade of color from the majority, cut one point for each 2 per cent of these present.

EXERCISE 13

A STUDY OF THE LEGUME PLANTS

It is always interesting to study about plants that are so important we would have a hard time doing without them. The legume family gathers nitrogen and adds it to the soil, and then other plants use the

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[2] Gehrs and James, op. cit., p. 89.

nitrogen and produce better crops.

Object. To study several legumes adapted to Kansas and to find why they are so valuable.

Materials. Several samples of legumes and seed samples if possible; spade.

Procedure. If this study is undertaken early enough in the fall, living specimens of alfalfa, soybeans, red clover, sweet clover, or Alsike clover may be obtainable. Secure a plant in full bloom if at all possible. Take the class and observe the growth of several legumes of the community. Observe carefully the soil types on which each is growing and the effect of soil on growth. Bring to the laboratory samples of all those found. Dig carefully in order to preserve any nodules that may be on the roots.

In the laboratory, choose a sample of alfalfa, soybean or sweet clover in full bloom. Examine carefully, check length of root system, whether tap or fibrous, and the type of leaves. Examine for nodules on the roots and compare the size of the nodules of various legumes.

Examine and handle until familiar with the characteristics until you can readily identify each plant. Examine seed samples until familiar with characteristics.

Discussion.

1. List the more important legumes adapted to Kansas climatic conditions.

2. Soybean hay properly cured is equal to alfalfa hay in feeding value. Give the advantages and disadvantages of growing each for hay.

3. Why is sweet clover so good for erosion control?

4. Plan several crop rotations, using various legumes in the rotation.

5. Look up in some reference work and report on the uses of soybean seed. Remember that Ford paints his cars with soybean oil.

EXERCISE 14

INOCULATION OF LEGUME SEED

Nitrogen is recognized as one of the most important plant foods. Without it, plants are stunted in growth and the leaves turn yellow. Nitrogen is essential to the growth of all plants. Research has established the fact that nitrogen is best and most economically added to the soil by the activity of certain bacteria. Just how this process is carried on in the nodules on legume roots is not well known.

Object. To show that the presence of nitrogen-fixing bacteria is necessary for the best legume growth.

Materials. Roots from legumes bearing nodules; slides; microscope, if available; soils from alfalfa fields; samples of legume seed; commercial inoculation cultures; several cans or flowerpots.

Procedure. To get results from this experiment in the laboratory may take so long, better results may be gotten by a field trip to watch a farmer inoculate his seed and then check results on the field for several months. If the teacher decides on a field trip to let the class watch the sowing of an inoculated field, a check plot, uninoculated, should be sown if possible, and growth of the two plots compared.

In the laboratory, two pots should be filled with soil from a field that has not recently had alfalfa grown on it. Inoculate seed according to directions given on the package of the culture and sow in one pot. Sow in-inoculated seed in the other and compare results. Then, if possible, secure soil from an alfalfa field and treat the same way as the other two pots. The results will show whether fresh inoculation is beneficial or not.

After the plants in the pots have grown until a difference in growth is noticeable, remove the plants and wash away the dirt carefully and examine for nodules. Any legume can be used. If alfalfa seed is not available, better results may be obtained by some large legume such as soybeans or lima beans. Be sure the proper culture is used which is always listed on the can.

Commercial cultures may be secured from most seed stores or by writing to the Nitrogin Company, Inc., 3747 North Booth Street, Milwaukee, Wisconsin.

If a high power microscope is available, the teacher can crush one of the nodules on a slide and show the bacteria to the class.

Discussion.

1. Does it seem to you that legumes could solve the fertility problem if properly used?

2. In what way do legumes improve soil tilth?

3. What is apt to be the effect on the first corn crop grown after alfalfa? What crop should follow legumes in rotation?

4. Without inoculation, do legumes furnish nitrogen to the soil? When are legumes soil-depleting crops?

EXERCISE 15

JUDGING SORGHUMS

The sorghum plant is another member of the grass family and is especially noted for its ability to withstand drought and to produce a crop under extremely adverse conditions. One can get varieties of sorghums adapted to any extreme of climate. The sorghum plant hybridizes rather easily, so it is important to know a true type head and a good seed head if best results are to be obtained.

Object. To learn what constitutes a good head of sorghum.

Materials. Several samples of different varieties of forage sorghums; a ten-head exhibit of grain sorghums; score card. (A good way to secure samples is by means of a field trip.)

Procedure. Read score card in order to familiarize yourself with the points on the score sheet. Check each head with score card in order to become familiar with deficiencies that may cause the head to be unsuitable for seed use. Score the ten-head sample until thoroughly familiar with the appearance of a good sorghum head.

Discussion.

1. What is the best reason for planting only pure sorghum seed? Does mixed seed produce as much as pure varieties?

2. What is the difference in grain and foliage of grain and grass sorghums?

3. How do sorghums stand drought periods?

4. What substance often makes forage sorghum seed unpalatable?

Score Card for Grain Sorghums[3]

Uniformity--Heads should be uniform in shape, size, and type according to the variety	5
Length of head--Standard kafir, 10-12 inches; dwarf kafir, 9-10 inches; milo, 7½-8½ inches	10
Circumference--Standard kafir, 7-8 inches; dwarf kafir, 6-7 inches; milo, 8½-9½ inches	10
Structure of head--Blackhull white kafir: the center stem should be at least three fourths as long as the head. The internodes or seed stem sections should be at regularly decreasing intervals and be not less than five in number--even spacing, uniformity in length, and close setting being desirable. Milo: center stem should be continuous. Spikelets or seed stems should occur regularly--even in spacing, close setting of the seed stems and uniformity in length being desirable	15
Seed stem branches--Well proportioned to length and size of head, no open spaces, each place for a seed being filled	10
Color--Kafir--white grain with pink speck on tip, enclosed in a black hull. Milo--varies with variety, milk white grain with black hull, and reddish-like grain with brown hull	5
Size and shape of kernel--Conform to standards	10
Shattering--All grain sorghums should not shatter	5
Exertion--Head must be pushed clear of foot	5
Seed condition--Sound, pure, and mature	10
Base--First seed stems not too long, thickly set and well filled close up to the main stem. An open base is undesirable	10
Tip--Kafir--not too tapering. Tip seed stems should not be more than one-fourth as long as head. Milo, rounding. Each should be well filled with sound and uniform kernels	5
Total	100

[3] Kary C. Davis, Field Crop Enterprises, (Chicago: J. B. Lippincott Company, 1929), p. 89.

EXERCISE 16

THE USE OF THE SILO

The preservation of feed in a succulent state is not a new thing in agricultural technique, yet it is only within recent years that the American farmer has made any great use of silage. With the newer knowledge about silage and newer practices that will permit almost any crop to be made into silage, the silo should become a necessity to every stock farm.

Object. To learn the manner of preparing and keeping silage and to understand the construction of silos.

Materials. Data from various silo construction companies; silo and silo filling equipment.

Procedure. A field trip to observe a silo being filled, and another one later when the feed is being fed is probably the best way of studying this problem.

On the first trip the things that should be noticed are construction and size of the silo, its general location as to convenience to the barn and feedlot and convenience or accessibility when filling. The feed going into the silo should be noted as well as its stage of maturity. The members of the class, as many as wish, should be encouraged to enter the silo and help tramp for a few minutes. Therefore, the visit should take place at an early stage in the filling job. If possible, about four or five days after completion of the filling, revisit the silo and record the temperature of the silage with a thermometer and with the hand thrust deep into the silage.

The third visit should be later in the winter when active feeding is going on. Also record temperature at the surface and two feet down. Notice mold or decayed silage at the edges and attempt to find the cause. Be sure to note odor of good and "spoiled" silage. If the silage is corn or kafir, try to find some grain and study changes made in the grain.

Discussion.

1. Enumerate the silos of the community and list the materials of which each is constructed. Why do you find so many kinds?

2. What is the best material to make a silo of in your community? Be sure you have good reasons and do not allow personal opinions to influence your decision.

3. If possible, secure purchase cost of silos. Does this include erection?

4. What crops are best for silage?

5. What causes silage to keep? How does grass and legume silage keep?

6. Give the advantages and disadvantages of upright, pit, and cornbundle or fence silos.

7. Why is tramping now believed to do little good?

EXERCISE 17

THE FARM GARDEN

The farm garden is perhaps one of the most important phases in successful country living and yet it is one that is frequently neglected. It yields dividends more valuable than money in that it aids the farm family to be comfortably fed. The farm garden is generally considered

to give a return of four times the production cost.

Object. To show the value of a good garden and to aid in planning the garden.

Materials. Seed catalogs and bulletins; drawing paper; ruler.

Procedure. Have each pupil plan at least a one-acre farm garden. However, the actual size will depend upon the size of the family; it may be larger, but in only exceptional cases should it be smaller.

1. Draw to scale on a sheet of paper the garden. (There are 43,560 square feet to one acre.) For convenience in cultivation, the rows should be wide enough to allow for horse-drawn or tractor cultivators and should run the long way of the plot. Now lay out the rows, allowing proper distances between rows.

2. Write on each row the vegetable to be planted and the planting date of each. Place the short-season crops in one group and the long-season crops in another. A planned sequence of vegetables should be arranged to allow for a succession of fresh vegetables. Calculate the amount of each vegetable or length of row according to tables found in seed catalogs. Do not forget to include rhubarb and asparagus in the garden. If the teacher wishes, small fruits might well be included in the plot, too.

Discussion.

1. How can the statement that the farm garden isthe most profitable acre on the farm be explained?

2. What is the difference in the method of controlling sucking and chewing insects?

3. Is it necessary to rotate garden crops? Why?

4. What soil practices should one follow in building up garden productivity?

5. How does location, drainage, soil and convenience affect the general use and value of the garden?

EXERCISE 18

HOW TO SET OUT PLANTS AND TREES

Transplanting a young or growing plant is one of the most critical periods in that plant's life. It should be done carefully so as to check as little as possible the growth of the plant.

Object. To learn the most successful method of transplanting.

Materials. Spade; pruning shears; trees or plants.

Procedure. The tree to be planted should be protected in every way possible against drying out. The roots should be dipped in mud of a creamy texture or kept in a bucket of clear water. The hole for planting should be larger than the root spread and deep enough to allow setting the tree deeper than it stood in the nursery.

Prune the roots, cutting off all dead and injured parts. The top should be pruned to balance the loss of roots. For one-year-old trees the top may be cut back to a height of two feet. For two-year-old trees, try to balance the head by leaving enough branches.

Set the tree in position, spread the roots and throw some of the best soil over them and tramp firmly in place. Fill the remainder of the hole and tramp well. If water is to be added, fill the hole about half full, pour in enough water to soak the ground thoroughly, then let stand an hour or so before the hole is filled up. Be sure the tree is straight.

Leave the soil loose on top for mulching purposes.

Transplanting other plants such as strawberries presents in each case some particular problem. Setting at the right depth is important. The crown must not be covered and must not project above the ground. Plants will die if the crown is covered. Care much be taken that a dashing spring rain does not cover the crown. Ground must be well pressed against the crown and roots. Holes are often dug with the hoe or a furrow is opened, the roots are spread and the soil firmed over them. Some water should be poured on each plant.

Discussion.

1. What damage occurs when roots are exposed to air too long before plants are set out?

2. What is "heeling in" and when should it be done?

3. Why is it harmful to place fertilizer too closely to plant roots?

EXERCISE 19

PROPER PRUNING OF FRUIT TREES

Pruning is as much a part of proper fruit growing as is cultivation, spraying, and picking. It may be the difference between a profitable crop or none at all, so it most decidedly is important.

Object. To learn some guiding principles of the pruning of fruit trees.

Materials. Pruning shears and knives; saw; ladder.

Procedure. Pruning should be done only by those who have had special instructions. In view of the detailed description necessary to cover all fruit plants, only a few guiding principles will be given here, and the pupil and teacher are referred to the Disston "Pruning Guide,"[4] which may be had free for the asking. The Stark Brothers Guide to Profitable Orcharding[5] is also free and is extremely helpful. Use State bulletins also. It may be wise to ask some experienced orchardist to demonstrate to the class.

Several things to keep in mind are:

1. Remove limbs that tend to rub on each other.

2. Never remove a large limb if the same results can be obtained by removal of smaller limbs.

3. Never leave a stub; coat a large wound with white lead. Always make smooth cuts.

4. In pruning diseased trees, disinfect tools with some standard disinfectant such as corrosive sublimate.

5. Always be sure the limb needs to be removed.

Discussion.

1. What are the main results to be secured by pruning?

2. When should pruning be done? Can it be done just any time?

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[4] Disston Pruning Guide (Philadelphia: Henry Disston and Sons, Inc., 1933), 36 pp.

[5] Guide to Profitable Orcharding (Louisiana, Missouri: Stark Brothers' Nurseries, 1928), 127 pp.

EXERCISE 20

INSECTS ON THE FARM

The statement has been made that this is actually the age of insects instead of the age of man. Certainly it is an age of struggle between man and insect for dominance. Before we can control them, we must learn something of their structure and life histories.

Object. To become more familiar with insects and their ways of life in order to more successfully control them.

Materials. Several live grasshoppers or June Beetles; preserved insects will do if live ones are not available; life histories of several insects; glass lantern globes; pots; tomato or potato plants; simple microscopes for closer study of mouth parts.

Procedure. Examine a grasshopper and notice the three divisions of the body; head, thorax, and abdomen. How does the size of the head compare with the thorax and abdomen? Notice that the outside of the body is hard. This hard outer substance is chitin. How is the chitin used for protection? Is the color an aid in protection? Examine the mouthparts. Is it a chewing or sucking insect? After it has been found how the mouthparts work, kill the grasshopper by placing in a killing bottle or by pulling off the head. Dissect out the mouthparts under the teacher's direction and observe with the microscope.

To observe life histories, secure potato bug eggs in the spring and place on tomato plants growing in pots covered by the lantern globes.

Observe growth from day to day, and after the larva pupates in the ground dig it up and study changes undergone. If cabbage worm eggs can be secured, they would be much better because they pupate above ground. The pupils might be interested in observing effect on growth of various conditions, such as heat, light, temperature, different plants as food, etc.

Record your results.

Grasshopper (External Structure)

Structure	Description of Organs	Use
1. Head What organs		
2. Thorax What organs		
3. Abdomen What organs		

Teachers should make copies of the "Insect Record Sheet" and have pupils complete them for at least ten different insects apiece.

Discussion.

1. What is meant by economic insects?

2. How have some of our most dangerous insects come into this country?

3. What agencies are doing most to control insects?

Things to Know About Insects[6]

Place where collected: Town _____ State _____
Name of insect: Common _____
Genus _____ Species _____
Date collected: _____
A. What plant, animal, or its products afford food for this insect? _____
B. What part of the food plant or animal is infested? _____
C. In what stage does insect spend the winter? _____
D. Where does insect spend the winter? _____
E. What kind of mouthparts has this insect? _____
F. Of what economic importance is this insect? _____
G. What is the injurious stage of this insect? _____
H. Control is directed toward what stage of this insect? _____
I. What control measures are recommended? _____
J. What insecticide, or other control, would be used? _____

Insect Record Sheet[7]

I. Common name of insect _____
II. Description
  1. Size _____ Color _____
  2. Mouthparts: Chewing _____; sucking _____; lapping _____.
  3. Number of wings _____
III. Where does insect live: Air ___; soil ___; water ___; host ___.
IV. On what does insect feed:

Item	Leaves	Blossoms	Fruits	Branches	Stems	Roots
Flowers						
Shrubs						
Orchard Trees						
Other Trees						
Hay Crops						
Grains						
Vegetables						
Other Crops						

[6] "4-H Club Insect Manual," Miscellaneous Publication No. 318, U. S. Department of Agriculture, p. 53. (Entire table taken from source quoted.)

[7] Ibid., p. 41. (Entire table taken from source quoted.)

Wood____; wood products____; woolens____; furs_____
Fabrics____; food materials____; stored products_____
Man____; animals____; other insects_____

V. Habits:
   1. How does it spend the winter:
      Egg____; larva____; nymph____; pupa____; adult_____
   2. Where does it spend the winter?
      _____
   3. Kind of life cycle:
      a. Complete (four stages)_____
      b. Incomplete (less than four)_____

VI. Economic importance:
   1. Pest_____
   2. Beneficial_____
   3. Questionable_____

VII. Control for pest:
   1. Stomach poison_____
   2. Contact spray_____
   3. Sanitation_____
   4. Cultural practices_____

EXERCISE 21

THE FUNGI AND BACTERIA, FRIENDS AND ENEMIES

Bacteria are too small to be seen without some special aid, yet among them are numbered some of man's best friends and worst enemies. The fungi are also beneficial and harmful; however, most fungi are large enough to be visible without magnification.

Object. To learn more about some of the causes of plant and animal disease.

Materials. Microscope, slides and cover glasses; cotton; test tubes; sour milk; sweet milk; stale bread; tumblers or beakers; rotten apple; corn smut; mouldy orange; etc.

Procedure. To get a good growth of bread mold, a typical fungus, moisten a small piece of bread and expose it to the air for about five

minutes. Put on a plate and cover with a glass tumbler. Keep moist but not wet, and in a warm place. In a short time the mycelium, a white, threadlike growth, will develop. With a pin or dissecting needle, mount a small portion of the mycelium on the slide in a drop of water. Place the cover glass and observe through the microscope. When the spore cases develop, examine them, as well as corn smut, wheat and oats smut, through a microscope. Get from a grocery store a moldy orange, place under a glass and watch the spread of the fungus plant.

Take six sterilized test tubes and fill each half full with sweet unpasteurized milk. Add a teaspoonful or about 5 cc. of sour milk to the sweet milk in three of the test tubes. Cap each with a cotton plug. Place one tube containing sour milk and one tube containing sweet milk in the refrigerator. Place two more, one with sweet milk and one inoculated tube in a warm place. Take the remaining two tubes and pasteurize both by heating to 142° F. for half an hour. Place at room temperature. Observe color, odor, and physical condition. Place a drop of sour milk under the microscope and try to find some bacteria.

Sample	48 Hours			72 Hours		
	Color	Odor	Condition	Color	Odor	Condition
1.						
2.						
3.						
4.						
5.						
6.						

List the names of the pests most destructive to the following in your community.

Crops	Garden	Fruits	Forests	Livestock	Others
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

Discussion.

1. What is a fungicide? Germicide?

2. What is sterilization? How does it prevent spoiling?

3. Give several ways we preserve food for later use.

4. How do the fungus plants and bacteria live over the winter?

EXERCISE 22

PREVENTING PLANT DISEASES

A scientist[8] recently made the statement that plant diseases cost the American farmer $3,000 per minute. Much of the loss can be prevented by proper seed treatment before planting.

Object. To treat seed to control fungus diseases.

Materials. Formaldehyde; Ceresan dust; copper-carbonate dust; thermometer; barrels.

Procedure. This experiment is best carried out by a field trip to a neighboring farm and treating seed at planting time according to directions.

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[8] C. C. Fumas, The Next Hundred Years, (New York: Reynal and Hitchcock, 1936), p. 120.

Two rather common varieties of smut are found on wheat, covered smut and loose smut. For loose smut, use the hot water treatment, and for covered smut, the formaldehyde, copper-carbonate, or Ceresan treatment. Corn smut is best controlled by rotation of crops, as also are certain blights, or by the growing of blight-resistant varieties, such as Fulcaster wheat for flag smut and Marglobe tomatoes to resist tomato wilt. Oats and barley are treated the same as wheat. To treat sorghum for kernel smut use the same method as for wheat.

Formaldehyde--Add one pint of 40% formaldehyde to 40 gallons of water. Wet thoroughly all seeds and cover to hold in fumes for a few hours. Sow while damp.

Copper-Carbonate--Mix two or three ounces of copper-carbonate powder with each bushel of grain. Mix in a machine if possible.

Ceresan--follow directions on the container.

Semesan (for loose smut)--Follow directions on package.

Hot water--Treatment by this method requires care and considerable trouble. Otherwise, the wheat is apt to be injured or the smut not killed. The method requires four main steps:

1. Soak the seed in cool water for 4 to 7 hours. Keep grain stirred to avoid caking.
2. Soak seed in warm water at 120° F. for one minute.
3. Soak seed in hot water at 129° F. for 10 minutes. Temperature should not go above 130° F. nor below 124° F.
4. Plunge into cold water. Spread out in a thin layer to dry some before sowing.

Because of the added expense for treatment, it is well worth while

to attempt to secure seed wheat free from loose smut.

Discussion.

1. How do smuts travel from place to place?

2. Does the United States aid in preventing the spread of crop diseases? How?

3. What plants are supposedly disease resistant?

EXERCISE 23

WEEDS AND HOW TO CONTROL THEM

Weeds might be called outlaw plants, or, perhaps, very successful plants since they can grow without man's help and often in spite of the efforts to eradicate them. It should be remembered, too, that weeds are not always harmful. They may prevent erosion or furnish fertilizer.

Object. To become familiar with the life histories of several weeds and the damage done by them; also how to control them.

Materials. Spade, collecting kit; microscope; a good manual on weeds.

Procedure. On a field trip collect as many weeds as possible to bring to the laboratory for study. Observe their growth and location, and try to determine why they are so successful. If the weed is mature, carefully note the method of seed dispersal. Try to find if the plant has other means than seeds for reproduction, and describe each.

In the laboratory, with the aid of the manual, try to identify the weed and make a rogues' gallery of the twelve most harmful weeds in your community.

Weeds' Rogue Gallery

Name	Where found	Damage done	Method of increase	Control
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				

Discussion.

1. Why can a weed grow when cultivated crops cannot?

2. Why does mowing often kill weeds, yet at other times it apparently has no effect? What time or what stage of maturity in weeds does your farm agent recommend for mowing to facilitate control?

PART III

EXERCISES WITH SOILS AND FERTILIZERS

EXERCISE 24

THE TILTH, TEXTURE, AND STRUCTURE OF SOILS

Since all food comes from the soil, its use and upkeep admittedly deserves careful study. The advent of man into any new territory has brought the old, old story of soil depletion and erosion. By proper care the soil can be increased in fertility instead of being worn out.

Object. To show the effect of organic material on soils.

Materials. Samples of various soils; test tubes; tin cans; lime; microscope; lamp chimneys.

Procedure. Examine samples of as many soils as possible under the microscope. What is the difference in size of the soil grains and how large are the sane grains, if any are present?

Take each soil sample and fill a test tube about half full with it. Pour in enough water and stir to make a batter. Let each dry and then examine them for crumbling ability. Stir a sample of clay into a batter and divide into four parts. To one, add about one-fourth its volume of pulverized organic matter; to another, add two or three spoonfuls of lime, and to the third add about one-fourth its volume of fine sand. Let all four dry and examine for the ease with which they crumble.

Use as many lamp chimneys as you have soil samples and tie a piece of muslin over the bottom of each. Fill each chimney with soil and set each in a pan of water at a uniform depth of about two inches. Watch to see in which chimney the water rises most rapidly. In which soil does water rise slowest? After a day compare heights to which the water has risen by capil-

lary action. To find the amount of water each soil holds, remove chimneys and drain overnight. Then remove an inch of soil from the top, set over a pan and carefully pour water in the top until it runs out the bottom of each. Measure the water and compare. The run-off is free or gravitational water.

Soil Sample	Capillary Action: Height in inches by hours							Gravitational Water: Amounts in order				
	1	2	3	4	24	48	72	1	2	3	4	5
1.												
2.												
3.												
4.												
5.												

Discussion.

1. What is meant by the water table of a soil?

2. How does the presence of organic matter affect the amount of water a soil will hold?

3. How can the tilth of soil be improved? What natural agencies make a soil more friable?

EXERCISE 25

CONSERVING SOIL MOISTURE WITH MULCHES

In most farming operations, success is dependent upon moisture. Proper methods of conserving soil moisture should be more extensively practiced, particularly by the farmer living in areas of light rainfall.

Object. To show that soil moisture may be saved by some form of a mulch.

Materials. Tin cans; lamp chimneys; air-dry soil; scales; sugar cubes; straw; fine and coarse sand; powdered sugar.

Procedure. A dust mulch or a mulch of any kind conserves moisture by breaking up the capillary action of soil water.

1. Chip off the top of a cube of sugar about one-eighth of an inch, then cover with powdered sugar to its original height. Now place it and a second whole cube in a shallow dish of water and observe im which cube the water rises to the surface first. This illustrates the action of soil water and a dust mulch.

2. Choose two cans that will fit snugly outside of the base of the two lamp chimneys. Place muslin over the bottom of each chimney and fill two-thirds full of air-dry loam. Pulverize some soil very fine and add an inch to one chimney. To the other add an inch of ordinary soil such as was used to fill it. Place each chimney in a can and add water. Weigh and record weights; weigh again after 48 hours.

3. To show the effects on soil of plowing under a dense layer of vegetation or a heavy application of manure, prepare two chimneys as before. Fill one completely full of air-dry soil. Fill the other about half full of soil, then place an inch layer of organic material, such as chopped straw or chaff, then fill completely with soil. Place both chimneys in a pan of water and watch the rise of water.

4. To show that cultivation helps retain moisture by breaking soils into finer particles, thus giving the soil a greater moisture capacity, prepare two equal measures of sand, one coarse and the other fine. Pour water over each until barely covered and compare amounts of water needed to cover each sample. Drain and weigh each sample in order to find which retained

the most water.

5. Soil mulches influence the temperature of the soils by controlling evaporation. The effects of evaporation may be shown by placing water on the back of the hand, then drying and placing alcohol or ether on the hand. Compare the cooling effects.

Results:

	Weight	24 hours	48 hours	Loss of water
Mulched Chimney				
Unmulched Chimney				

Discussion.

1. Evaporation from a square foot of soil or from an acre can be found by finding the area of the top of the chimney and then comparing with the area of a square foot or acre. Does mulching save enough moisture to help crops?

2. Compare the surface areas of a one-foot sphere and a two-inch sphere. How many smaller spheres will it take to make the same volume as the larger sphere? How do the total areas compare? How does this demonstrate water-holding capacities of soils and does it explain why some soils always dry sooner than others?

EXERCISE 26

ESTIMATING THE VALUE OF SOILS

The value of any soil is judged solely on its ability to produce

crops. Soil fertility is the absolute support of agriculture, and agriculture is the fundamental industry of the United States. Soil fertility is a national problem and influences more than any one other thing the economic status of the farmer and the community in which he lives.

Object. To study soils in order to find the characteristics of a good soil.

Materials. Soil score card; soil augers.

Procedure. Visit at least two of the more outstanding farms of the community and rate them according to the score card.

In judging soils, observe carefully the origin of the soil. Natural outcrops of rock may help with this, or there may be a few scattered rocks through the field. Depth and nature of subsoil should be determined as well as upper soil, by using the soil auger or by studying ditches or road cuts. The natural weed growth gives a good indication of soil usefulness. Drainage should be noted as well as erosion or probable erosion and probability of overflow.

Discussion.

1. Where are the best soils of the community located and why? Were upland soils ever as fertile as bottom land soils? Why?

2. Are the soils of your community particularly subject to erosion? What can be done about it?

A Soil Score Card[1]

	Possible Score	Soil Sample 1	2	3	4
Fertility (40)					
Color	5				
Texture	5				
Structure	5				
Depth of soil	10				
Character and depth of subsoil	10				
Character and nature of forest, weed, and crop growth	5				
Topography (35)					
Influence upon yield	10				
Influence upon ease of cultivation	5				
Influence upon erosion	10				
Influence upon drainage	10				
Physical condition (25)					
Ease of cultivation	15				
Retention of fertility and moisture	5				
Adaptability to staple crops of the community	5				
Total	100				

EXERCISE 27

PLANT FOOD IN SOILS

The amount of plant food in a soil depends upon how readily a soil absorbs plant food and the amount of crops removed from the soil.

Object. To find the ability of soils to absorb plant food and to study the amount of plant food in soils.

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[1] Henry J. Waters and Joseph D. Elliff, Agricultural Laboratory Exercises and Home Projects (Revised Edition; Boston: Ginn and Company, 1925), p. 157. (Adapted from source quoted.)

Materials. Lamp chimneys or quart bottles with bottoms removed; beakers; soil samples; manure or leaf mold.

Procedure. Cover the bottom of the chimneys with muslin and fill nearly full of soil, a different sample to each chimney. Use loam, clay, sandy soil, sand, and a mixture of half loam and half pulverized organic material. Stand upright with a beaker under each to catch the water that percolates through. Make a solution to pour through each by stirring barnyard manure or leaf mold in water until colored. Allow sediment to settle then pour colored water through the soil in the lamp chimneys. Note the color of water and record the amount which will be clarified by the various soils before the percolation begins to show color.

Sample	Amount of Water before Color Noticed
Loam	
Clay	
Sand	
Sandy Soil	
Mixture	

Discussion. Find in some reference book the amounts of fertilizing compounds removed by crops or use Appendix J, page 617 in "Modern Agriculture."[2] Since nitrogen is the most expensive fertilizing element, assume its value to be twenty-five cents per pound, phosphorus eight cents, and potassium eight cents.

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[2] Grimes and Holton, op. cit., p. 617.

1. What is the cost of the materials removed by a 65-bushel per acre corn crop? By a 30-bushel per acre wheat crop?

2. Secure the average production of all crops grown in your community and find total fertilizing elements removed by them per acre and list the value in dollars and cents.

EXERCISE 28

TESTING SOILS FOR ACIDITY

Due to continual cropping, the decay of humus and the secretion of acid by roots, soils have a tendency to have an acid reaction or become "sour." Some important plants, notably the legumes, are sensitive to sour soils and do not grow readily unless the soil is limed.

Object. To learn to test soils to detect acidity and to learn how to correct sourness.

Materials. Soil samples to be tested; beakers; litmus paper; distilled water; hydrochloric acid; potassium thio-cyanate; alcohol.

Procedure. Secure soil samples on a field trip and bring to the laboratory for testing. Several samples should be taken from the same field. Use care in handling soil so as not to touch it with the hands. Perspiration from the hands may cause the soil to have a wrong reaction. Keep soil samples securely bottled.

To test with litmus paper, place some soil on a clean plate and moisten with distilled water until thoroughly damp. Place strips of litmus paper on the dampened soil and leave them in contact for a short time. If the soil is acid, blue litmus paper turns pink. To verify this, add a

drop of hydrochloric acid or a few drops of vinegar to some of the soil and then test with litmus.

A much better and fairly simple test for soil acidity is the use of potassium thiocyanate. Dissolve 4 grams of potassium thiocyanate in 100 cc. alcohol to make the testing solution. Put about one-half inch of soil sample in a clean test tube, then fill the tube half full with the solution. Shake the test tube well and allow the sample to settle. Certain definite colors show up. If the solution is a dark red, the soil needs a good application of lime; if the color is light red, it needs liming; if no color develops, the soil is either neutral or has lime present. As a general rule, if any color develops at all, at least 2000 pounds lime per acre should be applied.

Test results:

Soil Sample	Kind of Soil	Color	How Much Lime Needed
1.			
2.			
3.			
4.			
5.			
6.			
7.			

Discussion.

1. Find the cost of lime per ton, trucking costs and labor costs, and estimate the cost of liming one of the fields.

2. Lime is not a fertilizer. What does it do to aid crop production?

EXERCISE 29

CROP ROTATIONS AND SOIL MANAGEMENT

Intensive farming as practiced today necessarily draws heavily on soil fertility. By alternating crops that exhaust fertility with those that restore fertility a balance between the two may be secured. Also, by diversification the farmer is enabled to operate the farm more economically and with better results.

Object. To study and plan crop rotations which will benefit agricultural production and soil upkeep.

Materials. Paper; drawing board; architect's scale.

Procedure. Draw to scale the home farm or one in the community. Show all fields, ditches, areas of tree, creeks, and any other natural objects that may influence a crop rotation. Label each field, show the number of acres, and type of soil in each; if possible, show what crops have been grown in each field previous to the present planning.

In general, two different types of rotations are found in Kansas. One type would be suitable for a grain farm and the other type for a livestock farm. In planning a rotation, decide which crops are the main crops and which are filler or secondary crops. Be sure in planning a rotation that crops follow in logical sequence, and take into consideration whether a plant is annual, biennial, or perennial, and the length of time a perennial is usually grown in your community.

In the first column put in the crops grown for the five-year rotation and make rotations such as a ten-year rotation or fifteen-year rotation. The length of the rotation may depend upon the type of crops grown.

Record of Crop Rotation

Field	Acres	1st year	2nd year	3rd year	4th year	5th year
1.						
2.						
3.						
4.						
5.						
6.						

Discussion.

1. How does a crop rotation tend to improve soil, conserve time, and aid in weed, disease, and insect control?

2. How long a time is alfalfa kept on the same field in your community? Is it advisable to have alfalfa in a two- or three-year rotation?

3. What legumes are good for short rotations?

4. What is the best crop to grow in a field that is so sloping it washes readily? Is it advisable to terrace pastures?

EXERCISE 30

A STUDY OF CHEMICAL FERTILIZERS

With the rapid increase of mechanized farms, some form of quickly available plant food must be used if satisfactory crops are to be grown. Chemical fertilizers are being used more and more and farmers should be more familiar with their composition and soil effects.

Object. To examine several samples of chemical fertilizers to find characteristics and uses common to each.

Materials. Shallow plates; fertilizer samples.

Procedure. Secure as many samples of fertilizers as possible and bring them to the laboratory for examination. Samples may be secured by writing to several packing plants and local feed stores or mills. Pour samples of each into the plates and record the results on the chart. Study the labels to help estimate contents. Use the following chart.

Properties of Fertilizers

Fertilizer Name				
Source				
Amount of Nitrogen				
Phosphoric Acid				
Potash				
Lime				
Color				
Smell				
Taste				
Crystal Powder				
Deliquescent				
Keeping Qualities				
Availability:				
Immediately				
Quickly				
Slowly or Very Slowly				
Cost per Ton				
Value per Pound of				
Nitrogen				
Phosphoric Acid				
Potash				
Other Remarks				

Discussion.

1. Enumerate the advantages and disadvantages of chemical fertilizers and green manures. How does each compare with animal manures?

2. The statement is sometimes made that fertilizers poison the soil. Could this be true?

EXERCISE 31

TERRACING TO CONTROL EROSION

Kansas crop-lands will be subject to erosion as long as the winds blow and rains fall. However, the undue washing and blowing away of soil is an expensive process and must be controlled. In recent years the governmental agencies have been active in aiding the farmer fight erosion. They have aided by supplying men and money and by establishing Civilian Conservation Corps to establish erosion control tracts. The individual farmer can do much by terracing his own land. It is not a difficult job when done correctly and should, in the end, mean money to the farmer.

Object. To learn some soil conservation methods by establishing terraces.

Materials. Engineer's level; sighting pole; or some leveling device; terracing implements; field to be terraced.

Procedure. If the farmer is unable to buy an engineer's or farm-level and unable to borrow one from the county farm agent's office, an inexpensive leveling device can be made by using a length of garden hose about thirty feet long. Two stout glass tubes should be inserted in each end and each end should be tied to a yardstick or measured, marked stick of some kind. The tube is now filled with water and two men can rapidly run a level line with this by keeping the water in the glass tubes at the same level or same mark.

Of the several types of terraces, two are in general use. One of these is commonly called a contour farming, which simply means farming on the same level as much as possible by cultivating any slope by following

the curve of the land.

The other method of terracing is often called the Magnum terrace, or the broad ridge terrace. To construct the latter properly, the terrace is line-staked out with the level allowing a slight grade for water to fall. This slight grade is about two or three inches per 100 feet for soils that absorb moisture readily, to about six inches per 100 feet for non-absorptive soils. The distance between terraces depends also upon slope of the land and the type of the soil. In general, for land sloping one foot in 100 feet, the distance will be about 175 feet. If the land slopes three or four feet per 100 feet, the distance between terraces should be about 100 feet. Terraces should start at the outlet end and should seldom be over 1000 to 1200 feet in length. They should take in only a few acres for the first terrace; an area of about three acres would be safe to start with if terraces open on both ends. Terraces should be highest at the outlet ends and at curves where breaks most often occur. The outlet should be sodded to prevent additional washing and curves would be safer if sodded, also.

Unless the teacher has had experience with terracing work, a demonstration should be held by the county agent or by a farmer who has terraced his own land.

Discussion.

1. Where did the Mississippi delta come from? How much has your farm contributed to it?

2. "All Kansas should be terraced." What do you think of this statement? Would you say the United States instead of Kansas?

PART IV

EXERCISES ON LIVESTOCK

EXERCISE 32

OUR LIVE STOCK AND THEIR ORIGIN

The development of livestock has gone hand in hand with man's progress from savagery up to a high stage of civilization. The most intelligent races have excelled in the development of livestock and in doing so have brought about the most progressive form of agriculture known.

Object. To study the origin of the various breeds of livestock and to trace their introduction into the United States.

Materials. Outline map of the world; ruler; pencil; colored pencils.

Procedure. On an outline map of the world, locate the area in which the major breeds of livestock originated. Use a different colored pencil for each and draw a line from it to the United States showing the route through which that breed traveled before being introduced. If possible, label the introduction by date, and also the probable dates of the breed's origin if known at all. If any of the major breeds that had their origin in the United States have been extensively exported for breeding purposes, it would be well to trace them also. If this cannot be put on one map, trace a map and use it.

Discussion.

1. If possible, account for England's leading place in developing good breeds of livestock.

2. What is necessary practice and technique in developing purebreds?

3. Do we have a need for all breeds of purebreds being raised now?

EXERCISE 33

A SURVEY OF LIVESTOCK OF THE COMMUNITY

One of the problems confronting a young farmer who intends to go into livestock raising, is the selection of breeds. Generally, it is advantageous to raise the same kind as those that predominate in the country.

Object. To find the predominate breeds of livestock of the community and the number of each.

Materials. Information gathered by each pupil.

Procedure. Let each pupil be responsible for a certain area or a certain number of farms of the community. Gather information asked for and bring to class where complete information can be compiled. On a map of the county or township, mark out the areas where livestock are found. List breeds raised by each owner.

Farm Owner	Beef Cattle	Dairy Cattle	Horses	Poultry	Sheep	Swine
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

List the number of each breed in the community:

Breed Name	Purebred	Registered	Scrub	Mixed Breeds

Discussion.

1. Would you say your community is a grain-raising district, or is it a livestock-growing center? Why?

2. Choose a breed and tell definitely why you like it. Also enumerate specific points why you dislike certain breeds.

3. Can it be proved that purebreds are definitely superior to grade animals? In what ways?

EXERCISE 34

FINDING THE NUTRITIVE RATIO OF LIVESTOCK FEEDS

The more successful farmer feeds his animals foodstuffs mixed as carefully as a dietician prepares foods for a championship football team.

Object. To find the nutritive ratio of feeds.

Materials. Tables of feeding standards and digestive nutrients; any standard book on feeds and feeding.

Procedure. The nutritive ratio is the ratio of the non-nitrogenous nutrients to nitrogenous nutrients. The formula for determining the nutri-

tive ratio of feeds is as follows: N.R. = $\frac{\text{(fat x 2.25) + carbohydrates}}{\text{digestible protein}}$.

Waters and Elliff have this to say:[1]

> In computing the nutritive ratio only the digestible portion is usually considered. Included in the carbohydrates are the starch, sugar, crude fiber, and fat. As the fat contains about two and one-fourth times as much energy as starch or sugar, the amount of digestible fat in the feeding stuff is multiplied by two and one-fourth before it is added to the other carbohydrates. This process is termed converting fat into carbohydrate or starch equivalent. The nutritive ratio is obtained by dividing the per cent of total digestible carbohydrates by the per cent of digestible protein contained in the foodstuff. In stating the nutritive ratio the protein is expressed as 1 and the carbohydrates as the quotient obtained. As an example, corn contains 7.8 per cent of digestible protein, 66.8 per cent of digestible carbohydrates, aside from fat, and 4.3 per cent of fat. Multiplying the fat by $2\frac{1}{4}$ (4.3 x $2\frac{1}{4}$) and adding the product (9.7) to the carbohydrates (66.8), we have as the total carbohydrates 76.5. Dividing this amount (76.5) by the amount of protein (7.8), we have as the quotient 9.8. Thus the nutritive ratio of corn is one part digestible protein to 9.8 parts digestible carbohydrates, written 1:9.8. This means that for every pound of digestible protein in corn there are 9.8 pounds of digestible carbohydrates. Feeds in which the difference between the amount of protein and carbohydrates is small are said to have a narrow nutritive ratio, as 1:2, while those feeds in which the difference is large, as in the case of corn, are said to have a wide ratio.

List the feeds you have on your farm in the following table and classify them as narrow, medium, and wide.

Nutritive Ratio of Farm Feeds

Feed	Narrow	Medium	Wide
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

[1] Waters and Elliff, op. cit., p. 92.

Discussion.

1. Most farmers pay little attention to rations. Why is this so common? Do you think it actually pays to determine to a fraction the feed requirements of animals?

EXERCISE 35

BALANCED RATIONS FOR LIVESTOCK

A ration with a nutritive ratio that is adjusted to the needs of the animal to which it is being fed is called a balanced ration. One which does not supply in proper proportions the nutrients needed is unbalanced. The needs of farm animals have been carefully studied and the daily nutritive requirements have in most cases been determined.

Object. To learn to balance rations for farm animals.

Materials. Appendix J and K in "Modern Agriculture"[2] or any standard manual on feedings.

Procedure. Animals must be fed differently depending upon their age and use. By combining feeds we can find the nutritive ratio of the whole ration.

> The requirement for each class of animals is called a "feeding standard" and when a ration is so made up that it meets the requirements of the standard it is said to be a "balanced ration." If the ration that is fed has a nutritive ratio of less than the standard, it is said to be "too narrow," or if greater than the standard it is "too wide."
>
> . . . . . .
>
> Example.[3]--Calculate a ration for a fatting steer weighing 900 pounds. Make up the ration from the following feeds: corn silage, red clover hay, soy bean hay, corn and cob meal, and cottonseed meal.

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[2] Grimes and Holton, op. cit., pp. 617-21.

[3] C. A. Willson, Arithmetic in Agriculture and Rural Life (Ann Arbor, Michigan: Edwards Brothers, Inc., 1935), pp. 98-100.

Solution: The standard ration for a 1000 pound fattening steer is:

Total dry matter	Dig. crude protein	Total dig. food nutrients	Nutritive ratio
20-25	1.7-2	15.5-18.5	1:7.0 or 8:0

A 900-pound steer will require one-tenth less, or

18-22.5	1.5-1.8	13.9-16.6

Being governed by feeders' rules, we will try the following:

	Dry matter	Digestible protein	Food nutrients
30 lbs. silage	7.98 lbs.	.33 lbs.	4.95 lbs.
5 lbs. red clover hay	4.36 lbs.	.38 lbs.	2.17 lbs.
5 lbs. soy bean hay	4.57 lbs.	.59 lbs.	2.15 lbs.
	16.91	1.30	9.27
This leaves a deficit of	3.34	.35	5.98

which has a nutritive ratio of 1:17. This deficit may be made up by the addition of 6 lbs. of corn and 1 lb. cottonseed meal and be within the limitations of our standard.

6 lbs. corn	5.37 lbs.	.375 lbs.	4.64 lbs.
1 lb. cottonseed meal	.93 lbs.	.37 lbs.	.41 lbs.
Total of trial ration	16.91 lbs.	1.30 lbs.	9.27 lbs.
Total for ration	23.21 lbs.	2.045 lbs.	14.32 lbs.

which has a nutritive ratio of 1:7.

Discussion.

1. Explain why exact measurements are necessary for properly balancing rations.

FEEDERS' RULES[4]

1. Feed ½ lb. grain per hundred weight per day to horses doing moderate work, 1 lb. for medium work, and 1½ lbs. for heavy work.
2. Ordinarily a full feed of grain for 900-1000 lb. steer is 12-14 lbs. daily. Cottonseed meal should not exceed 6-7 lbs.
3. In winter feed dairy cows 1 lb. grain for each 3-3½ lbs. milk produced. In summer when cows are on pasture feed 1 lb. for each 8-10 lbs. milk produced.
4. A full feed for hogs is 3-3½ per cent of their live weight.
5. Feed to hogs not more than 3-4 lbs. milk for every pound of grain fed.

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[4] Ibid., p. 98.

6. One pound of grain per head daily is liberal feeding for sheep.

7. A good rule for feeding milk to calves is to feed daily 10 lbs. milk for the first 100 lbs. live weight, 5 lbs. for the second, and 2½ for the third. A 300-lb. calf then should receive 17½ lbs. milk.

8. Hogs should produce 12 lbs. pork per bushel corn fed.

9. To find the feeding value of 100 lbs. skim milk multiply the market price of live hogs in cents per pound by 6.

10. 100 lbs. of skim milk is worth as feed one-half the price of corn per bushel.

11. The daily feed should come from four plant sources.

12. The quality of the feed should not exceed the quality of the fattening animal.

13. Silage should not be fed in too large quantities. Usually 30-40 is sufficient for fattening cattle and dairy cows.

14. Only the feed fed above the amount required to keep an animal alive and at normal weight returns a profit. The Scotch have a saying, "Give to a steer a gallon of meal and it is a gallon wasted. Give him two and he will pay for three."

15. Whey is worth one-half as much as skim milk for hogs.

EXERCISE 36

ESTIMATING LIVESTOCK WEIGHTS

When weighing scales are not handy, a fairly close estimate of the weights of cattle may be secured by the use of certain measurements. It is much more accurate than the old method of guessing, and by constant practice it will give the student of agriculture an idea of weight in an animal.

Object. To learn how to estimate weight of livestock.

Materials. Fattening cattle.

Procedure. "The following formulae are adapted from formulae derived by Lawes and Gilbert and are taken from Arithmetic in Agriculture and Rural Life.[5]

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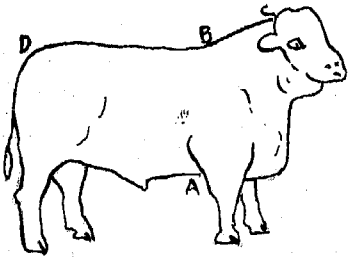
[5] Ibid., p. 102.

1. Live weight, fat cattle = $Girth^2$ x length x .00347.
2. Live weight, medium fat cattle = $Girth^2$ x length x .00369.

The measurements apply only to fattening cattle and are to be taken in inches. Care must be exercised in making measurements. Establish the point B as 1/3 of the way down the collar space on the shoulder. Then C will be on the top line vertical to B. The point D is a point that is vertical to the square of the rump. All measurements should be taken three times and an average of the three taken as a final. Dressed weight of cattle will vary from 54% to 62% of the live weight depending upon fatness of the animal.



EXERCISE 37

UNSOUNDNESSES IN HORSES

For anyone using or dealing with horses, the major defects and unsoundnesses should be readily recognized.

Object. To become able to recognize defects readily.

Materials. Horses showing defects; pictures; etc.

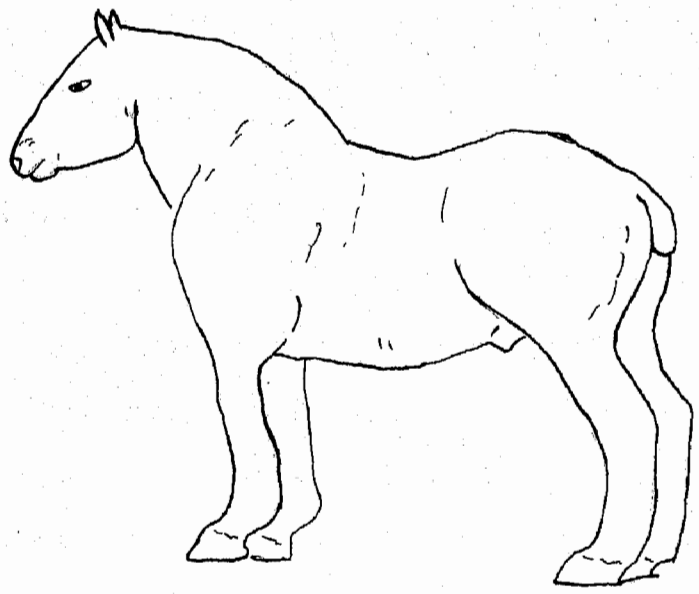
Procedure. If possible, have the local veterinarian point out to the class the chief defects of the horse that may impair its usefulness. Or a trip to a nearby sale pavilion after defects have been studied may serve to help the class locate the major unsoundnesses.

Locate the defects on the accompanying chart.

Discussion.

1. What is meant by the following terms: (a) blemish, (b) unsoundness, (c) defect, (d) vice.

Unsoundnesses in Horses



Write the names of the chief unsoundesses of the horse in the blank below and locate on the above chart by putting the number of the unsoundness in the right place.

1. _____ 7. _____

2. _____ 8. _____

3. _____ 9. _____

4. _____ 10. _____

5. _____ 11. _____

6. _____ 12. _____

EXERCISE 38

JUDGING HORSES

The heyday of the horse has gone, but many farmers still have occasion to buy and sell horses. They should be able to choose a good horse for their purpose.

Object. To learn to judge horses by means of a score card.

Materials. Score card; horse to be scored; pictures.

Procedure. Preliminary work should consist of a study of the score card as well as a detailed study of several pictures showing points of a good horse. The various parts of the horse should be committed to memory, also. During the early stages of judging, work on a small number of animals, particularly those with outstanding differences.

Discussion.

1. Why are the feet of so much importance in draft horses?

2. Has the tractor changed the type of horse in your community any in the last twenty years?

EXERCISE 39

JUDGING BEEF CATTLE

The art of judging is the foundation of all cattle shows and is mainly the method of determining value in cattle offered at public sales.

Object. To learn to be a better judge of beef cattle from the standpoint of the breeder, feeder, and butcher.

Materials. Score card; pictures of good type animals; beef cattle for judging.

Procedure. Learn the parts of the beef animal and be able to locate the parts. Study the score card until familiar with it. Beef cattle are judged by both the hand and the eye. The eye determines the form, size, color, and symmetry. The hand determines the texture of hair, the condition of the skin, and the thickness of flesh. Check the animal carefully from the standpoint of the farmer, the feeder, and the butcher, and judge according to the points on the score card.

Discussion.

1. Is it possible to determine by the score card alone the value of an animal for breeding purposes?

2. What is meant by quality and type in beef cattle? Is it necessary for breeding animals to score high on "type" in order to be good "breeding animals"?

Score Card for Breeding Beef Cattle[6]

Scale of Points				
Weight and size, according to age	10			
Form--deep, broad throughout, low set, straight top and underline	25			
Constitution--good depth and width of chest . .	15			
Quality--smooth throughout; good handler as indicated by soft loose skin covered with fine mossy hair; bone, fine yet of sufficient substance and strength to carry the body	15			
Condition--carrying natural flesh enough to indicate vigor; free from patchiness . .	10			
Breed type and color--clean cut head and neck with good form; color marking typical of the breed				
Sex character--strong masculine head and neck in bull; more refinement throughout cow than in bull	10			
Disposition--docile with quiet temperament				
Total	100			

6 "Judging Beef Cattle," Farmers Bulletin No. 1068, United States Department of Agriculture, p. 12.

EXERCISE 40

JUDGING DAIRY CATTLE

The art of being able to select a good dairy cow is essential to good dairying and high milk production. It is possible to detect with few exceptions the value of a dairy cow by following certain suggestions.

Object. To learn how to select good dairy cattle.

Materials. Score card; pictures of dairy cattle; charts; dairy cows to be judged.

Procedure. As in previous exercises, thoroughly acquaint yourself with the score card and the points on the dairy animal. Become thoroughly familiar with the dairy type. Score several animals and if possible weigh and test the milk of each and compare your judgment with that of the owners of the cows.

Discussion.

1. What is dairy type and temperament?
2. Why is "beefiness" so criticized when found in dairy cattle?

Score Card for Dairy Cows[7]

Points		1	2	3	4
Indicating efficiency of milk secreting system (40)					
Udder--large, evenly quartered, well held up, not meaty, attachments long, teats squarely placed, and of convenient size	30				
Milk veins--capacious, entering large wells	10				
Indicating capacity (25)					
Muzzle--wide	1				
Jaw--wide in angle, strong	1				
Barrel--deep, wide, long, well held up, with ribs broad, long, far apart, well sprung	23				
Indicating constitutional strength and vigor (15)					
Nostril--large, expanded	1				
Eye--prominent, bright, intelligent, placid	1				
Chest--wide, deep	4				
Skeleton--developed for strength, of good quality, roomy, long and level at pelvis	5				
Skin--loose and mellow showing good circulation	2				
Carriage--energetic, alert, prompt, not nervous	2				
Indicating dairy temperament (10)					
Body wedge shaped, lean, angular, clean cut and neat	10				
Breed type (10)					
Size, color, temperament, ruggedness of build, etc.	10				
Total	100				

EXERCISE 41

TESTING MILK FOR BUTTERFAT

Milk is sold and its value determined by its butterfat content. The

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[7] Ullrich, op. cit., p. 381.

cow that gives milk with the highest test is a more valuable cow than the cow giving milk of a low test. Only by accurately testing can we distinguish between boarder cows and those returning a profit.

Object. To learn to test milk and cream for butterfat.

Materials. Milk tester and bottles; scales; 17.5 cc.; 17.6 cc. and 18cc. pipettes; acid measures; glymol; sulphuric acid; (Sp. Gr. 1.82); samples of cream and milk; dividers.

Procedure. Do not attempt to test either milk or cream except in bottles made especially for the purpose. For milk, use either an 8 per cent or a 10 per cent bottle. Either weigh out exactly 18 grams of milk or measure out exactly 17.6 cc. and place in a clean milk test bottle. Now add about 17.6 cc. of sulphuric acid. When adding acid tip the top of the bottle away from the face and rotate gently while pouring the acid. It may break. When the milk is properly cooked by the acid it should have a dark brown color resembling chocolate. Place bottles in the tester and whirl at the proper speed for five minutes. If the tester is fourteen inches in diameter, the speed should be 900 r.p.m. Remove and immerse in a water bath at 180° F. for five minutes. Next add water to bring the level up to about the 4 or 5 per cent mark. Whirl for two minutes. Add more water to bring water up to the 8 per cent mark and then whirl for one minute. Place all bottles in a waterbath at 135° F. for ten minutes. To read, place one arm of the dividers on the lower end of the fat column and the other arm at the extreme upper end of the fat column. Now hold the arms rigid and place one arm on the zero mark of the bottle and the upper arm will point to the line indicating the per cent of butterfat. The water bath is important in testing both milk and cream. Do not let it cool off.

To test cream, warm all samples to 110° F. and mix each very thoroughly. Weigh out exactly 9 grams of cream for each sample and transfer to cream testing bottles graduated to 55 per cent. When all samples have been weighed, cool the cream to 68° F. by immersing in a waterbath. This is to make for proper acid action. Add slowly to each bottle 8 cc. of sulphuric acid by allowing acid to run down the bottle neck. Revolve slowly in order to wash down all cream. Mix with a whirling or rotary motion until the sample is a rich chocolate color. Now treat as for milk, except the last run of one minute is omitted when testing cream. The final waterbath should be 140° F. and never below 135° F. Before reading the test observe the color of butterfat. It should be golden yellow. Any curd or foreign material will cause an error and all such samples should be retested. To read the test, add about five drops of glymol to the surface of the butterfat column. Place one arm of the dividers at the lower end of the fat column and the other at the division line between the glymol and the butterfat. Now proceed as for milk in order to get final readings. If no glymol is available, try to set the dividers about half way on the meniscus on the upper end of the fat column.

Several samples should be tested until the pupil is proficient. Record results.

Owner	Sample Test				
	1	2	3	4	5

Discussion.

1. Of what value are the cow-testing associations?

2. Do you think it would be profitable for the farmer to test individually each cow in his herd? Why?

EXERCISE 42

SANITARY MILK PRODUCTION

The healthfulness of milk depends upon its freedom from disease-producing germs. Milk is a favorable medium for the development of many. Dirt, too, is found in some milk and, while it may not be dangerous, it does impair its keeping qualities.

Object. To learn some of the principles of sanitary milk production.

Materials. Petri dishes with culture medium; cotton pads as used in strainers; pint bottles; milk pails.

Procedure. This exercise can be completed on a field trip or directions can be given the pupils and they can bring the materials. Sterilize one covered milk pail and one open pail, and milk a cow in each. Pour samples into sterilized bottles, plug with cotton and set in the same place and observe results.

Secure some sour milk and place a teaspoonful in each of two sterilized bottles and shake well. Pour out the milk and sterilize one bottle, then place the same amount of fresh milk in both bottles and seal with cotton plugs. Observe results.

Immediately after milking, prepare two samples of milk in sterilized bottles and plug with cotton plugs. Cool one immediately, but let the

other cool at room temperature. Observe the time it takes for each to sour.

Buy a sample of milk at a store and test carefully for sediment by straining it through the cotton strainer pads, or use a regular sediment tester secured at the produce house.

Discussion.

1. What is the chief cause of dirty and unsanitary milk? What is Kansas doing about it?

2. What dangerous diseases are milkborne?

3. How does it "pay" to produce clean milk?

4. Discuss: Malta fever, streptococcci sore throat, undulant fever, and other diseases carried by milk. Can typhoid fever be carried by milk?

EXERCISE 43

JUDGING HOGS

On too many Kansas farms too little consideration is given to quality in hogs. Breeding is confined to no particular breed, mostly on the assumption that "pigs is pigs," and one hog will do as well and return as much profit as another. Since the hog is grown on more than three-fourths of the farms of the United States, some study of profitable hog-raising should be done.

Object. To learn the characteristics of hogs in order to understand better the uses of each breed and their adaptability to farm conditions.

Materials. Score card; pictures; live hogs for judging.

Procedure. Study the score card and learn the names of the parts of the hog. Study the material in the textbook dealing with the judging of

hogs. Visit some nearby farm that produces purebred hogs and practice judging until thoroughly familiar with the procedure. If possible, visit some public sale pavilion and study the type of hogs that are sold there.

Discussion.

1. Do the farmers of the community believe in pure bred hogs as much as pure bred cattle? Why?

2. Should Kansas grow the lard or bacon type of hog? What are the advantages of each?

Score Card for Breeding Hogs[8]

Points		1	2	3	4
Type (40)					
Weight--according to age and condition . . .	15				
Height--according to age	10				
Body--long, deep, wide	10				
Back--wide from end to end, high, strong . .	10				
Legs--straight and strong, bone heavy but smooth	10				
Pasterns--short, straight, and strong	5				
Symmetry (15)					
Smooth, well proportioned and well balanced from end to end	15				
Quality (10)					
Fine hair, clean bone, mellow flesh, smooth conformation and finish	10				
Character (10)					
Neat but strong head, wide open eyes, masculine appearance in boars, feminine appearance in sows, stylish, vigorous . .	10				
Condition (5)					
Well enough finished to show essential features to the best advantage	5				
Total	100				

Duroc and Poland China boars should average about 40 to 42 inches in height. Other breeds should average 38 to 38 inches in height. Sows of all

[8] Kansas State College of Agriculture, Manhattan, Kansas.

breeds average about two inches less than the boars.

EXERCISE 44

JUDGING SHEEP

Most farms in Kansas should have sheep, yet they should never be thought of as a get-rich-quick scheme. They will, in most cases, be profitable if handled correctly.

Object. To be able to judge the value of sheep.

Materials. Score card; pictures; suitable animals for judging.

Procedure. Study the score card and learn the parts of the sheep. The same general procedure is followed as with other animals with certain exceptions. Generally, sheepmen do not like to have their sheep handled by amateurs and the wool torn apart for examination. So unless full consent is obtained from the owner, it may be well to judge from a distance only. In catching sheep, always catch them by a hind leg and never by the ears or wool.

After deciding upon the type and breed of sheep to be raised, try to select a group for a farm flock, always keeping in mind the ideal type.

Discussion.

1. Good sheepmen never use any ram except a purebred. Is a purebred more essential with sheep than with other farm animals?

2. What is the difference between mutton and wool types of sheep, and which is more suitable for average Kansas conditions?

Score Card for Mutton Sheep[9]

Scale of Points					
General appearance (38)					
Weight--according to age	8				
Form--long, level, deep, broad, low set, stylish	10				
Quality--bone, clean cut; hair, silky; skin, pink; offal, light	10				
Condition or finish--covering, deep, even, firm, free from patches; dock, thick; purse and flank, full; neck, thick	10				
Head and neck (6)					
Head--short, clean cut; eyes, large, clear; ears, fine, alert; muzzle, large; lips, thin; nostrils, large, open; forehead, broad	4				
Neck--short, thick, free from folds; shoulder vein, full	2				
Forequarters (6)					
Shoulders--smooth, evenly covered, compact on top	4				
Brisket--broad, neat	1				
Legs--short, straight, wide apart; forearm, full; shank, smooth, fine	1				
Body (23)					
Chest--wide, deep, full	5				
Back--broad, long, straight, thickly covered; ribs well sprung, close together	10				
Loin--broad, thick, long	8				
Hindquarters (15)					
Hips--wide, level, smooth	2				
Rump--long, level, wide	4				
Thighs--deep, wide, full	4				
Twist--deep, full	4				
Legs--short, wide apart, smooth	1				
Wool (12)					
Wool, fine	12				

[9] Kansas State College of Agriculture, Manhattan, Kansas.

EXERCISE 45

SELECTING CHICKENS FOR THE FARM FLOCK

During recent years the poultry business has developed tremendous popularity. The chicken is a highly profitable farm animal, and the consumption of poultry products has held up well. Few farms or suburban tracts are too small and none too large to raise some poultry.

Object. To learn to recognize good laying hens and to realize that egg-laying and good type are closely related.

Materials. Score card; poultry to be judged; pictures.

Procedure. Study the score card thoroughly and study the parts of the chicken until you know all the various parts. Study the pictures of good fowls until the type is fixed in mind. Now, using the score card, score the chicken as you have done other animals in previous exercises. This score card is primarily for egg producers and is not so well adapted to the heavier breeds of chickens. It stresses the points significant in egg production. Score individual fowls until proficient, then judge some in order to select a few of the best birds. If the owner trapnests his flock, compare your judgment with his records.

Discussion.

1. Why is vitality so important in selecting hens for the laying pen? Is vitality so essential for the heavier breeds?

2. How long should a hen be kept for egg production?

3. How many eggs should a hen lay each year in order to be profitable?

Utility Score Card for Live Poultry[10]

General appearance--the fowl shall give the appearance of strength and vigor. It shall be stylish in carriage and active in movement. Body shall be compact and balanced.	15
Condition--the fowl shall be free from all diseases and deformities and the plumage smooth, clean, and glossy . . .	10
Body--the head shall be carried well up and be broad, deep, and of medium length. The beak shall be strong, medium in length, well curved, and broad at its base. The eyes shall be strong, large, full, brilliant, and clear. The face shall be full and bright red in color. The comb and wattles must be well developed, firm, smooth in texture and bright red in color.	19
The neck should give the appearance of strength and be well arched.	5
The back shall be long and broad for the breed, flat at the shoulders and the width carried well back toward the tail. The oil gland at the base of the tail shall be well developed.	10
Wings shall be medium in size, well folded, and carried close to the body.	2
Tail shall be well feathered, well spread.	2
The breast shall be broad, full, and rounding.	10
The body and fluff shall be wide, deep, and long, showing evidence of capacity. The abdomen shall be well tucked up and firm. Keel straight.	14
Legs--the shanks shall be stout, straight, and smooth. . . .	5
The thighs shall be stout, straight, well muscled, and set well apart at the hip and hock joints.	5
The toes shall be stout, straight, and smooth, with the nails short, strong, and well worn.	5
Total	100

EXERCISE 46

PRODUCING MARKETABLE EGGS

Produce houses regularly return thousands of eggs to the producer because of some flaw in the egg. The egg producer must regulate his

[10] Waters and Elliff, op. cit., p. 98.

management in order to produce more marketable eggs. It costs no more to produce good eggs, but it is expensive to produce poor eggs.

Object. To learn how to produce marketable eggs.

Materials. Samples of eggs of various sizes; colors and conditions of cleanliness as secured from a produce house; candler; score card.

Procedure. A candling device may be made by using a small electric light bulb and fastening it inside a four-pound cheese box. Cut a hole in the box slightly smaller than the egg and paint the outside of the box a dark color. Or, a candler may be borrowed. Study the score card and score the eggs accordingly. Be sure to observe the egg for freshness while candling. Fresh eggs have only a very small air space at the large end. Older eggs have a larger air space.

On a field trip to some poultry farm, observe the methods taken to produce clean eggs. It is easier to produce clean eggs than to clean them later, and washed eggs seldom bring the full market price.

Discussion.

1. What influence does temperature have on stored eggs? How often should eggs be sold in hot weather?

2. Is it profitable for the farmer to grade the eggs he sells?

Score Card for Eggs[11]

Weight--one dozen eggs should weigh between twenty-four and twenty-six ounces.	18
Uniformity--the entire dozen shall be uniform in size, shape, and color.	6
Shell shape--the shell should be symmetrical with reference to the longitudinal axis, oval in general outline but distinctly more pointed at one end than at the other, and free from ridges and roughness.	6
Shell color--the color should represent the respective breed. If white, the shell shall be free from glossiness or creaminess, if brown, it shall represent a fair average of the breed. All eggs shall show the bloom of a new-laid egg and shall be free from all spots and shall be even in color throughout.	4
Shell condition and texture--the shell shall be sound, perfectly clean, and unwashed. It shall be smooth and free from excrescences of any sort, and shall be of such strength and thickness as to afford protection to the contents.	18
Contents, fulness--the contents shall clearly fill the shell. The air cell shall be barely visible at the large end of the egg and stationary.	12
Contents, yolk--the yolk shall be barely visible before the candle and shall be free from spots, clots, or bloodrings and show no signs of heating or of incubation. It must float freely in the white when the egg is revolved.	18
Contents, white--the white shall be viscuous, clear and free from spots. The tendency to be weak and watery shall be severely discriminated against.	18
Total	100

EXERCISE 47

KEEPING BEES ON THE FARM

Most farms have a need for a few colonies of the right kind of bees hived in proper hives and properly located. The beginner in beekeeping

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11 Waters and Elliff, op. cit., p. 100.

will be more than repaid by getting the right start. The chief need of bees is their valuable work in pollinating flowers of plants. Honey is a wholesome and valuable food.

Object. To make a study of beekeeping, its requirements and possibilities.

Materials. Hives of Italian or Caucasian bees; smoker, bee veils for each pupil; hive tool; bee magazines.

Procedure. If the teacher is not familiar with the technique of handling bees, it is best to confine this exercise to a study of available literature. Perhaps an experienced beekeeper can be found to help out. Most of them will be glad for the chance to help. The bees selected should be Italian or Caucasian because they are much more gentle than others. In fact, frequently the hive can be opened without smoke and without exciting the bees. The hive should be opened in the proper manner to show that bees can be handled without stinging the operator. During the demonstration the queen should be located and the class allowed to see. The workers, drones, and queen should be carefully studied so they can be readily recognized in the future. The construction of the hive and frames should be given some attention as well as the construction of the honeycomb.

Try to find out what plants are furnishing pollen and nectar at the time of examination. Notice the cells full of pollen or "beebread," as it is called. Examine the combs for larvae bees and eggs. Generally, these will be found on frames in the middle of the hive.

One of the best ways for the beginner to get started is to buy hives and package bees, or attempt to find enough swarms for a start. Swarms

should be requeened at the earliest opportunity as they generally are black or German bees and are cross and difficult to manage.

Discussion.

1. Do you think that if most people knew that some bees very seldom sting, it would help to popularize beekeeping?

2. What aid do bees give to the alfalfa and other legume crops and the fruit crops? Can you cite any evidence to show that bees have been directly helpful?

3. What are the possibilities of profit in your community with bees? Why is not honey a more important article of food?

PART V

EXERCISES ON FARM BUSINESS

EXERCISE 48

THE BUSINESS OF FARMING

The farm today, more than at any other time, calls for men with sound business judgment and training. The successful farmer needs training in almost every branch of science. He must know something of biology, chemistry, engineering and many other things totally unnecessary a few years ago. He must be a good financier with plenty of natural intuition in all matters of farming.

Object. To learn some of the best business principles and practices of farming.

Materials. Blanks for various business forms such as checks; notes; receipts; contracts; mortgages; leases; deeds and insurance papers; milking records; egg records; farm account books.

Procedure. Use the above blanks for practice writing until each pupil is familiar with each one. If possible, have a banker come before the class to explain the use of the various forms. Or the class can be taken to the bank and shown how the business transactions of the farm are handled there. Perhaps an insurance man may be secured to talk about farm insurance.

Have each pupil bring to class an itemized account of the farm's capital, showing the percentage invested in each division of the farm. Compare with other members of the class and note any comparison or diversion. Is it due to location or to personal interest?

Each pupil should get a land description from the deed to his home place. If the deed is not available, perhaps the parents can furnish the

land description. Practice drawing sections on the black board with divisions and label them properly until all pupils understand the method of land description.

Visit some of the cooperative enterprises of the community, such as stores, creameries, elevators, etc., and determine their use and value to the community. Give a report on the cooperative societies of Denmark. How do they compare with ours?

Discussion.

1. In a discussion, bring out the fact that farming is a business and a way of life, and show that it is governed by the same business principles as the bank or the elevator visited.

2. Do you think it would pay some farmers to hire an efficiency expert to help them plan?

3. Who would profit most by a closer cooperation between townpeople and farmers? Why?

EXERCISE 49

THE FARM INVENTORY

Just as other business firms make an inventory yearly, so should the farmer check to determine gains and losses and the reasons for each.

Object. To find the net value of the farm and to find profit or loss.

Materials. Farm account book.

Procedure. Carefully list all property on hand at the beginning of the year and again at the end of the year. If permission can be obtained

from a neighbor, take an inventory for him, also, with his help. This will aid the pupil in estimating value of farm machinery and commodities. Generally, the best time to take inventory is sometime during the winter months. Work is slack at that time and most crops are in and their amount will be more accurately estimated than at other seasons. Also, it is the time when other business firms take inventory. But whatever the date selected, it should be as constant from year to year as possible.

All commodities on hand must be classified. These include real estate with buildings and improvements, all live stock, all machinery, all feeds and supplies, all crops, all cash on hand and accounts renewable. Have the owner aid in estimating value or have the deputy assessor talk to the class and explain values and methods of listing property for taxation. A good inventory will greatly aid the assessor in his work.

Liabilities should show all debts of the farmer; that is, everything he owes to others. All small items should be shown or they can be lumped in one general sum.

The pupil should understand that an inventory properly made up and used shows only gain or loss over a certain period of time. It does not show which of the farm's departments made a profit or loss. A separate inventory would have to be kept to do this, or a daily record kept.

If possible, talk to a banker or a finance man and have them explain how accurate books would aid the farmer.

Discussion.

1. What reasons can you give for the farmer's general antagonism to keeping books? How has this been broken down in recent years? Would any other business with an investment as large as the farmers fail to keep books?

2. What commercial courses would be helpful to the farmer? How?

EXERCISE 50

PLANTING THE HOME GROUNDS

It is seldom that the farm owner gives much attention to the improvement of the grounds surrounding the farm home. Few farmers realize either the financial or the esthetic value of a well-planned and planted farmstead. It is possible to make any farmhouse into an attractive home. Money and time put into such improvements yield returns in satisfaction, pleasure, and comfort. Remember, every farmstead presents some sort of a picture to a passerby, depending upon the care given it. You can make yours present the kind of a picture you wish it to present.

Object. To learn how it is possible to make the farmhome a more comfortable, attractive place to live.

Materials. Bulletins; seed catalogs; large sheet of paper; architect's scale.

Procedure. The first thing to do is to plot the farmstead to scale and put on all existing buildings, fences, drives, trees, and other objects that must be considered in remodeling the home grounds. Study carefully and try to visualize an arrangement that would be a more convenient and satisfactory arrangement for the farmer. As soon as some changes are thought of, start making a second plan showing the buildings, trees, fences, etc., relocated. Keep the two plans for constant reference. Changes may need to be made later.

Study the catalogs of some of the better seed houses and nurseries

in order to get an idea of what plants to use. Native plants may be more hardy if it is possible to secure them. Some State Agriculture Colleges publish a list of hardy shrubs adapted to your locality. Write to yours for additional information about your problems.

Use the revised plan and arrange selected plants on it. Always use a plan and after it is completed, stick to it. It may save you a costly mistake later, and you can get some idea of how these shrubs will look together through the use of a nursery catalog so that later changes should not be necessary. Remember, your farmstead is the only one like it and the plan should be made for it alone.

Some of the aims in landscaping are;

1. To make a building seem part of the landscape.

2. To hide ugly buildings or portions of a place.

3. To give protection from winds and to afford shade.

4. To give an uninterrupted line of vision where the visa is pleasing.

5. To give some kind of a ground cover.

After the list of plant materials is complete, figure the cost from the nursery catalog. Keep it conservative and plan it to carry over a number of years.

Discussion.

1. Can you suggest any better reasons why farmers, as a rule, do not have more attractive farmsteads?

2. Which type of plant should the farmer use most extensively; annual, biennial, or perennial? Why?

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