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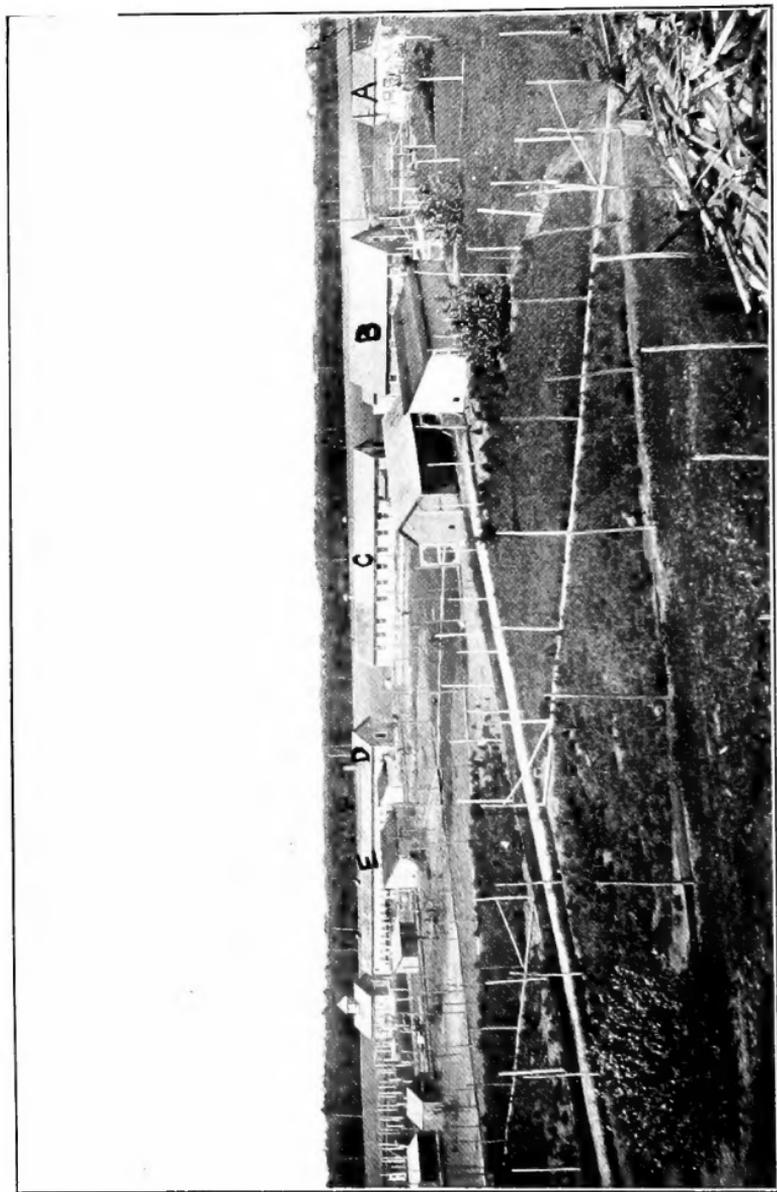
POULTRY LABORATORY GUIDE



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FRONTISPIECE.

Location of incubator cellar and brooder houses, showing only a few of the laying houses. The buildings are as follows: A. Feed room; B. Incubator cellar; C. Individual brooder house; D. Boiler house; E. Long-pipe brooder house.

POULTRY
LABORATORY GUIDE

*A MANUAL FOR THE STUDY OF PRACTICAL
POULTRY KEEPING*

BY

HARRY R. LEWIS, B.S.

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ILLUSTRATED

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INTRODUCTION

THE object in publishing this laboratory manual is to fill a long-felt want in poultry short courses, where the classes are large and where a great amount of practical work must of necessity be crowded into a short period of time.

There is a growing demand for systematic laboratory work in all of our practical agricultural studies, and especially so in the short courses. The purpose of this work, therefore, is to aid the beginner in obtaining the maximum amount of benefit in the least possible time, and also to better enable him by personal study to grasp the fundamental principles underlying the work without the close personal attention of the instructor, which is impossible in our poultry classes.

The manual may also be used as a guide for laboratory work in collegiate courses, more than one period being given to the more important exercises ; which should be left to the discretion of the instructor, the amount of time being devoted to each part depending on the equipment

of the department, length of the course, and age and previous training of the students. If used in connection with a short course of less than nine weeks, it will be necessary to introduce the exercises dealing with incubation at an earlier period in order to finish the work of brooding before the end of the course.

The exercises begin with the very elementary work and touch only the practical side (the work which each student should do and observe for himself) and with which every poultryman should be very familiar. It is not designed to take the place of a text, but to be used in connection with and as a supplement to a thorough modern text-book, the idea being to discuss the various problems in such a manner that the student can solve them by deductions from his own observation and experience.

If the institution is equipped with a department of Zoölogy and Mechanic Arts, the work in entomology and the repair and operation of boilers and heating plants should be taken up in their respective departments.

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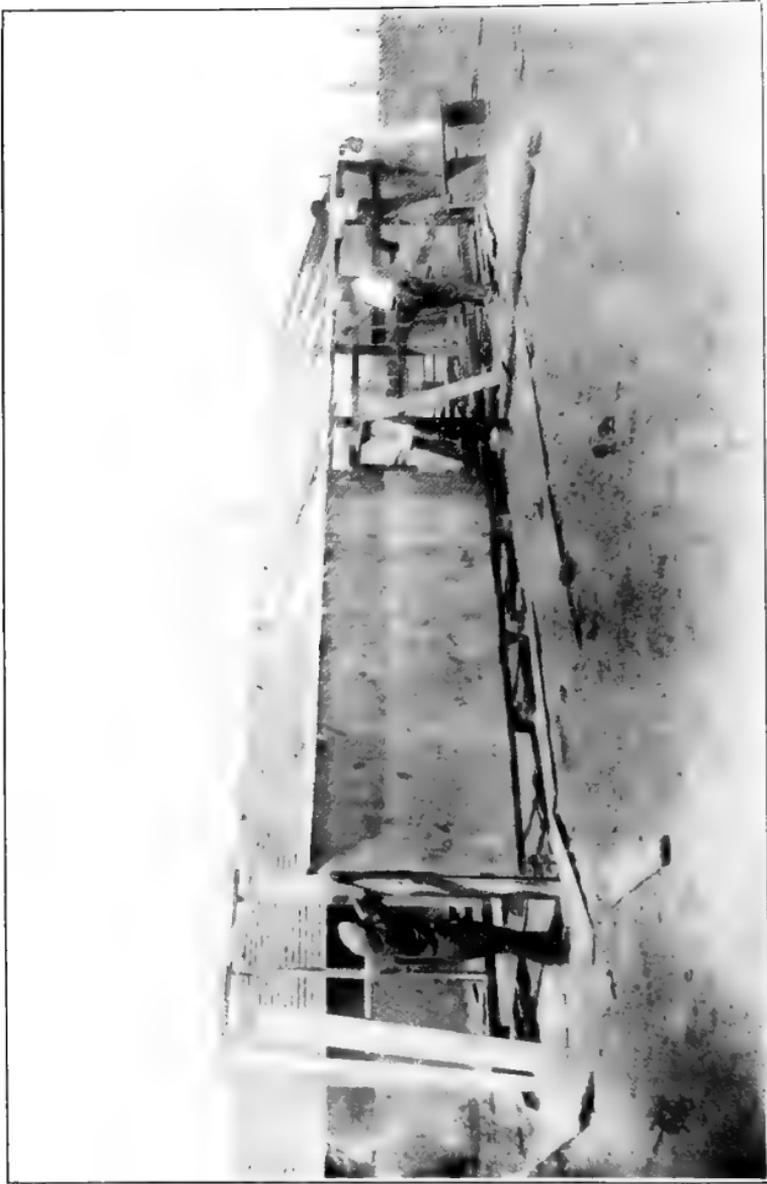


FIG. A. — Students constructing poultry house of the double-pen shed-roof type ; showing the method of framing.

POULTRY LABORATORY GUIDE

EXERCISE I

CLEANING AND DISINFECTING POULTRY HOUSES PREPARATORY FOR USE BY THE STUDENT

PLACE all movable fixtures out of doors in the sunshine, cleanse, and thoroughly spray with the following disinfecting solution. Prepare as follows :—

$\frac{1}{2}$ gallon of crude carbolic acid.

$\frac{1}{2}$ gallon of crude sulphuric acid.

Add the sulphuric acid very slowly to the carbolic acid, stirring all the time. The vessel containing the carbolic acid should be placed in a large receptacle containing water, thus keeping the mixture cool, as a large amount of heat will be generated. One part of the mixture to twenty parts of water makes a strong, reliable, inexpensive disinfectant for use in and around the poultry house. The undiluted acid should not be allowed to touch the skin or clothing, as it is very caustic in its action.

Sweep walls and ceiling thoroughly, removing all dirt and cobwebs. Remove all litter from the house and burn or mix with compost. If the floor is of dirt, remove a few inches of the top soil and in its place put fresh clean sand or gravel.

Next close the house, making it as air-tight as possible, and thoroughly fumigate for several hours by burning flowers of sulphur. The powdered sulphur should be placed in a metallic basin on top of an inverted pail or pan. Alcohol may be used to aid ignition. Care should be taken to avoid all danger from fire. One pound of sulphur will thoroughly cleanse a house which contains 120 square feet of floor space. Allow the sulphur to burn continuously for a number of hours, after which air the house for an hour by opening all doors and windows. Next spray the house with the disinfecting solution, being careful to touch all inside parts.

Replace all movable fixtures and give the inside of the house a good coat of whitewash, after which wash the windows perfectly clean with sand soap and hot water, outside and in, to admit all the sunlight possible. Fresh clean nesting material and clean litter to the depth of four or five inches must next be placed in the house, and everything arranged in neat and orderly manner for future use.

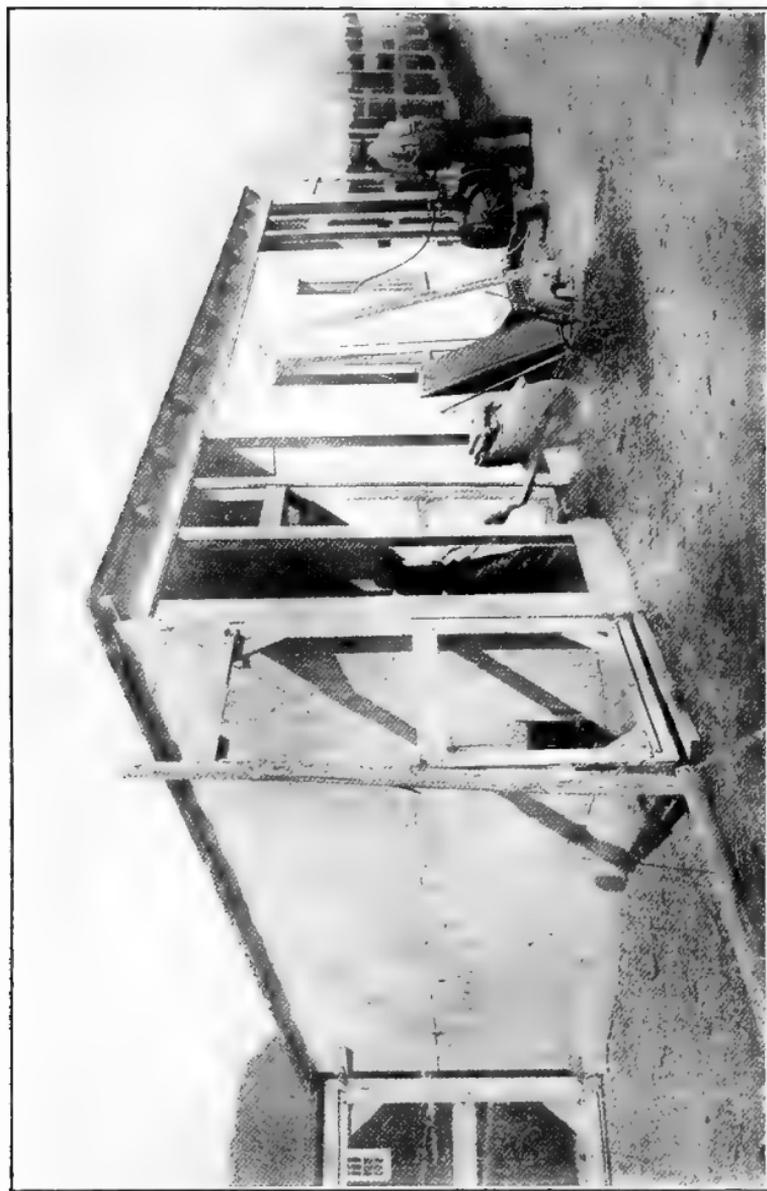


FIG. 1.— Students cleaning and disinfecting poultry house, showing force pump and barrel mounted on wheels to insure ease and thoroughness in disinfection. On the end of the pipe which passes into the house there is a Bordeaux nozzle which gives an even distribution of the disinfectant.

EXERCISE II

A STUDY OF THE VARIOUS TYPES OF POULTRY HOUSES

Examine carefully the various types of houses found on the college plant. Note the kind of material used for foundation. Does it answer its purpose in every particular? The following materials are commonly used for the foundations of poultry houses: wood, brick, stone, and cement, either as posts or as a solid wall. Which do you consider best, and why?

Note the size and arrangement of sills, posts, studding, plates, and rafters, as well as the kind and grade of lumber used. Are the outside walls single or double? If double, what advantage is obtained? If double walls, note the difference in construction between the outer and inner wall.

Next examine the construction of the roof and note shape. Compare with other types of roofs as regards pitch, amount of lumber used, labor required, and amount of roofing material required to cover same. The following types are commonly used in the construction of poultry houses: shed roof, gable roof, or even span, two-thirds span, three-quarters span, monitor

and half monitor, and A-shaped roof. Compare each of these types with regard to the previous mentioned differences and determine which you think is the most economical, and why.

Note the kind of material used to cover the roof and examine its condition. With a tape find the area of the roof and determine which would be cheaper, shingles or paper, taking into consideration both the initial cost and the length of time which each will last if properly taken care of; using in each case the current price of shingles and paper.

Upon examining the house from the front, note the construction of the front wall. If a large portion of it is open, covered only with wire and canvas curtains, there being no separate laying and roosting room, the house is of the open-front type. If, however, the house is built with four solid walls, lighted by windows and to one side is attached an open shed the front of which is covered with wire, it is of the scratching shed type.

Enumerate the advantages to be derived from having the front of a house open or having an open shed attached.

Go through each poultry house, discussing the various advantages and disadvantages of each type, taking notes on the construction, type of



FIG. 2. — Single-pen house with gable or even-span roof, especially adapted for the colony system of poultry keeping.

roof, and design of front wall. Any type of house not exemplified in the poultry plant should be briefly described during the trip of inspection and its points of resemblance to the existing types thoroughly explained. Each student should know what is meant by and become familiar with the following kinds of houses: open front and scratching shed. These may be single pen, double pen, or arranged in succession to form the long house.

The work in the construction and types of poultry houses should include not only a careful study of houses already built, as outlined above, but where possible each student should be allowed to take part in the construction of some new poultry building. Where this is possible and if time will permit, the exercise may be divided between four or more laboratory periods.

EXERCISE III

INTERNAL EQUIPMENT AND ARRANGEMENT OF POULTRY HOUSES

In making a study of the internal fixtures of the poultry house visit all the houses in turn, comparing the good and poor points of each.

Perches. — Examine carefully and note the following points: kind and size of lumber used,

arrangement and method of construction. Are they all on the same level, or is one above the other in the form of steps? Which arrangement is best, and why?

Measure the distance from the ground to the roost. They should always be near enough to the ground so that the birds can fly to them easily. (From one to three feet, depending on the breed.) If dropping-boards are used, the roosts should be raised at least six inches above them to admit of easy cleaning. Measure the total length of roost and determine the number of fowls it will accommodate, allowing the following space for the various breeds: the small egg breeds require from six to seven inches of roost per bird; the medium-sized fowls, such as Plymouth Rocks, from seven to nine inches; and the heavy Brahmas and Cochins, from eight to ten inches.

The perches should be constructed with the idea of convenience for the fowls and so arranged that the droppings will be caught without dropping to the floor or soiling the litter, and so that they will be left in an easy position for cleaning and removing.

Are the perches movable; if so, what is the advantage?

Dropping-board. — Note the kind of lumber

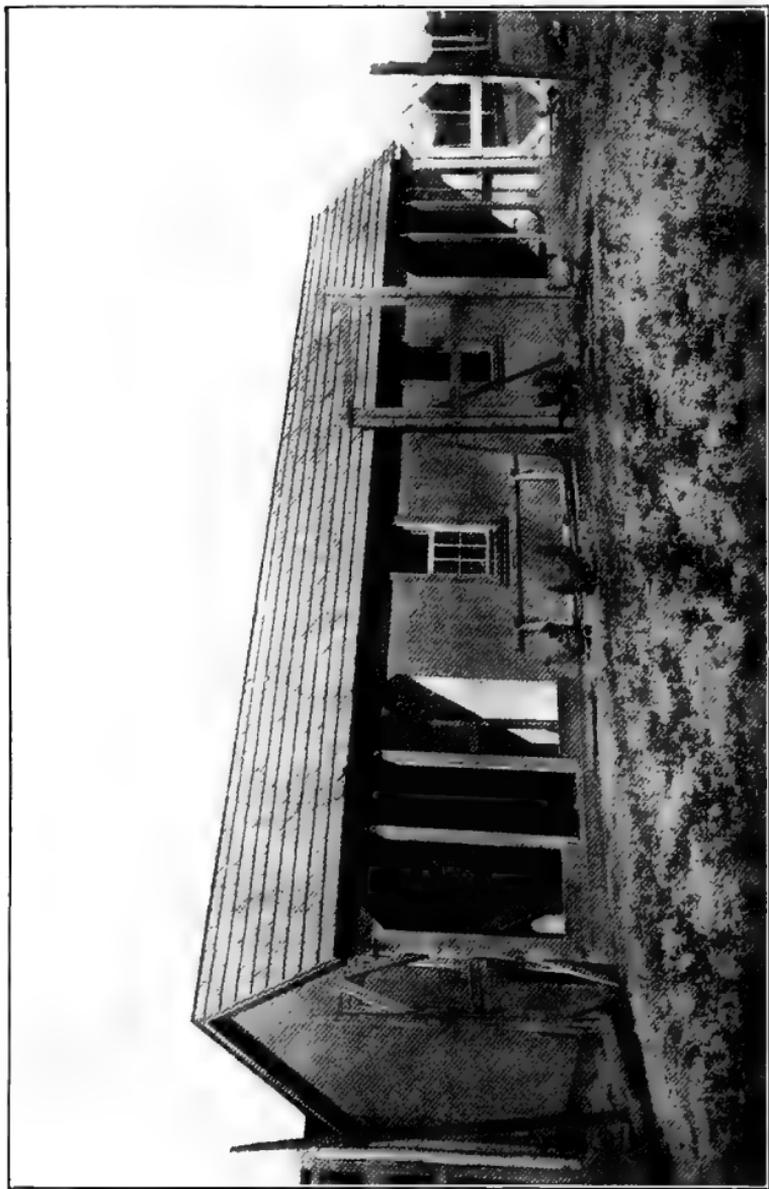


Fig. 3. — Double-pen scratching room house with a shingled roof of the two-thirds span type. Showing the laying and roosting rooms in the centre.

used in construction. They should have a perfectly smooth upper surface. Why? Measure the width of the dropping-board and determine the width per roost. For single roosts it should be eighteen to twenty-two inches wide, and for double roosts about three feet.

Is the dropping-board movable or built permanently into the building? What is the advantage of having it movable?

Nests. — In deciding on the advantages and disadvantages of different kinds of nests there are at least three things to be considered:

1. They should be situated so that they are more or less darkened.

2. They should be so arranged that the eggs can be easily collected, and so constructed that they can be easily and thoroughly cleaned.

3. They should be raised above the floor, thus making all the room available for the birds.

Note the size and kind of lumber used, shape and size of nests, also method by which they are attached to the wall or dropping-board.

Enumerate the different kinds of nesting material used. Which do you consider best, and why?

Trap nests. — Make a study of the different trap nests available, and after following out the method of tripping and locking, decide which

one is the simplest, which one trips the easiest, the quickest, and makes the surest catch; also which one is the easiest to register the layers, to collect the eggs, and reset.

Drinking fountains. — Note the different shapes of fountains, how the water is held in them, and how it is kept clean if the vessel is open. Note the different materials of which they are made, also their construction with reference to ease and thoroughness of cleaning and quickness of filling. Are they placed on the ground, on a raised platform, or are they suspended or hung from the side of the wall? Which is the best? What provisions are made, if any, for keeping the water cool in summer?

Feed hoppers and troughs. — Note size, shape, and method of construction, kind of material used, and how attached to the wall. Examine carefully and study methods used to keep the birds from wasting the dry food.

If wooden or metal troughs are present for feeding wet mash, note size and shape, also what method is used to keep the birds out of the trough and of keeping the food clean.

All food hoppers should be so arranged that they can be easily taken out of doors, emptied, cleaned, and should be so constructed that the birds will not waste or soil their food while eating.

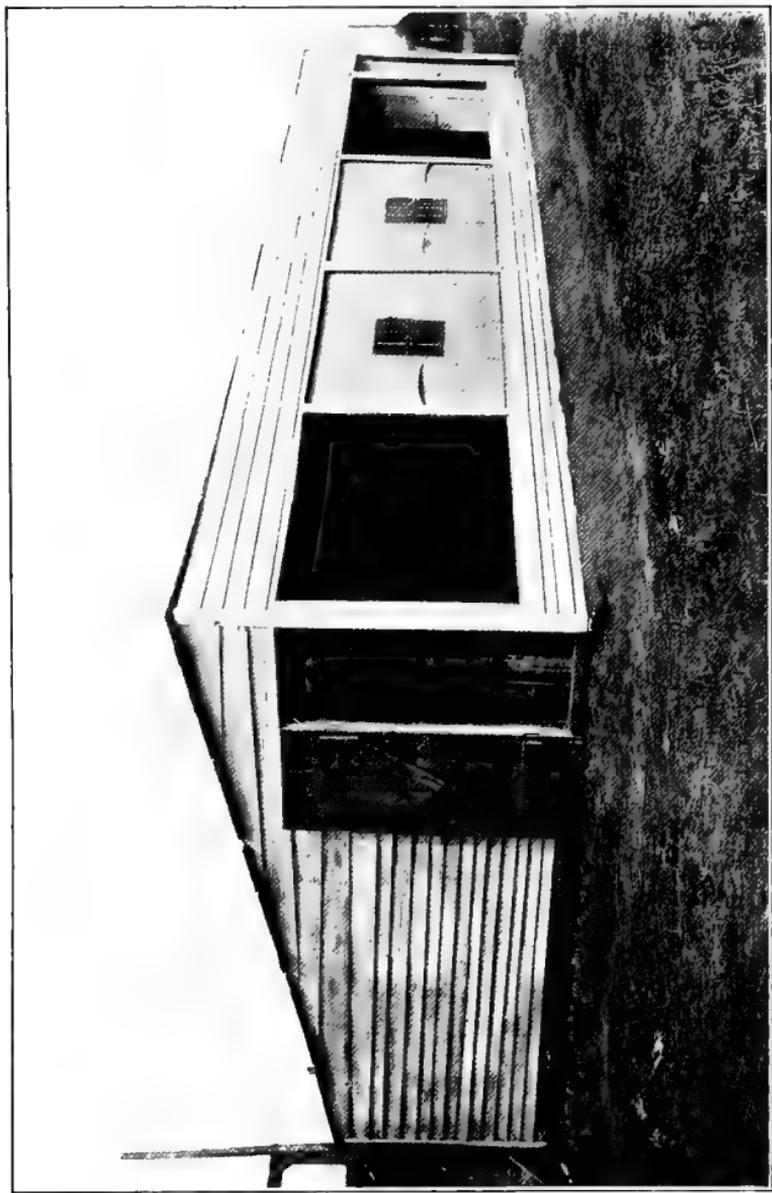


Fig. 4. — Open-front house, showing the two centre curtains down and the end ones raised. This shows the sash in the frames for admitting light on stormy days when it is not advisable to raise the curtains. This is a good example of the shed-roof type of house, and the general design here pictured is rapidly coming into general use.

Notice the presence of some form of self-feeding hopper, usually metal, for the feeding of grit and shell.

A cage with one or more partitions fastened to the wall in a secluded corner away from drafts can be used for confining surplus males when the alternating system is used, and makes a handy place for breaking up broody hens.

In very cold climates or in houses with open fronts a frame or curtain of burlap or cloth is often provided for use in front of the roosting place if protection from freezing is necessary. Notice the construction of the curtain, also the way it is raised and lowered. Does it roll as a curtain or is it made in the form of a frame and hinged? Which do you consider best, and why?

In open-front houses note the construction of the curtain front, whether hinged or rolled, presence of window sash to admit of light on stormy days, thickness of curtain, and method of opening and closing.

EXERCISE IV

METHODS OF YARDING AND CONSTRUCTION OF
FENCES

If the birds are to be given free range, there are no yards to be planned or fences to be built; but if they are to be kept in confinement, the planning of the runs and the cost of fencing become a big item in the cost of construction and repair.

If the fowls are confined, notice whether each pen has a single yard or two yards for alternating. With double yards what are the advantages? Are the yards in permanent sod, or is a system of rotation cropping carried on?

Measure the yard and determine the number of square feet per bird. How do the figures correspond with the following: If the yard is in permanent sod, a safe estimate is one hundred square feet per bird. If a system of double yarding is used or the green food is supplied from outside sources, from twenty-five to thirty square feet per bird is sufficient, simply for exercise purposes.

Note the presence or absence of shade in the yards and the character and kind of shrubs used for the same.

If a system of crop rotation is carried on with



Fig. 5.—Group of drinking fountains, showing various types of satisfactory fountains. The large barrel fountain in the background is home-made and designed especially for ducks, where a large amount of water is needed daily. All fountains to give entire satisfaction in every way should be of the vacuum or siphon type.

alternating yards, a list of the crops planted should be kept, showing the time planted, date of germination, rapidity of growth, age and height at which the birds were pastured on it, and the length of time that it supplied them with green food; so to determine by actual practice the best crop suited for poultry pasture.

SYSTEM OF CROP ROTATION WHERE DOUBLE YARDS ARE USED

PEN No. I		
Date	Yard A ;	Yard B
March 25 to April 30	Peas and oats	Feeding
April 30 to May 25	Feeding	Peas and barley
May 25 to June 15	Dwarf Essex Rape	Feeding
June 15 to July 10	Feeding	Oats, buckwheat, kafir corn
July 10 to Aug. 1	Buckwheat	Feeding
Aug. 1 to Aug. 20	Feeding	Cowpeas and millet
Aug. 20 to Sept. 20	Rye, vetch and cr. clover	Feeding
Sept. 20 to Dec. 1	Feeding	Rye and vetch

The dates in the above will vary slightly with location, but the crops mentioned will grow well in all parts of the United States. The above is

especially adapted to the latitude of Pennsylvania and New Jersey.

It will be noticed that while the birds are feeding in one yard there is a crop growing in the other, and it is a simple matter to grow four crops a year in each yard.

The rye and vetch that are seeded in yard B about September 20 should be allowed to grow until planting time in the spring, when they will furnish an abundance of green feed until the spring-planted crops are ready.

The birds should not be allowed to feed on any of the above crops until they are at least four to six inches tall; if allowed on the feed before this age, it will last but a few days.

Fencing. — Examine the material used for posts, — wood, concrete, or iron. If wood, what kind? Note the size of posts, both corner and intermediate, also the method of bracing the corner posts by means of poles from the top to the bottom of the next posts in line, and the running of a tension wire from the bottom of the corner post to the top of the next post.

With a spade dig around the bottom of a few of the posts and see to what an extent decay has taken place and estimate the future life and usefulness of the posts in that way. If different



FIG. 6. — Group of feed hoppers and troughs, showing two open troughs in the centre for feeding of wet mash; all of the others are designed for dry mash. The great disadvantage in feeding dry mash is to secure a hopper from which the birds will not waste the food. The upper one pictured has given the best results along this line.

kinds of posts are used, determine which is the best as to rot-resisting qualities.

The following materials are used to a greater or less extent for poultry fences:—

1. Pickets or laths nailed to a scantling for a frame.

2. Poultry netting, one, two, and three inch mesh—any width.

3. Woven wire fences made with small meshes at the bottom and larger ones at the top.

Measure the height of the fence, and if made from poultry netting, is the whole height made by stretching one wide strip or two narrower strips? What are the advantages of making it of two narrow strips? Note the method used to fasten the two strips of wire together, either by wiring them with a short piece of pliable wire or by twisting the selvages. Examine the method of fastening the wire to the posts by means of galvanized wire staples. How far are they placed apart? Also notice the method used to fasten the wire to the ground. The best way is by means of a baseboard six to twelve inches wide nailed to the bottom of the posts, and the bottom of the wire nailed to the bottom of the board. In order to keep fowls which will fly over a six-foot fence separate for breeding pur-

poses, it will be necessary to keep them confined in a covered run.

Notice the location of gates, whether they are sufficient in number and so located as to be convenient and give easy entrance or exit. Determine the size and kind of lumber used, method of bracing, number and size of hinges used, also method of fastening them shut.

Examine the wire carefully and determine its rust-resisting qualities, also the per cent which should be allowed for depreciation and repairs on same.

If there are any holes in the fence which need repairing, take a piece of wire the same size mesh as the fence to be repaired, cut it a little larger than the hole, and carefully twist the loose ends of the patch around the strands of the old fence; the loose ends of the old fence should then be twisted around the strands of the patch. Take great care to leave no loose ends, as the birds are apt to injure themselves on them.

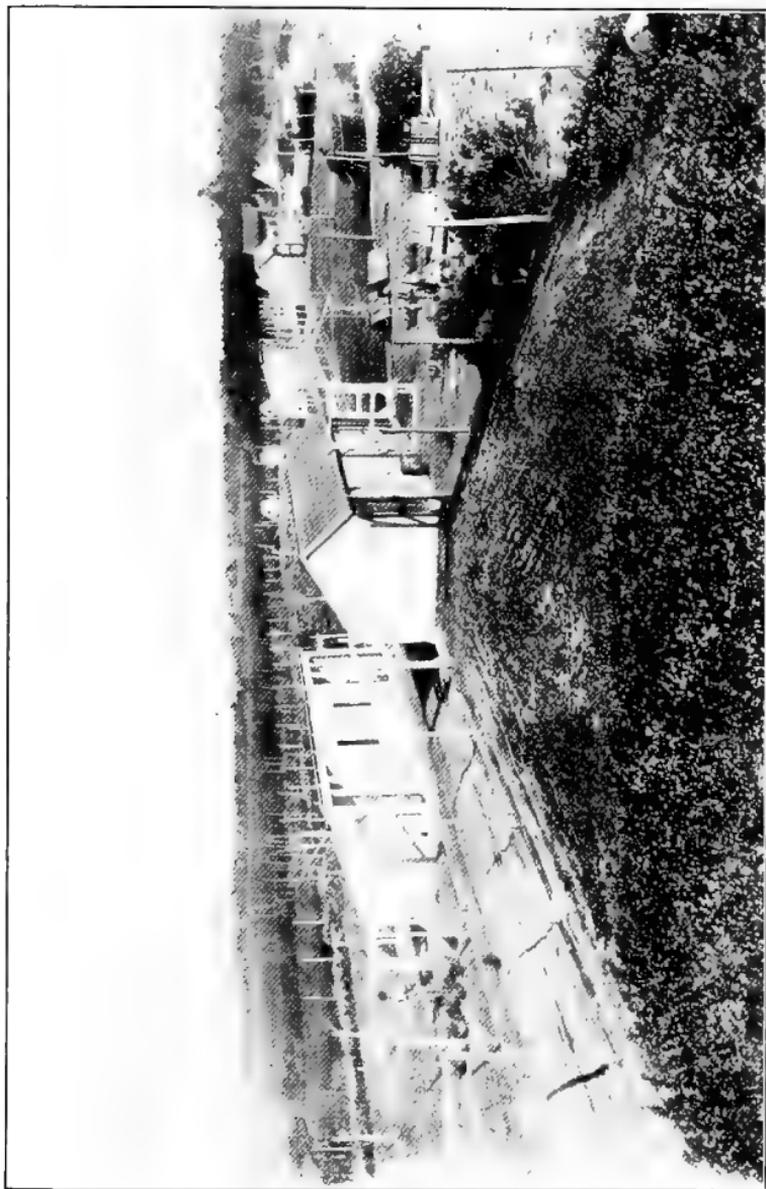


FIG. 7.— Showing the arrangement of fences where double yarding is used. Note the crops growing in the first, fourth, fifth, and eighth yards. Also note the method of furnishing artificial shade where trees or shrubs are lacking.

EXERCISE V

COLLECTION, SELECTION, AND KEEPING EGGS
FOR INCUBATION

Eggs for incubation should be regularly collected, carefully selected, and properly kept previous to being placed in the incubator. In order to impress upon the beginner the importance of the above facts, each student should be allowed to collect and select the eggs from his own coop or coops, keeping always in mind the following facts or rules:—

Eggs for incubation should be selected only from birds which are properly mated, housed, fed, and which are strong, vigorous, and healthy. They should rarely be saved from pullets, but preferably from yearling hens. The eggs should be collected daily, the number of the pen from which they are taken being written with pencil on one end. If they are from trap-nested stock, the number of the hen should also appear on the egg. In handling and carrying the eggs, care must be taken not to crack or severely shake them, the former ruining the eggs for incubation purposes, and the latter causing a partial breaking or rupturing of the contents.

The eggs should next be taken to the storing-

room and the entire lot gone over, and only the ideal ones saved, the others being separated and sold as market eggs. The eggs selected should be stamped with the date on which they were laid, so that when it comes time to place them in the incubator the older ones can be used first, and also that eggs of nearly the same age can be put in the incubator together.

Under the most favorable circumstance the eggs will vary to the extent that there is room for much selection. Select eggs of a medium

TABLE

BREED	AGE	LARGE CIR- CUMFERENCE	SMALL CIR- CUMFERENCE	WEIGHT PER DOZ.
Leghorns	Hens	6.3 in.	5.2 in.	1 lb. 10.2 oz.
	Pullets	6.3 in.	5.2 in.	1 lb. 10.3 oz.
Plymouth Rocks	Hens	6.31 in.	5.4 in.	1 lb. 11.2 oz.
	Pullets	6.22 in.	5.37 in.	1 lb. 8.8 oz.
Wyandottes	Hens	6.5 in.	5.33 in.	1 lb. 9.6 oz.
	Pullets	6.34 in.	5.3 in.	1 lb. 8.4 oz.
Rhode Island Reds	Hens	6.2 in.	5.31 in.	1 lb. 8.0 oz.
	Pullets	6.0 in.	5.19 in.	1 lb. 6.4 oz.
Brahmas	Hens	6.18 in.	5.2 in.	1 lb. 8.0 oz.
	Pullets			
Cochins	Hens	6.12 in.	5.37 in.	1 lb. 6.4 oz.
	Pullets			
Langshans	Hens	6.0 in.	5.12 in.	1 lb. 9.6 oz.
	Pullets			
Average of all breeds		6.19 in.	5.27 in.	1 lb. 8.05 oz.

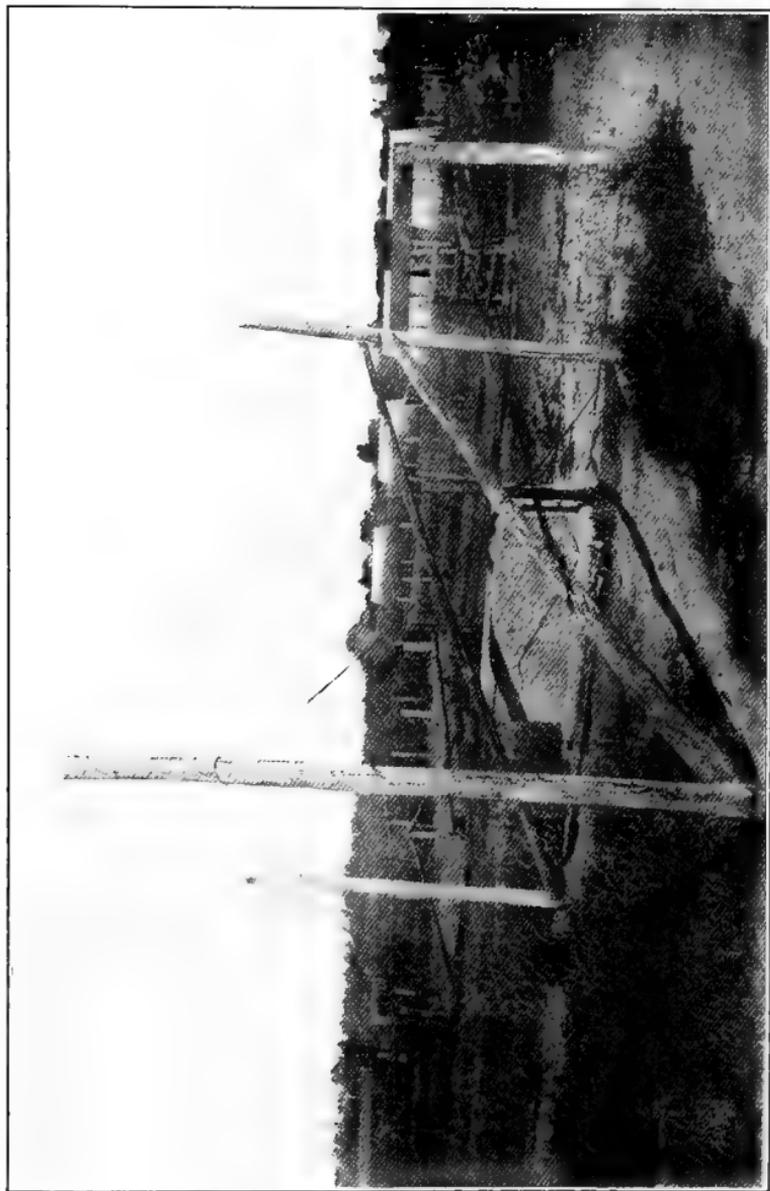


Fig. 8. — Corner fence bracing.

size and average as regards color and shape. The selection should be influenced by the average product of the hen or breed.

The preceding table shows average sizes and dimensions and weights of eggs from our common breeds.

Measure and compare a number of eggs with the above table; after a little practice it will be very easy to readily judge by sight and touch the size, shape, and weight of each egg which is handled. An unusually large egg may be a freak of nature and cannot be expected to hatch. An unusually small egg may be defective and should not be used for incubation. An even, uniform lot, assorted as to size, color, and shape, will be more apt to give the best results. An egg of unusual length or rotundity should not be saved, the probability being that a chick, if it developed at all, would be so malformed as to be unable to leave the shell.

The following figure illustrates normal and abnormal eggs.

If the egg is at all soiled, it should be washed clean, wiped dry, and placed with the others in strong trays or racks. Care must be taken in washing not to jar the contents, as it may injure the egg for hatching. As fast as they are placed in the racks they should be covered with a few

layers of clean cotton cloth to prevent them from chilling. If the temperature of the room is sixty degrees or above, this is not necessary. The trays should be so arranged that the position of the eggs can be easily changed daily. If eggs are not in trays, but loose, each egg should be partially turned each day to prevent the germ from sticking to the shell. Incubation eggs in storage should be kept at a temperature of from fifty to sixty degrees; they will stand from forty to eighty degrees Fahrenheit for a short time. Great care must be taken to prevent them from drying out, so they should not be exposed to currents of air, steam, or vapor.

Freshness is a prime necessity, and an egg over twenty-one days old should never be set; while it may hatch, yet the chick will be weak and hard to raise. Fresh eggs hatch early, and the chicks are usually stronger than from older eggs. About twelve hours previous to placing eggs in the incubator it is well to stand them on the small end, allowing the yolk to balance itself and the air cell to assume its proper place. It is a poor practice to set eggs of more than one breed in an incubator at the same time, as different eggs vary in thickness and strength of shell and in the amount of heat and moisture required.



FIG. 9.—Two satisfactory types of poultry gates, showing the method of bracing the posts by means of twisted wires from post to post. The gate in the foreground illustrates a very permanent construction. It is made from 2 by 3 inch material. All joints are mortised and bolted.

SUMMARY

Eggs for incubation must be carefully and promptly gathered and cared for. The egg has as much to do with the results of incubation as has the incubator, and therefore the machine should not be blamed for not hatching a defective egg.

EXERCISE VI

LOCATION AND CONSTRUCTION OF INCUBATOR
CELLARS

The successful running of an incubator depends largely upon the place in which it is located and upon the ease and quickness with which we can adjust and keep the desired conditions present; therefore careful consideration should be given to the subject of incubator cellar, location, and construction.

Inspect the incubator equipment and discuss the above questions with the following facts in view:—

The location of the incubator house with reference to the brooder house. Is it connected to the brooder, adjacent, or at some little distance? Which is best, and why? If connected, how would that fact affect the labor question, the ease of

transferring chicks, and the danger from fire? Is it located on a side hill or on level ground? Would the former location have any advantage over the latter? Which way does the cellar face, especially with reference to the prevailing wind direction? ¹

Are the incubators located below the level of the ground or above? What advantage is there in having them below the ground level? Are they located in a room or rooms which are a part of some other building, or are they located in a building constructed primarily for that purpose? What are the advantages of the latter method over the former?

Note method of ventilation; usually one of two systems:—

King system.

Double sash, with or without curtains.

Note the presence or absence of the direct rays of the sun shining directly on the incubators. If the sunlight is present, what method is used to darken the cellar? What is the objection to having the sun shining directly on the machine?

If the building is below ground, note character of the foundation, whether stone, brick, or cement, also depth below ground. Are the incubators entirely below the ground level?

¹ See frontispiece.

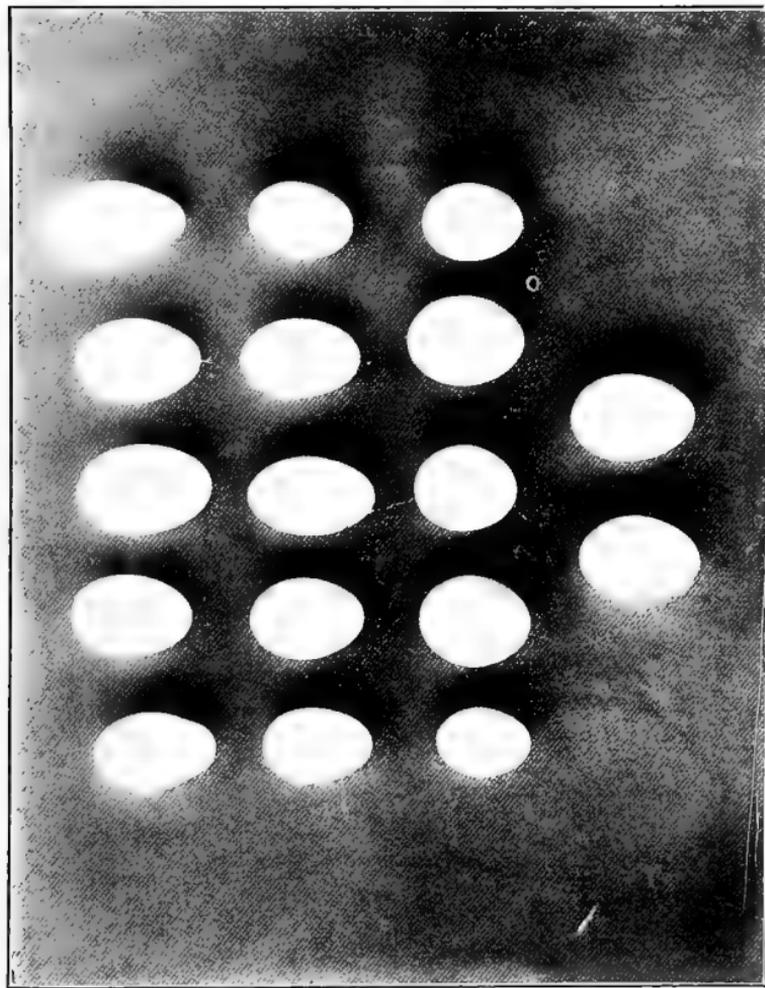


Fig. 10. — Various sizes and shapes of eggs. The two bottom eggs show the average or true egg shape ; the others vary from the true shape by being either too long, too round, too large, or too small.

What kind of material is used for the floor? Cement is best. Why?

Note carefully the method of construction as regards the shape of the building, type of roof, lumber used, and whether double or single walls. Is there any provision made for regulating the temperature of the cellar? The most desirable temperature is from fifty to seventy degrees, but incubation may be successfully carried on in a temperature of thirty-five degrees, the disadvantage being more in rapid variation than in a too high or too low general temperature.

Connected with the incubator cellar there should be a small room which is easily darkened for the testing of eggs during incubation. The presence of shelves or tables conveniently located should be noted — one upon which all surplus lamps are kept and where all trimming and filling are done; another one should be for the turning and cooling of eggs. A closet or shelves for the keeping of thermometers, hygrometers, incubator parts, records, etc., is very essential. The presence of a faucet from which water can be taken to increase the humidity of the room is very desirable.

Estimate carefully the probable cost of such a building or room, also figure the capacity of the cellar in dozens of eggs and determine the cost

per dozen. This will be much greater if the incubator room is an individual building by itself than if it is located in the cellar or room of another building.

An economical and efficient building can be constructed for from ninety cents to one dollar per dozen eggs, not including labor.

Figure the cubic feet of air space and determine the volume per dozen eggs. The amount of air space required depends on the system of ventilation. A good safe figure is about ten to twelve cubic feet for each dozen eggs.

EXERCISE VII

A STUDY OF THE INCUBATOR

Carefully examine all parts of each incubator, beginning with the general appearance of the entire machine. It should be built of well-seasoned lumber, be well put together, and should also be substantial looking. It should have a good smooth finish both for looks and durability.

See that the machine is perfectly level. Why? Note the size of the legs and the method of attaching them to the incubator. Are they easily removed for shipment or not? By placing the hand on the front edge of the incubator see if it is squarely and firmly resting on all four legs. If

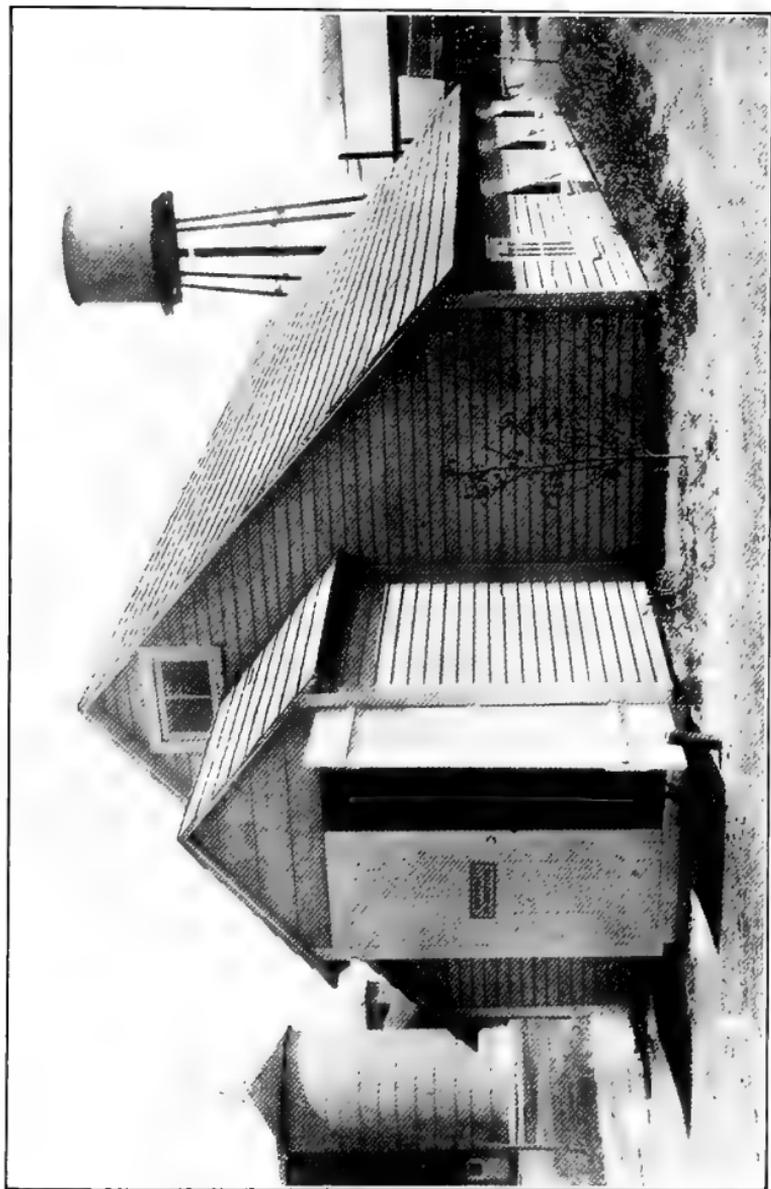


Fig. 11. — External view of a modern incubator cellar, showing the sash hinger at the top.

not, place a thin piece of wood under the free legs to steady it. Open the door and take out all internal fixtures, including the following: diaphragm, egg trays, thermometer, and if the incubator is equipped with nursery drawers remove same with covers. Clean these parts thoroughly and wash all woodwork, including inside walls, egg trays, etc., with a sponge moistened with a ten per cent solution of creolin. Allow parts to thoroughly dry before replacing them in the machine.

Determine whether the machine is of the hot air or hot water type. In the hot water machine note the presence of tubes or tanks in the top of the incubator through which the water circulates. If hot air, a round metal tube will be seen running from the top of the lamp chamber about three quarters of the way across the top of the incubator, through which the hot air travels.

Remove lamp, and notice means of support. Practise putting in and taking out the lamp, being careful each time to have the burner fit the base of the chimney perfectly. Examine the lamp box and determine the course taken by the pure warm air on its way to the egg chamber, also that of the foul air direct from the flame. What is the object of the asbestos packing about the lamp box?

Study carefully the self-regulating qualities of the machine. They will consist of two essential factors:—

First, a sensitive thermostat.

Second, a simple but accurate method of transferring the energy of the thermostat to the lamp.

The self-regulating mechanism should admit of easy and simple adjustment and should be so constructed as not to lose its efficiency with age. The successful operation of most thermostats is based on the varying coefficient of expansion of different metals. Note method of construction so as to take advantage of this expansion.

See that the entire regulating apparatus is properly connected, and study the form and function of each part. Adjust the thumb nut so that the lever arm is balanced and the damper suspended over the chimney. By turning the thumb nut to the right the incubator is cooled, and by turning it to the left the temperature is raised. Why?

Trace the current of warm air through the machine and out at the bottom. Notice methods used to filter the air and stop it from flowing rapidly. Why?

Remove the top of the incubator and note the presence of double walls. What is the advantage?

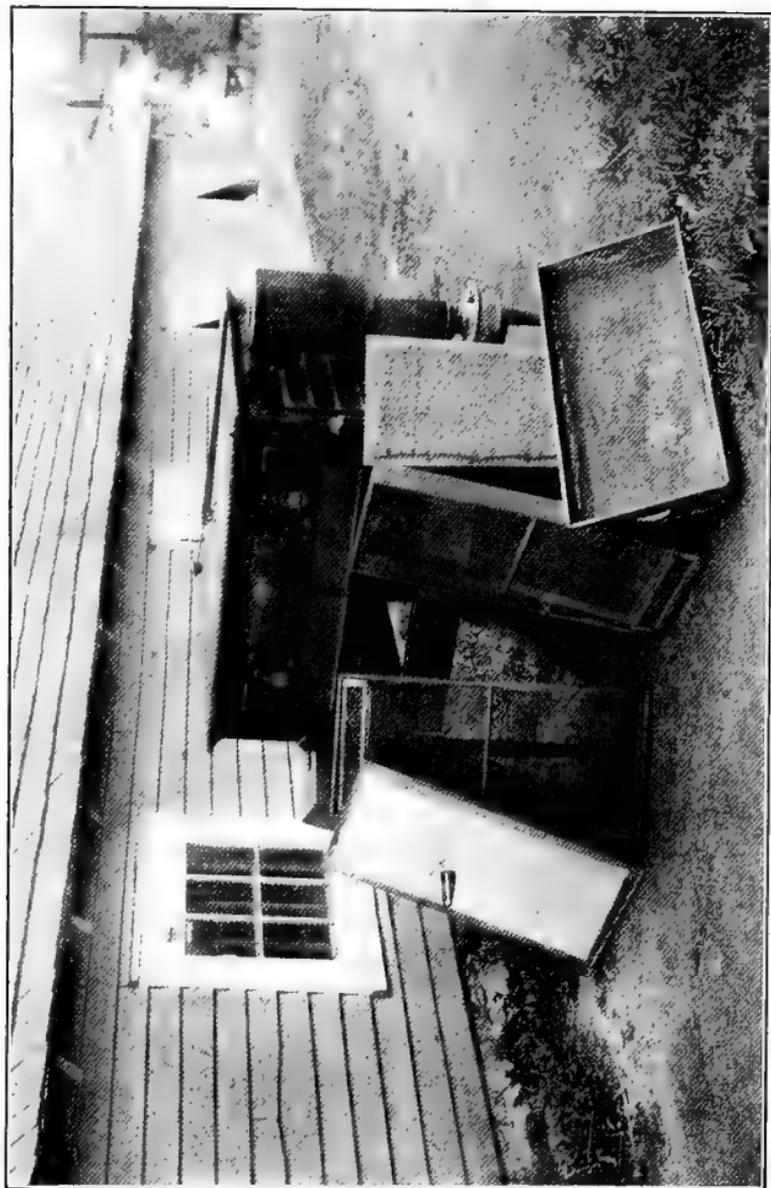


FIG. 12. — Incubator of the nursery drawer type with all the parts taken out for cleaning and aërating.

Remove the cotton, felt, and cardboard used for insulation purposes, and note how perfectly the machine is protected from outside changes of temperature.

Examine carefully all ventilators, follow them into the machine, and determine how the air is made to circulate. Look for ventilators in the bottom of the incubator; if absent, note the open construction of the bottom. Note the presence or absence of a drop-bottom which when down leaves the entire bottom of the incubator open. What is the advantage of this? Are there any special arrangements for supplying moisture to the incubator; if not, how does the moisture get to the eggs?

After the machine has been thoroughly inspected, replace all internal parts in their proper positions, close the door, and leave the entire machine in first-class condition for running.

Note the position in which the machine is placed with reference to danger from fire and the probability of strong drafts of air blowing directly upon it.

Repeat these observations, using every different make of incubators possible.

EXERCISE VIII

RUNNING AN INCUBATOR

Previous to each hatch thoroughly overhaul the incubator, clean inside and out, and wash all internal parts with a carbolic solution. The lamp should be cleaned, filled, and a new wick put in.

Start the lamp and run the incubator for seven days before putting the eggs in, to test its accuracy and see that it is properly adjusted; during this time regulate with the thumb nut until the incubator reads the desired temperature constantly. To cool the egg chamber turn the thumb nut to the right, to warm turn to the left. Why?

Before putting the eggs in the machine, place them in a warm room so that they will gradually warm up and not be subjected to too sudden a change. The eggs may completely cover the tray but must not be on top of one another.

Trim and fill the lamp once a day, at a regular time each day. Do not fill too full, and keep all oil wiped from the lamp. Be sure that the lamp is set firmly and properly in the incubator, thus avoiding danger from fire and smoke. After lighting lamp and placing in position leave it

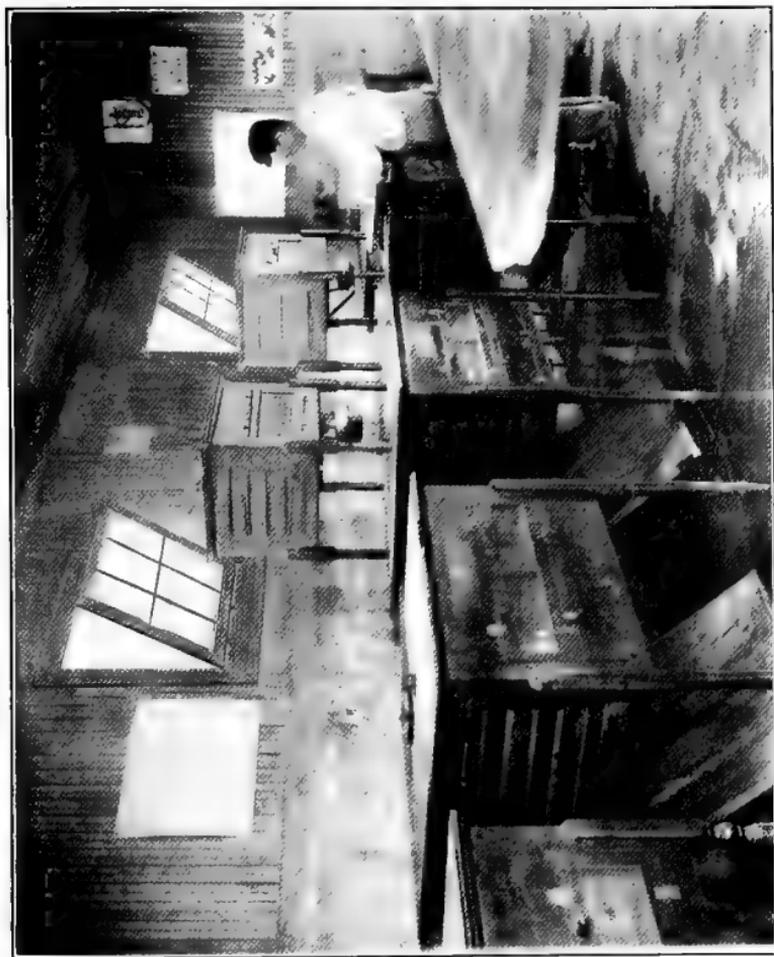


FIG. 13.—Interior view of incubator cellar, showing arrangement of incubators, concrete floor and walls; also student in the act of turning eggs.

turned low for a few moments until it burns up and then it may be safely turned to the desired height. Never leave lamp flame turned up high enough so that there will be any danger from smoking. Keep flame the same and do all regulating by the thumb nut, except in some cases the lamp wick will need turning down on the nineteenth day. Why? Do not allow any drafts of air to blow directly on the lamp.

On the evening of the third day take out the eggs and turn them, continuing this process twice a day morning and night until the evening of the eighteenth day. What are the objects of turning? Change the position of the trays regularly to admit of all the eggs being subjected to a uniform temperature.

In cooling the eggs the operator must be governed by the temperature of the room and the season of the year. In general it will be safe to start cooling on the fifth day and cool five minutes if the temperature of the room is above sixty degrees. Eggs require less cooling in cold weather, the time required for turning usually being sufficient. Gradually increase the length of time for cooling until during the last week of the hatch they may be cooled for over twenty minutes under favorable conditions. What are the objects of cooling? Stop turning and cooling

by the end of the eighteenth day, before there is any chance of the chicks starting to pip.

The temperature of the incubator may range from 101 to 104 degrees. During the first week it should be kept at 101 to 102 degrees on the fertile egg, which means 102 to 103 degrees above. The temperature should gradually rise until the end of the hatch, when it should read 104 degrees. Never let the incubator run over 106 degrees, a high temperature during the first week of the hatch being more fatal than during the latter part.

The amount of ventilation and moisture depends largely on the kind of incubator used and on the relative humidity of the incubator room. Enough fresh air should always be admitted to supply fresh oxygen to the eggs, but it should not be admitted in sufficient quantity to cause a too rapid evaporation of their contents. Moisture is supplied in different ways and amounts in the various makes of incubators.

Study carefully the different systems of ventilation and the various methods of supplying moisture. Which is the simplest, which gives the best results, and why?

Keep a careful record of all the work done. Plot the temperature and moisture curve, and compare with the ideal.



FIG. 14. — A convenient method of setting the hen and caring for the hen and chicks.

Figure carefully the following percentages :—

Per cent of fertile eggs to total eggs.

Per cent dead germs to fertile eggs.

Per cent broken to fertile eggs.

Per cent dead in shell to fertile eggs.

Per cent crippled to fertile eggs.

Per cent vigorous chicks to fertile eggs.

Per cent vigorous chicks to total eggs.

The following is a very satisfactory form of incubator record containing all the facts pertaining to the hatch.

EXERCISE IX

SELECTION, CARE, AND PLACE OF SETTING A HEN

The majority of chicks are hatched by the natural method, and where only a few fowls are to be kept this method is usually very satisfactory.

Mature fowls are better than pullets for incubating eggs; not all hens make good sitters, however; for that reason select with care a bird possessed with as many of the following qualifications as possible. She should be of medium size, in perfect health, neither thin nor grossly fat, possessed of a quiet, gentle disposition, allowing herself to be easily handled after dark; she should

INCUBATOR RECORD

Record No. _____ Make of Incubator _____
 Incubator No. _____ Date Eggs were put in _____
 Name of Operator _____

DATE OF INC.	DATE	HOUR	ROOM TEMP.	RELATIVE HUMIDITY	WERE EGGS TURNED	WERE EGGS COOLED
	Run for seven days and			keep		
1						
2						
3						
4						
5						
6						
7	Put the	eggs in now		if the	machine	perfectly.
1						
2						
3						
4						
5						
6						
7	Test eggs	first time.				
8						
9						

feel warm to the hand when it is placed under the body with the finger touching the skin.

If only a few hens are to be set, almost any place where they will be free from disturbances will be satisfactory. A barrel, box, or specially prepared shelter may be placed on the south side of a building, wall, or bank where it is protected from winds and storms.

If a large number are to be set, the nests are placed in surplus stock pens or in houses from which layers have been removed. Wherever the nest is located, thoroughly disinfect, cleanse, and see that no vermin are present.

Nests must be roomy, neat, and natural, and must be provided with a small door or curtain to darken the nest and keep the hen contented and comfortable. It should usually not be smaller than twelve by fourteen inches.

Place in the bottom of the completed nest loose, dry loam, firming same and hollowing out place in the centre, being sure to keep corners and sides high. Why? Place medium-length straw, hay, or excelsior in the nest, pressing it down firmly to form the hollow shape. Dust thoroughly with lice powder, and place two or three china eggs in the same.

After dark select the hen, dust her carefully with lice powder, working it into the feathers

close to the skin, place her gently on the eggs, and close the nests. Towards the evening of the next day remove curtain and open door. If after coming off to eat and drink she returns to her nest, the sitting of thirteen eggs may be safely placed under her.

Provide fresh water, whole grain, preferably corn, and some fine dry loam for dusting. Open the nest morning and night for her to come off to eat, drink, and dust herself ; after she returns, which is usually about twenty to thirty minutes, close the nest again. Thoroughly dust the hen every seven days with lice powder, and test the eggs on the seventh and fourteenth days.

Number each nest consecutively, — No. 1 for the first hen set. Fasten over each nest a card corresponding to the number of the nest, upon which an accurate record should be kept showing the following facts: —

Date when set.

Variety and kind of eggs.

Number of eggs.

Date of first test, number fertile, infertile, and dead.

Date of second test, number fertile and number dead.

The hatch.

Number of live chicks taken from the nest.

Number of dead in the shell.

If the nests are out of doors, the above record can be kept in a book or the card kept on file and used when needed.

Never set the same hen twice the same season.

EXERCISE X

TESTING, SEVENTH AND FOURTEENTH DAYS

For testing satisfactorily the room must be made totally dark, as light makes the contents of the egg less visible.

The light for testing may be supplied by a kerosene lamp, acetylene lamp, or by an electric light placed in a small box, in which has been bored a round hole one inch in diameter on a level with the most intense part of the light. When kerosene lamps are employed, specially constructed chimneys are available for this purpose. Acetylene lamps or electric lights are the best.

When everything in the testing room has been made ready, the eggs should be taken from the incubator in the tray and set on the table at the left of the testing lamp. At the right of the lamp should be placed a duplicate tray to receive the tested eggs.

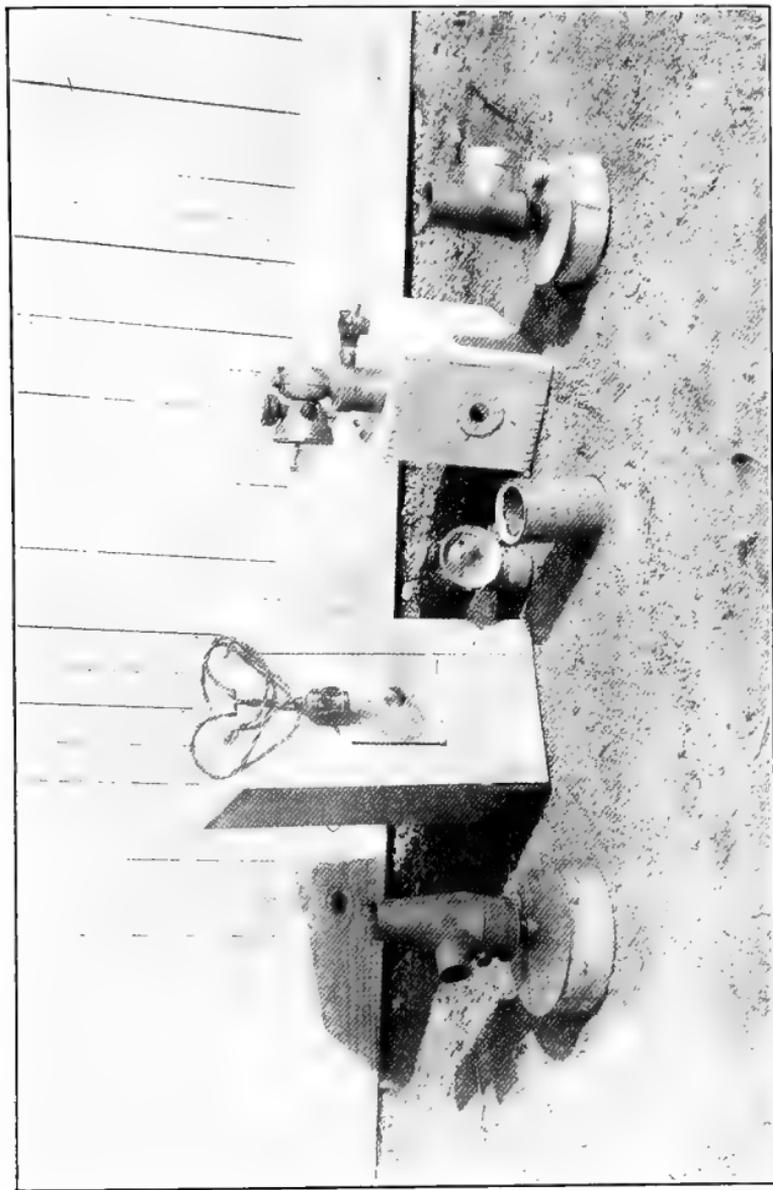


FIG. 15. — Showing three methods of furnishing light for testing, namely, electricity, acetylene gas, and the kerosene lamp.

The circular opening should be about six inches above the waist line for the best work. Take the untested eggs in the left hand, two or three at a time, transfer them one at a time to the right hand, grasping the eggs between the thumb and two first fingers with the large or air-cell end outwards. Place this large end in the circular opening in the testing box, gently revolve the egg between the fingers, and the strong rays of light will penetrate the egg, making its contents visible. This causes the germ, if present, to change its position, making it the more easily distinguished.

The important facts to be noted in the first test are the following:—

Size and location of air cell.

Infertile eggs.

Dead germs.

Germs adhering to the shell.

Cracked eggs.

I. The size of the air cell varies with the period of incubation and the rapidity with which the liquids of the egg have evaporated during incubation. The more moisture in the air the less evaporation, and consequently the smaller air cell; the drier the air the more evaporation and the larger the air cell. Under normal humid conditions the air cell of a hen's egg

will appear in size approximately as follows:—

- 5th day, $\frac{1}{4}$ of one inch deep.
- 10th day, $\frac{1}{2}$ of one inch deep.
- 15th day, $\frac{5}{8}$ of one inch deep.
- 19th day, $\frac{3}{4}$ of one inch deep.

If the air cell is too large, moisture must be increased to stop rapid evaporation, and if too small, evaporation must be increased. An air cell which is not in its normal position at the large end of the egg will probably result in a crippled chick if it succeeds in getting out of the shell. It is caused by insufficient turning.

II. Any egg which appears clear or translucent with no dark lines appearing in its centre is infertile. Mark all infertile eggs in some distinguishing manner, and put in separate tray. They may be used for chick feeding when hard boiled, and if tested on the fifth day are perfectly safe for culinary purposes.

III. A normal egg will show an air cell with the edge clear-cut and distinct; upon slightly revolving, the germ will be seen to move about in the egg. Rotating from the germ and circulating around in the egg will be seen numerous dark lines or veins.

An egg showing a fixed bright red line in the

form of a circle or semicircle around the germ is dead, the blood of the embryo having settled on the shell.

An egg on which the germ appears clear and distinct as a single dark spot against the shell is dead, having become fastened to it by insufficient turning. Remove all eggs containing dead germs, and when through testing bury them.

An egg showing an air cell and a small, poorly developed germ is weak, and the chances are that it will die. It should, however, be left in the machine until the fourteenth day.

When through testing, place all good eggs with normal germs in the machine immediately, and record the number of eggs tested out under their proper headings on the incubator record.

On the fourteenth day proceed in the same manner as in the first test. At the second test there are two objects in view, namely: observing the increase in the size of the air cell and determining whether it is normal or not, also the taking out of any egg, the germs of which were doubtful or have died since the first test.

A normal egg at this time should have a large, distinct air cell with the edges clear cut, about five eighths of an inch deep. The whole centre of the egg should be uniformly dark in color, nearly

opaque, and show no well-defined germ or veins, and should shade to a lighter color near the pointed end.

An egg containing a dead germ at this period will show no clearly defined air cell, the whole egg showing dark and light colors in spots, which gives it a hazy appearance, the dark portion running irregularly up into the air cell. Mark all eggs containing dead germs and bury them; also remove all cracked or broken eggs. Why?

Any egg which is not clearly understood and over which there is any doubt as to whether it is dead or not should be so marked and placed in the machine, a note being kept whether it hatches or not, and if so what kind of a chick comes out.

In cold weather the eggs should be left out no longer than necessary. Always examine each egg carefully, and as the appearance of normal and abnormal germs becomes more familiar try to increase the speed of handling the eggs. An experienced tester is able to run through 240 eggs in from eight to ten minutes.

EMBRYOLOGY

EXERCISE XI

FORMATION OF THE EGG

SECURE an old hen, and if possible one in the laying condition. Kill her by sticking, extra care being taken to bleed thoroughly. Lay the bird on her back and with a sharp knife skin the breast and abdomen as far back as the cloaca. Tear the peritoneum, which is the membrane lining the intestinal cavity, and remove the organs of digestion, namely, liver, gizzard, intestines, spleen, etc., being very careful not to rupture the oviduct or ovaries.

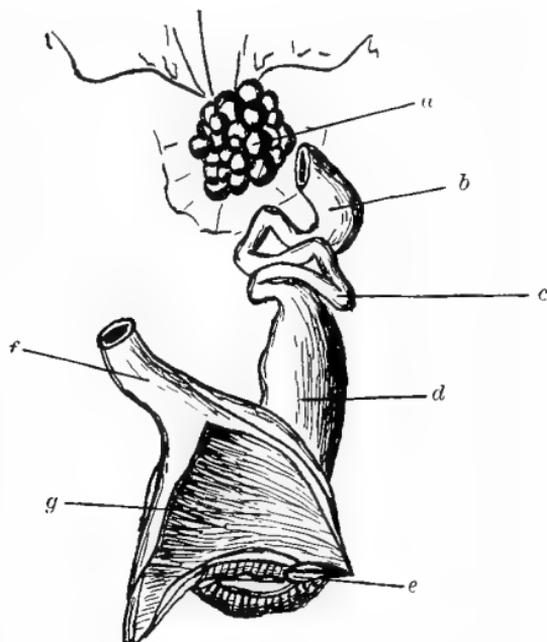
At the same time prepare a fresh egg for study. Break the shell carefully, and allow the contents to run into a shallow dish without rupturing any more than possible. Most of the parts discussed can be seen with the naked eye.

Examine organs of reproduction as they lie in their normal position. They consist of a single ovary and oviduct; the ovary lying on the left side of the body resembles somewhat a bunch of

grapes, the external appearance being that of a granular body attached to the spine by a folding of the peritoneum. The nodules or ovum will be seen irregular in size, some small and white, and as they develop becoming large and yellowish.

Remove one of the largest ova, and examine it for the following characters. The development of the ovum is caused by the accumulation of the yellow or yolk food, which causes a distention of the ovarian sack or calyx that encloses the ovum. As it develops this yolk sack becomes more or less separated from the ovary and forms a complete covering for the ovum, remaining attached to the ovary only by a narrow base or stem called a pedicle. The calyx or yolk sack will be seen to consist of two membranes joined together by connective tissue and blood vessels. These blood vessels seem to end in a transverse white line which crosses the largest part of the calyx. This band is called the stigma, and begins to appear when the ovum is well developed, and when fully developed the calyx gives way along this line and the egg slips from its capsule and passes into the enlarged funnel-shaped opening of the oviduct. The empty sack collapses, diminishing in size rapidly until it is finally absorbed.

FIG. 16. — REPRODUCTIVE ORGANS OF FEMALE.



- (a) Ovary.
- (b) Funnel-shaped opening to the oviduct.
- (c) Portion of the oviduct which secretes the albumen.
- (d) Uterus or shell-forming portion.
- (e) Opening of the oviduct.
- (f) Intestine.
- (g) Cloaca.



Make an outline drawing of a fully developed ovum.

The oviduct is a white tube which during the breeding season is larger than the largest intestine, covered with a network of branching blood vessels. It starts near the ovary with an enlarged funnel-shaped opening, and follows a curved course, being bent upon itself three times, finally reaching the cloaca, where it opens.

When the ovum enters the oviduct it consists of a yolk or vitellus enclosed in a thin vitelline membrane. Immediately upon its entering this organ fertilization takes place, and it is propelled by the peristaltic contraction of the duct toward the cloaca with a rotary or revolving motion. The passage of the ovum stimulates the membranes to secrete three layers of albumen as it moves along, the first one being dense and rich, containing threadlike forms connected at each end which hold the yolk in place. These threadlike pieces are called chalazæ, and are twisted in opposite directions by the rotations of the ovum. Each of the following layers of albumen is thinner and more watery than the ones which preceded it.

When the ovum reaches the small part of the oviduct two dense layers of albumen are added, which form the inner and outer shell membrane.

A space at the large end between these membranes being filled with air is called the air cell. As the egg, small end first, nears the cloaca, the last secretion, consisting of a thin liquid, is added; this condenses and forms the shell. The passage of the egg down the oviduct requires from four to six hours' time. During the non-breeding season the organs are greatly reduced in size and nearly disappear.

Remove the oviduct, cross-section same, and determine the different dilations which secrete the various fluids. Make a sketch of the entire oviduct.

The color of the shell depends upon pigment matter secreted by certain membranes of the uterus. What are the composition and function of the shell?

EXERCISE XII

FORMATION OF THE CHICK, FROM THE THIRD TO THE SIXTH DAY

Take from the incubator or from under the hen eggs which have been incubated for from three to six days, one for each day. Test them to make sure that they are fertile and of normal development. Empty the contents of each egg carefully into a separate dish, preferably porce-

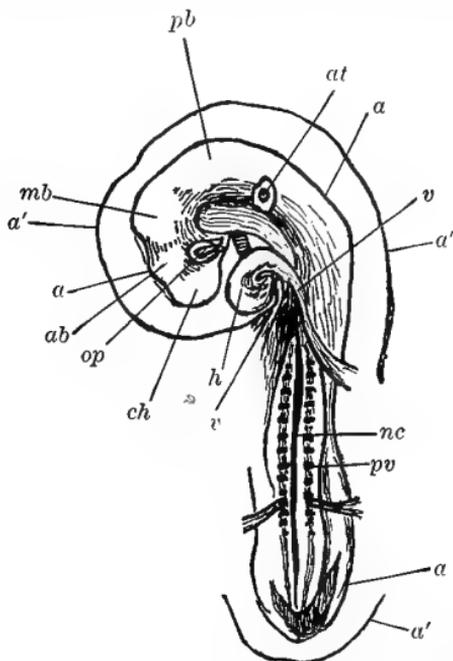
lain-lined, using great care not to rupture the yolk. Examine with the naked eye, and note any great differences or marked stages in their development. A hand lens will aid in more clearly distinguishing and understanding many of the stages of development.

The growth of the embryo up to the seventh day is briefly outlined as follows: During the first twenty-four hours the embryo develops those parts which afterwards become some of the leading organs of the body, namely: the head, the vitelline vein, neural fold and groove. Note the clear area about the embryo, called the *area pellucida*. Note the presence of a peculiar membrane which envelops the embryo, forming a cavity in which it lies. It is made in folds, and when these folds meet and coalesce above the embryo, they unite so that the inner folds form a continuous inner membrane or sack and the outer membrane forms an outer membrane or sack. The inner membrane forms a complete closed sack around the embryo, and is called the amniotic sack, or true amnion. The liquid which it contains is called the amniotic fluid. The outer membrane lies close under the vitelline membrane and is called the false amnion, and goes to make up the serous membrane of the body.

Note the general shape of the embryo and any change in the general position from day to day. Examine the development of the brain as characterized by the projections on the head. Locate the following: cerebral hemisphere, fore-brain, mid-brain, and cerebellum. Examine carefully the development of these, and note the rapid development of the optic vesicle and the growth of the lens. Just above and a little to the rear of the optic vesicle will be seen the auditory pit or vesicle. At the base of the head fold, below the optic vesicle, will be seen the heart, and running from it are the numerous veins and arteries which form the vascular system. The heart begins to beat and blood to flow during the second day. The vascular system increases in size very rapidly, and at the end of the third day is nearly complete.

Passing down the body of the embryo in the centre will be seen a dark line, which is called the noto-cord, and develops into the spinal cord. On each side of this cord will be seen small dark projections called the proto-vertebræ, which later form the bones of the spinal column. On the third day the embryo turns on its left side, the head bends downward, the vitelline circulation is completed, and the events after that day are distinguished by the extension of parts already

FIG. 17.— EMBRYO CHICK ON THIRD DAY.
 Seen from below, with head turned to one side.



- | | | | |
|------|-----------------------------|------|---------------------|
| (a') | False amnion. | (op) | Optic vesicle. |
| (a) | Amnion. | (at) | Auditory vesicle. |
| (ch) | Cerebral hemisphere. | (h) | Heart. |
| (ab) | Anterior cerebral vesicle. | (v) | Veins and arterics. |
| (mb) | Middle cerebral vesicle. | (nc) | Notochord. |
| (pb) | Posterior cerebral vesicle. | (pv) | Protovertebræ. |

marked out rather than by the formation of new ones. On the fourth day the wing fold appears midway on the curvature of the body, and the folds forming the hind limbs also appear, being shorter than the front limbs. The embryo increases greatly in size.

Make a sketch of the six-day-old embryo, showing the organs above named. Take notes on the differences seen in the various-aged embryos, briefly describing changes as seen.

EXERCISE XIII

DEVELOPMENT OF THE CHICK FROM THE EIGHTH TO THE NINETEENTH DAY

Take from the incubator or from under the hen eggs whose embryos are eight, twelve, sixteen, and nineteen days old respectively, and test to see if they are normal. Carefully break the shell and place contents in shallow dish, using great care not to break the yolk. Examine carefully with the naked eye the development which the embryo makes from day to day.

From the seventh day on, the business of the chick (for such it may now be called) is to grow, and it is only necessary to notice a few of the more important changes which take place bring-

ing about the distinctive type of the species and variety.

The feathers begin to appear on the ninth day: by the thirteenth day they are found all over the body to the length of a quarter of an inch. The sacks in which they are enclosed do not break until after hatching. The white of the egg will be seen to have disappeared, and a very thick viscid mass remains at the lower surface of the egg. Note the greatly increased length of the limbs and the division of the distal ends into fingers and toes.

On the eighth day the beak begins to form, and can be distinguished as a chalky-looking mass, which by the twelfth day has developed into a horny beak, although still soft. On the thirteenth day the nails may be seen, which together with the beak are considerably hardened by the sixteenth day. During the fourteenth day the embryo moves its position so that it lies lengthwise in the shell, its beak touching the inner shell membrane; the air space at the broad end will be seen greatly enlarged. It is in this position that the chick must lie in order to make its way out of the shell. If not so placed, it will represent a false presentation and will probably be unable to make its exit.

By the twelfth day the chick will be seen to

occupy the whole of the shell except the air space. The yolk will be seen almost entirely absorbed, the walls being loose and flabby. Just previous to hatching the yolk is drawn into the body, the walls closing over it at the umbilicus. This yolk enclosed within the body serves to supply the chick with food for twenty-four to thirty-six hours after hatching.

Notice the movement of the embryo after the fourteenth day, also the beating of the heart, which will continue for a long time after the embryo has been taken from the egg.

Make a sketch of the embryo as seen on the fourteenth day, marking all the parts.

The following is the process of hatching, briefly described. Carefully observe same when the chicks are hatching in the incubator.

When ready to come out, the chick raises its head and pierces the inner shell membrane, and immediately starts breathing the air in the chamber, which causes the pulmonary circulation to become active and the embryonic circulation to cease. The head is next raised into the air chamber, and the chick deals blows upon the shell, which when often repeated in the same place result in fracturing it. This process is repeated until the shell is broken around about one third of the way from the large end. The chick then

presses its head against the large end and its feet against the small end, and then by pushing is able to throw off the shell lid and make its exit.

By observation note the length of time which it takes for the chick to get free from the shell from the time that it starts to pip.



FIG. 18.— Individual brooder house equipped with double indoor brooders and Universal hovers. Note the runs of pipe for regulating the temperature of the room, also the presence of covered runs within the building.

ARTIFICIAL BROODING

EXERCISE XIV

LOCATION AND CONSTRUCTION OF BROODER HOUSES

The following systems in brooder house design are in common use.

(a) Long house.

1. Continuous hover heated by hot-water pipes.
2. Indoor individual brooder, double or single, heated by kerosene lamps.
3. Equipped with fireless brooders.

(b) Small colony brooder house with indoor brooder.

In long brooder houses the entire house is usually kept at the desired temperature by means of wall or ceiling coils of pipes, and the hovers are heated separately.

Which of these systems are in use on the plant being studied?

Note the location of the brooder house with reference to the incubator cellar. Is it near at hand or at considerable distance? Which is

best, and why? Note the location with reference to the prevailing wind direction. Are the windows, doors, and yards so placed as to receive protection from the building itself? Note its location with reference to the points of the compass, observing the various amounts of sunshine which enter the house at various times during the day.

What type of roof is used? Do you think the one in use has any advantage over other types? Are the walls single or double? Which of the following materials are used for the outside walls: shingles, clapboards, or paper? With a tape, measure the surface to be covered and figure the relative first cost of these three materials. Considering durability, which material would it be most desirable to use? Note the height and width of the building. Estimate the amount of material used in construction, and figure the cost of same per running foot. Does a walk run through the centre of the building with pens running towards each wall, or is the walk arranged on one side with the pens running to the front? Is the walk on a level with the floor of the building, or is it depressed? The advantages of the latter are as follows:—

I. The ease with which the brooders and lamps can be attended.

II. By having the chick floor elevated, the chicks are brought nearer the ceiling, which is the warm part of the house; this reduces the enclosed air space, which means a saving of heat required to maintain a given temperature.

If a pipe brooder house, examine the construction of the hover. Are the pipes carried through the top of the hovers, supplying heat from above, or are the pipes carried under the hover, supplying heat by means of a drum in the centre? The latter method is rapidly coming into general use. Observe the height of the windows from the brooder floor, also the presence or absence of muslin curtains at the windows for ventilation. Is the building supplied with ventilators for carrying off the dust and foul air? Test the ventilators with light fluffy feathers or a lighted match to see if they work the right way.

Are there any labor-saving devices such as mechanical fixtures for opening and shutting windows, cords or pulleys for raising or lowering hovers, thermostatic arrangements for regulating the temperature of the room, etc.? If so, note their construction and arrangement.

Note the construction of the inside pens. Does the wire run to the ceiling, and does the attendant enter the pen to clean, feed, and water, or are the pens constructed with a covering of

wire about a foot from the floor, allowing the work to be done from the walk by simply removing or raising the wire frame? The latter method is adapted for young chicks and especially where individual brooders are used.

Figure the total square inches under the hovers, also the total square inches of chick floor space in the whole house, and determine the capacity. Each chick requires about four to five square inches of hover space the first week, which amount should gradually increase until at six to eight weeks of age they require from ten to twelve square inches of hover space. The idea is to give them sufficient room to spread out and not to crowd.

Is the heater located in the centre of the brooder house or at the end? If the runs of the pipe are to be over one hundred feet, the heater will prove more efficient if placed in the centre with the runs of pipes running each way; if less than one hundred feet, it is best placed at the end of the house.

NOTE. — See Frontispiece.

EXERCISE XV

A STUDY OF THE ARTIFICIAL BROODER

There are four requirements for a successful brooder: —

I. An inviting, properly ventilated hover to which the chicks may flock at any time and warm up quickly.

II. A ventilated and lighted brooder or apartment warm enough to prevent the chicks from chilling.

III. A run protected from the wind and storms by being enclosed within a brooder house.

IV. An outside yard available in pleasant weather.

An indoor brooder must of itself supply the first two requirements; while the outdoor brooder must supply the first three to be complete.

Having gathered together all available brooders of as many makes as possible, carefully examine them to see how perfectly each one is designed to fulfil the above-mentioned requirements.

First examine the indoor brooders and note the following points. Some are constructed with single and some with double hovers, in either

case one lamp being sufficient to supply the necessary heat. Remove or open the top of the hover and examine the method of heating. Follow the course of the warm air from the lamp through the heat tubes. Note the varying amount of radiating area. Some heating arrangements will be seen to be very complex, others very simple.

Hovers will be seen of various shapes, some square, others round, and in some the heat is radiated from above and in others from the side. Which do you consider best and why? Do you ever find the heat coming from below? If not, why?

Note the way that the hover is ventilated. Is it sufficient, in your estimation? Also notice the ease with which the various hovers can be properly cleaned and ventilated, as well as the ease with which the attendant can observe the chicks when they go under the hover. Is the hover movable or stationary? Which is best? Does the method of heating the hover give it a uniform temperature throughout? Notice the method of taking the temperature by inserting a thermometer through the top of the hover. In some hovers there will be found a thermostat for automatically regulating the temperature; with others it is necessary to raise and lower the



FIG. 19.— Three brooders which are in very common use, the left-hand one being a type of the Universal hover, which is adapted for use in the colony brooder house or in long individual brooder houses. The other two are common types of outdoor brooders.

hover to change the temperature; in still others the hover is turned; while in some all regulating must be done by the lamp. What material is used to separate the hover from the brooder apartment and yet allow the chicks to move in and out at will? How is this material prepared and attached?

Note the presence, except in the Universal hovers, of a large, well-lighted, and ventilated brooder apartment closely connected with the hover, in which the chicks may stay when not desiring the heated hover.

When studying the brooder take it to pieces whenever possible, noting the kind of lumber used, how it is fastened together, and position and attachment of the lamp. Measure the floor space of the hover, and determine the capacity of the brooder.

OUTDOOR BROODER

Examine all outdoor brooders, and determine if they fulfil the requirements outlined at the beginning of the exercise, observing the same points that have been noted in regard to the indoor brooder.

Besides the hover and the brooder compartment the modern outdoor brooder will be found

to possess a third compartment ; namely, a run protected from the wind and rain, in which the chicks may exercise when the weather is not suitable for them to be out of doors.

Examine the construction, carefully noting the double walls, position of the lamp, and presence of a chimney, also the way in which the roof is constructed and attached to the brooder and how the entire brooder is made waterproof.

EXERCISE XVI

ART OF RUNNING A BROODER

Successful brooding depends on the conditions affecting the egg before and during incubation, also upon the circumstances and conditions affecting the chick during the brooding period. Four days before the brooders are to receive the chicks, give them a thorough overhauling and cleaning. Wash all inside parts with a five per cent solution of creolin; see that the heat tubes, if any, are properly connected. Start the lamp so as to have the brooders properly warmed and regulated before the chicks are ready. Empty out any old kerosene which may be in the lamp, put in a new wick, fill with new kerosene, and see that the wick is properly trimmed. When placing the lamp in the brooder, see that it is set

firmly in place and that the chimney is set firmly on the burner. Turn the flame low at first. After the brooder has thoroughly dried, cover the floor about an inch deep with fine sand over which place fine chaff, preferably in the form of clover or alfalfa leaves.

Keep the temperature under the hover from ninety-five to ninety-eight degrees the first week, gradually lower it to about eighty degrees the second, and during the third week it may drop to seventy degrees. The chicks themselves will show to the careful observer the temperature which should be maintained, the object being to keep them comfortable. A great variation in temperature must be avoided.

Remove the chicks to the brooder in closed basket or nursery drawer when they are from thirty-six to forty-eight hours old, taking care not to chill them during the transferring. Place them under the hover, about fifty to each brooder. Supply them with an abundance of white crystal grit and fresh water for the first day, all other food being withheld. Why?

During the first twenty-four hours confine them closely to the hover so they will learn where to go and warm up quickly, thus largely preventing huddling, after which time they may be allowed the run of the brooder.

The hover as well as the entire brooder should be well ventilated, so that an abundant supply of fresh air may be drawn into the same and gently forced into the hover. On warm, pleasant days, when the chicks are out, open the brooder as much as possible, allowing the sun to strike all parts of it.

Keep the brooder dry and clean.

Once a week clean the brooder thoroughly, putting in fresh sand and litter. Sprinkle a little clean sand on the floor daily. Thoroughly cleanse and disinfect the brooder before each brood.

Keep an accurate record of the temperature of brooder and room, also of all deaths as they occur, together with any notes in regard to the same, as symptoms, general appearance, probable cause of death, etc. The accompanying brooder record will be found especially adapted to this purpose.

NOTE. — The feeding of little chicks is purposely omitted, as a thorough discussion of the subject is not in line with the object of this work.

BARON DE HIRSCH AGRICULTURAL SCHOOL, WOODBINE, N.J.

POULTRY DEPARTMENT

BROODER RECORD

Brooder No. _____ 19__

Chicks	Incubator	Notes

MORTALITY

MAKE DAILY RECORDS

Date									
Number dead									
Date									
Number dead									
Date									
Number dead									

TEMPERATURE

A. M. } Brooder									
} Room									
M. } Brooder									
} Room									
P. M. } Brooder									
} Room									

A. M. } Brooder									
} Room									
M. } Brooder									
} Room									
P. M. } Brooder									
} Room									

Notes

EXERCISE XVII

HOUSING, LOCATION, AND CARE OF HENS AND
CHICKS

Houses or shelters for hens with chicks may be very simple and inexpensive. An empty barrel laid on its side, raised a few inches from the ground, provides an efficient shelter. A-shaped coops constructed of lumber from dry goods boxes, barrel staves, etc., make suitable houses.

Whatever kind of a shelter is used it should be at least one and one half by two feet square, and must be provided with a wooden floor to keep out vermin. It should also be provided with a wire or board door for use at night to keep out all prowlers. If located out of doors, the house must be raised a few inches from the ground to keep water from standing in it, and it should have a sloping roof which is waterproof. A shelter for protecting the front of the coop in bad weather may be constructed of boards about three feet wide and allowed to project over the front.

Construct a suitable shelter, keeping in mind the above requirements.

Place the coop in the shelter of some building,

hedge, or wall, facing it to the south or east and where the chicks can find abundant shade if they desire. Cover the floor about two inches deep with nesting material cut fine.

If the shelter in which the chicks were hatched is in good condition, it will be best to let the hen brood them in the same nest. Twenty-four to thirty-six hours after hatching carefully remove the chicks for a few minutes while the old nesting material is cleaned out, the nest disinfected with a carbolic spray, and new nesting material replaced.

As the chicks are placed under the hen, mark them with a punch well into the web, taking care not to injure the bones of the foot. The marks are to designate different matings. Replace only the strong, healthy chicks, remove and kill any weak ones, allowing twelve to fourteen chicks to a large hen and nine to a small one.

Keep the hen and chicks close to the coop for the first few days until they get strong and know their home. If cats, hawks, and other enemies are troublesome, it will be necessary to provide covered runs until the chicks are four weeks old.

Dust the hen and nest often with lice powder, and watch the chicks for head and body lice; should head lice appear, rub lard on the head, which will cause them to leave.

Keep fresh water, grit, and an abundance of green food before them all the time.

Keep a record of each hen and her chicks, the per cent of mortality, the gain in weight, and the apparent health and vigor of each brood, and compare with artificial brooding.

NOTE. — See Figure 14.

EXERCISE XVIII

CRATE FATTENING

The main requirements for economical fattening are: —

- I. The partial confinement of young fowls.
- II. The feeding at regular intervals, two or three times a day, of a suitable mixture of ground feed.

Construct a fattening crate out of 1 × 2 inch scantling and laths, making it two feet high and dividing it into three or four pens, each of which should be about 2 × 2½ feet. Each pen will then hold from four to six birds, depending on the size. Provide a shelf on the front, level with the floor, for the feed troughs.

Place the crate in a building which can be partially darkened, raising it about three feet from the ground and placing it back to the wall if possible. If it is desired to fatten a large num-

ber, the crates may be placed one above the other to economize space. Construct a V-shaped feeding trough out of 1 × 4 inch boards.

Success in crate fattening depends largely on the selection of the birds to be fattened. The Plymouth Rocks and Wyandottes give much better results than the smaller breeds.

Next select the birds for fattening, choosing only those which are strong and healthy, those which have a large frame capable of putting on a lot of flesh, and those which have yellow skin and shanks. White plumage is preferable to colored, as the bird dresses better.

Having selected the birds, leg-band them and weigh carefully, keeping an accurate record of each.

Place them in the crates four in each pen, and keep the room partially darkened except when feeding, at which time it should be as light as possible. Feed regularly three times a day by placing the feed trough before them for twenty minutes at a time and removing it at the close of each meal. Keep water before them all the time.

A ration which gives good results consists of the following:—

One part of fine ground oats.

One part of fine ground corn meal.

This mixture may be fed dry in the feeding trough, or it may be mixed with skim milk. When once mixed with skim milk, do not keep it over from one feeding to another. Why?

Weigh the birds daily, recording the variation in weight. Determine the time of maximum gain and the time when the birds should be slaughtered for the best results. The time usually required to satisfactorily fatten is from two hundred and fifty to three hundred and twenty-five hours. Figure the profit, keeping in mind the following points:—

Weight before feeding.

Selling price per pound before feeding.

Total value before feeding.

Gain in weight before feeding.

Cost of food consumed.

Cost of producing a pound of flesh during feeding.

Weight after feeding.

Selling price per pound after feeding.

Total value after feeding.

Profit from feeding.

If time permits, carry a number of different lots through the crate, using different rations and determining the relative merits of each.

Always bear in mind the fact that animals fatten better at rest, since the economy of food

is promoted by diminishing the demand for heat and energy.

EXERCISE XIX

MACHINE FATTENING

Select the birds to be fattened, and place them one or two in each crate. The stall should be made smaller than in crate fattening, about sixteen by eighteen inches, and should be provided with a sliding door.

Construct the crate with movable pans or sliding boards in the bottom. Why? Place the coops one above the other in a building which can be darkened.

Before attempting to feed the birds with the machine, study its construction carefully, noting the following parts and the work which each part performs. Note the construction and shape of the food chamber. What is its capacity? Measure the diameter of the piston and the length of the stroke. How much food does one stroke of the piston force through the cylinder? Find the spring which brings the piston and foot lever back into place. Examine the nozzle and food tube; how is it constructed so as not to injure the bird's mouth or throat? Find the stop for regulating the amount of food, move it up and

down; notice in each case the length of the piston stroke. Examine the treadle construction and lever attachment.

After becoming familiar with the principle of the cramming machine, prepare the following feed for use in same.

2 parts fine ground oats.

1 part fine corn meal.

1 part fine ground buckwheat.

Pulverized charcoal 5 lbs. to each 100 lbs.
of mixture.

A few hours before feeding take a sufficient quantity of the above stock ration and mix it with skim milk to the consistency of cream, fill the food hopper, and at feeding time wheel the machine in front of the birds to be fed.

Take the bird in the left hand, holding its feet and flight feathers firmly in the same hand. Stretch out the neck with the right hand, and push the feed tube down the bird's throat, being sure that the nozzle ends in the crop. Place the fingers of the right hand on the crop and press the treadle with the foot. The pressure of food in the crop will tell when the right amount of food has been given. Feed lightly at first, gradually increasing the amount up to the second week, when the bird should receive a full ration three times a day until killing time, which is usu-

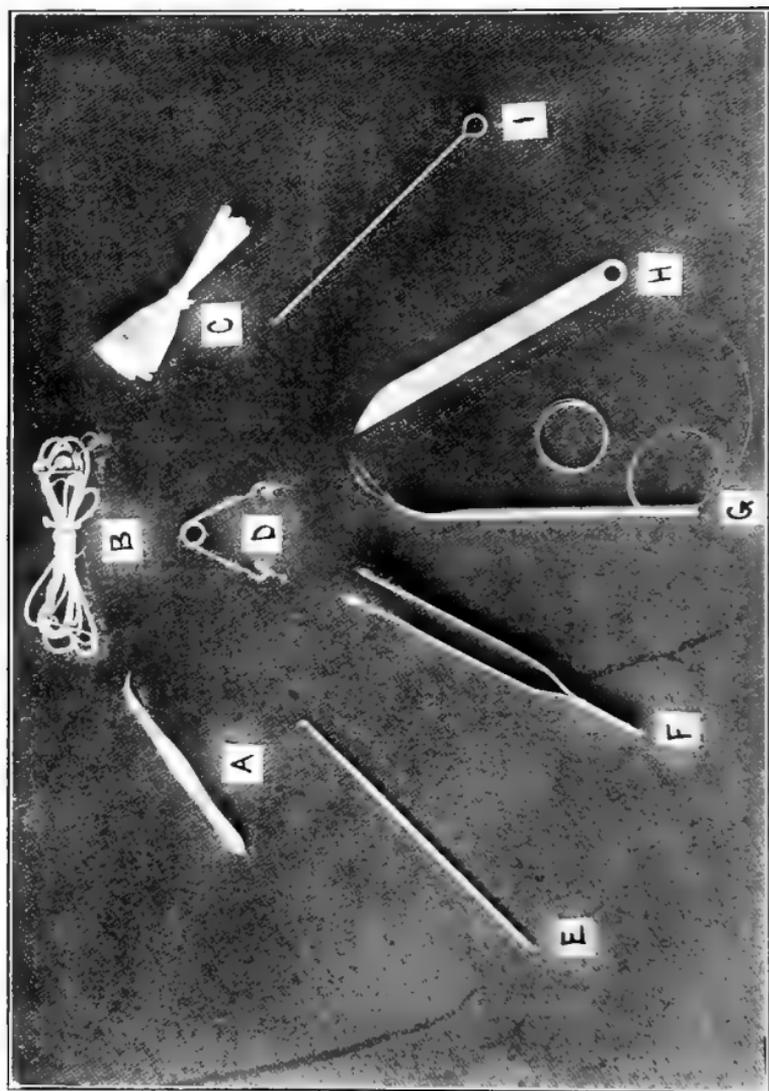


FIG. 20. — Instruments for performing the operation of caponizing.

- | | | |
|--------------------|---------------------|----------------------|
| A. Tweezers. | D. Spreader. | G. Cannula and wire. |
| B. Hooks and cord. | E. Caponizing hook. | H. Caponizing knife. |
| C. Leg bands. | F. Spoon forceps. | I. Probe. |

ally from eighteen to twenty-one days. Weigh the birds each day, noting the gain in weight. If fed properly, the greatest gain will occur during the second week.

Figure the profit from cramming, taking into consideration the gain in weight, amount and value of food consumed, also value before and after feeding, and extra labor required.

EXERCISE XX

CAPONIZING

Select some young cockerels four months old, shut them up, and withhold all food for from twenty-four to thirty-six hours before operating. Secure a narrow table, box, or barrel about three feet high and one which is light, so that it can be easily moved about. Before attempting the operation, study the instruments carefully, learning the name of each of the following and how it is handled.

Hooks and cord.

Caponizing knife.

Spreader.

Caponizing hook.

Probe and spatula.

Cannula and wire or patent scoop.

Spoon forceps.

Tweezers.

THE OPERATION

Lay the bird on its left side and wrap the cord twice around the legs, making a half slip with the hook; attach to the other end a weight about the size of a half brick. Wrap the second string around the wings, bringing them together at the back, and let the weights hang over the opposite sides of the table, thus holding the fowl secure. Moisten the feathers with a two per cent solution of creolin. This tends to prevent bleeding, and makes the feathers stay where placed, and kills any germs which may be present.

Pluck a few feathers above the first and second ribs, and pull the skin with the left hand toward the hip so that after the operation the skin will move back, covering the opening. Grasp the knife in the right hand, and make the incision between the first and second rib, cutting away from the backbone. In making the cut push the point of the knife in quickly about one quarter of an inch, and hold it there, as the bird will move its ribs up and down for a moment; then increase the cut to about an inch in length, taking care to cut between the ribs. Next insert the spreader by pressing it together and having the hook ends catch between the ribs. Should the wound bleed freely, wipe it off with a piece of cot-

ton saturated with the creolin solution. With the caponizing hook next tear the thin skin or peritoneum until the right testicle is plainly seen, and have the opening large enough to admit the cannula easily. The hook must be used with care, as there is danger of rupturing the arteries and intestines. Next with the probe locate both testicles, moving the table if necessary so that the light shines directly in the incision. Take the cannula in the left hand and thread it properly with the wire, having the loop in the shape of an oval a little larger than the testicle. Insert it in the opening, and with the aid of the probe catch the lower or left hand testicle in the loop; gradually draw the loop up with the right hand, gently shaking the cannula and allowing the wire loop to slip up around the testicle until only the spermatic cord is left. Now, gently pull the rest of the loop into the cannula, giving the wire a sliding motion which will sever the cord and leave the testicle free. Remove same immediately with the spoon forceps. Next remove the right or upper testicle in the same manner as the left. The left testicle should always be removed first, as it is the hardest to remove, and if the right one is taken first bleeding may follow which will entirely hide the lower one from view. If for any reason it is impossible to take the lower one out,

it will be necessary to turn the bird and repeat the operation from the left side. Use great care to get all of the testicles out, for if any is left attached it will cause a slip ; by which is meant a bird partially altered, but which possesses very few if any of the advantages of capons. If much blood is caused to flow, use a piece of cotton and the tweezers to absorb same.

Remove the spreader, allow the skin to settle back covering the opening, and wash the wound with a disinfecting solution. Place the birds in clean, shady quarters, with plenty of fresh water. Feed them a soft mash for the first week at least, and do not allow them to exercise violently for the first few days.

The day following the operation look the birds over for wind puffs near the incision, which will be made to disappear by piercing them with a sharp needle.

If a bird is killed during the operation, it is as good for food as if it had been bled in the neck.

When through caponizing cleanse all instruments, wipe them dry, and place in the case for the next operation.

Mark each bird operated upon with leg-bands to keep them from getting mixed with male birds.

Weigh them each week and keep a record of

their gain in weight, and compare with unaltered cockerels of the same age.

EXERCISE XXI

THE PRESERVATION OF EGGS

Secure four jars holding about two quarts each; they may be of stoneware or glass. A two-quart Mason glass jar with rubber seal is excellent. Scald the vessels thoroughly with boiling water.

Place in each jar fifteen fresh-laid eggs, not over one week old, which have been kept in a cool place and washed clean. Number the jars with printed labels one to four.

Next prepare the following solutions:—

No. I. Take one pint of water glass or silicate of soda, and add to it nine pints of boiling water, which makes approximately a ten per cent solution. Pour this solution of water glass over the eggs in jar number one until they are completely covered, and seal the jar.

No. II. Take one pound of quicklime and one pound of table salt, and thoroughly mix them with four quarts of boiling water. After slaking and settling pour off the clear solution, and use same to cover the eggs in jar number two.

No. III. Make a solution by dissolving three and one half ounces of common table salt in two quarts of boiling water, which makes a six per cent solution. Cover the eggs in jar number three with this solution, and seal.

No. IV. Dissolve two ounces of salicylic acid (crystals) in alcohol, and add this solution to one quart of water. Immerse the remaining fifteen eggs in this solution for one hour, allow them to dry, and pack separately, small ends down, in the remaining jar in fine dry sand. Be sure to cover all the eggs and seal the jar.

Mark on each jar the date and character of the preservative used; also keep a record of same in the notes. Place all four jars in a dark, cool place, preferably on a dirt or cement floor in a cellar. Leave them entirely alone for from six to twelve months, at which time test them and determine the advantages of the various preservatives.

If eggs have been laid down at some previous time for testing, examine them carefully and compare with the strictly fresh egg as regards the following:—

Color of shell.

Color of yolk.

Color of albumen.

The presence or absence of mould on the inside of the egg.

Consistency of yolk.

Consistency of albumen.

Flavor.

Smell.

Size of air cell.

Rotten or not.

Determine whether the eggs are usable for culinary purposes or not, and rate each preservative in terms of per cent according to the number of eggs which are good or bad; 100 per cent meaning all good and 0 per cent all bad.

EXERCISE XXII

NEW ENGLAND METHOD OF KILLING

Secure a plump chicken or other fowl which is ready for killing. Attach a stout cord, with a noose at the loose end, to a beam or ceiling, in such a position that the bird when struggling will not strike any obstacle. Take both feet in the right hand and thrust them through the loop, tighten it, and be sure that they are held securely and that the head of the bird is about opposite the waist line or a little below. Next lock the wings to prevent flapping; this can be done by

bringing one over the other and catching the tip of the upper wing under that of the lower; this makes it impossible for the bird to free itself and allows the picker free use of both hands. Grasp the head firmly in the left hand, opening the beak by the use of the thumb and the middle finger.

When you have a secure hold, thrust the blade down the throat until the point is just behind the head, draw it across with the point slipping along the neck or backbone; this severs the jugular vein and insures good bleeding. Withdraw the knife, and allow the bird to bleed freely for a few moments; this may be hastened by holding the tongue down with the knife. Next place the point of the knife against the roof of the mouth with the cutting edge towards the left hand and force it through the membrane into the brain cavity, turn it once around by a twist of the wrist, and then draw the blade directly across the base of the brain, thus severing the spinal cord and thereby destroying the control which in life the bird has over its feathers. As soon as the brain has been pierced, turn the knife into the skin of the lower beak and make a hole, through which place a hook suspending a weight such as a horse-shoe or brick. This keeps the neck extended and insures a thorough bleeding, which is all-important.

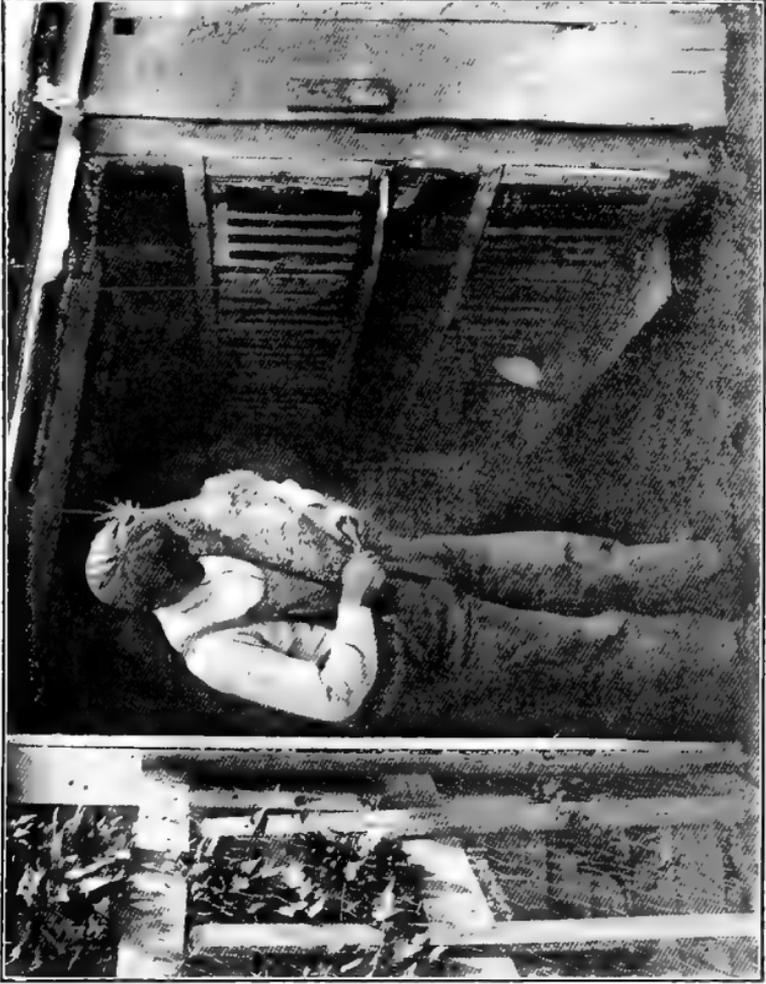


FIG. 21.— Student making stick. Note fattening pens in the background.

After this operation quickly rub the hands down the neck, removing the feathers therefrom and allowing them to fall into a barrel or box provided for the purpose. Pull the tail and wing feathers by a quick twist, and throw them on the ground, then begin to remove those from the tenderest parts of the body first, which on the chicken are the breast and back near the base of the tail and on the turkey the breast and the thigh. Never use the fingernails to pick with; the side of the forefinger and the end of the thumb are much quicker and will not scratch. When pulling the short or pin feathers, the nails will have to be used, but great care must be taken that only a careful, clean pluck is made, as not a scratch or scrape will pass in first-class products.

By the time the body is picked the bird will be so nearly dead that flapping will be almost impossible; then the wings may be unlocked and picked clean. With turkeys the wing or flight feathers may be left on, and with chickens the wings may be cut off at the outer joint, not hurting the sale of the bird in the least.

When through picking, immerse the bird in clean, cold water for one hour, which takes out all of the animal heat and causes the body to plump up.

Weigh the bird before and after killing and picking, and find the shrinkage.

EXERCISE XXIII

NEW JERSEY METHOD OF KILLING AND PICKING

Secure a large box about two feet square and two feet high, fasten a leather boot leg to one side, and place a box or stool beside it for a seat. Select the fowl to be killed and hold it under the left arm with the back up so that the neck is stretched out when the arm is extended. Grasp the head in the left hand, and open the beak from the under side with the forefinger; with right hand stick the bird with a sharp knife similar to the New England Method.

While the bird is bleeding hold her by the base of both wings and pluck the large wing and tail feathers, then strike the head once or twice with a short stick to stun and stop bleeding. Now sit beside the box, thrusting the bird's head into the boot leg, holding it there with the knee and holding the wings between the knees. Hold the legs in the left hand and pick with the right; first take out the breast feathers, then the back and legs, finishing with the small wing feathers.

When picking, keep the bird stretched out and

always pull the feathers towards the head. Throw all soft feathers into the box, those with quills being discarded. Use a knife and the thumb in drawing the pin feathers.

When through picking, immerse the bird in cold water, allow to drain, and it is ready to pack for shipment.

What are the advantages and disadvantages of the two methods previously outlined?

EXERCISE XXIV

SHAPING AND DRESSING

In preparing birds for market the appearance of the dressed carcass governs the price; for this reason any method which increases the desirable qualities should be favored.

Shaping, while employed in this country to but a small extent, is however a common practice in Europe, and the value of the birds is thereby greatly enhanced.

Construct a V-shaped trough thirty inches long out of two $\frac{3}{4}$ inch boards, the back board being six inches high and the front one five inches. Have the end pieces extend eight to ten inches below the trough to act as legs and raise it from the floor and table. As soon as the birds to be

shaped are plucked, tie the hocks loosely together so that the legs lie flat against each side of the breast. Before tying draw the meat upwards by means of the hands, thus improving the appearance of the bird. Next strike the stern against a clean wall or bench, flattening it and making it fit the shaping trough easily. Lay each bird in the shaping trough breast down, with the neck and head hanging over the front. The first bird must be pressed firmly against the side of the trough and a weight placed by its side to hold it in position; as succeeding birds are placed in the trough, the weight should be moved along until the trough is packed full. It is very essential to have them firmly and tightly packed.

Next lay a board about five inches wide over the backs of the fowls just behind the wings, and place upon it a heavy weight, which must be equally distributed over its entire length, about eight to ten pounds per bird. Allow the birds to remain in the trough for several hours until they are cold and set, after which they may be removed, dressed, and packed for shipment.

Shaping adds nothing to the weight; it simply improves the appearance.

DRESSING

Fowls which are to be marketed in the common or wholesale manner must never be drawn or cut in any way. This work is left to the middleman to perform in accord with his customers' requirements. When selling direct to the consumer and in a high-class retail trade it is best to deliver the birds ready for cooking.

With a bird to be roasted proceed as follows: place a handful of straw in the stove and when blazing hold the bird above the same, burning or singeing all hairs from the body. Use care not to blacken the skin; this is why paper is objectionable.

After singeing proceed as follows:—

I. Notch the skin of each leg just above the joint so as to cut the sinews; twist the shank, breaking the joint, and sever the tendons with a knife.

II. Remove outer joint of wing in the same way.

III. Pull the skin of the neck towards the body and sever the neck about one inch from the body; thus when the skin is released, about one inch of free neck skin is left.

IV. Make a cut two inches long at one side of the breast, exposing the crop; remove same,

being careful not to increase the size of the opening.

V. Turn the bird with the tail towards the operator and make a longitudinal cut about two inches in length from the vent towards the point of the keel. Insert the forefinger and carefully loosen the tissue and fat around the intestines and gizzard; when entirely loosened draw them out, taking care not to rupture any part. When all are out make a circular cut around the vent and remove same with the intestines.

VI. Next remove all internal organs, as liver, gall, spleen, reproductive organs, heart, and lungs, taking care not to tear the flesh around the opening.

VII. Wash bird out thoroughly with warm water followed by cold.

VIII. Open gizzard and heart and wash out and place with the liver in the body cavity.

IX. Take small white thread and needle, gather loose neck skin over the end of the neck, and sew smoothly together and fasten.

X. Take six or eight stitches in the breast in the opening from which the crop was taken, leaving it perfectly smooth.

XI. Lay the wings flat and secure on the sides of the body, and pass white cotton string

twice around the entire body and fasten, thus holding them close and smooth.

XII. Tie a piece of string around the hock joints, having them two inches apart, one on each side of the keel, and bring them down close to the body, tying the strings firmly to the tail.

XIII. Immerse the bird in clear cold water for one hour, when the muscles will be firmly set; after draining and drying it is ready for the customer.

EXERCISE XXV

PACKING EGGS FOR SHIPMENT

A large part of the profits in poultry-keeping depends on the marketing of the products. A careful grading of all poultry products pays, since each grade will sell better if sold by itself. The low-grade products in a mixed lot will lower the selling price more than the high-grade products in the same lot will raise it.

Egg packages must be selected with reference to the needs of the trade for which they are to be consigned. When shipping direct to the customer in lots of a few dozen each, the small pasteboard carton with a capacity of one dozen eggs is the most desirable. They cost from five to eight dollars per thousand, according to the

quantity. The above estimate includes the cost of printing on the cover, which gives to the poultryman a constant source of advertising. When it is desired to make express shipments to private customers, the three-dozen size placed in a durable and attractive shipping crate is very desirable.

Construct a shipping crate for a three-dozen size carton as follows. Make it $11\frac{1}{2} \times 12$ inches inside measure and 4 inches deep; the sides and bottom should be made of $\frac{3}{8}$ inch material, light and durable, as Georgia pine, the ends of the same material about $\frac{7}{8}$ of an inch thick, and the cover of $\frac{3}{8}$ inch material, reënforced with two $\frac{1}{2}$ inch strips to prevent warping and splitting. Fasten the cover on with two $2\frac{1}{2}$ inch strap hinges and a 2 inch hasp and staple; further strengthen the case by fastening a band of $\frac{1}{2}$ inch galvanized iron strapping around the edges. When finished, give it a good coat of paint and varnish, and when dry, place the name and address of the poultryman or farm shipping the eggs on the top and sides of the case. This can be most easily done with a stencil. The capacity of the above shipping crate can be increased in series of three dozens each by simply making it deeper according to the number of layers of cartons desired. Fifteen inches in depth accom-



FIG. 22. — Various methods of packing eggs for shipment, showing the way of assorting to color and size.

modates five layers, or fifteen dozen. The crate as described is 4 inches deep, while the carton is but 3; the remaining space is designed for packing material to avoid breakage en route.

When shipping to large customers or commission merchants, the eggs are packed in standard thirty-dozen crates with pasteboard fillers. These crates may be purchased second hand for from five to fifteen cents apiece, and can be made much more durable by removing the back and replacing it with $\frac{3}{8}$ inch Georgia pine and providing a cover of the same material, cleating it to prevent warping and fastening it to the crate by means of 2 or 3 inch strap hinges and a 3 inch hasp and staple.

Secure all of the different styles of egg cases possible; note their construction and especially the means employed to keep the eggs from striking against one another.

Fill the cases with fresh, clean eggs, always placing them small end down. If any are dirty, wash them before packing. Sapolio is good for removing stains. Avoid washing them when not dirty. Why?

Note the length of time it takes to fill the various style cases. What are the advantages and disadvantages of each style? All eggs should be shipped by express. Why?

EXERCISE XXVI

PACKING AND SHIPPING POULTRY

LIVE POULTRY

For shipping poultry to market, well-constructed crates are especially desirable. They must be of sufficient size to cause no undue crowding of the birds and not too large for easy handling. When long crates are used, partitions should be placed every two feet to prevent the birds being thrown together when the crate is tipped, thus preventing many birds from being killed by smothering.

When the birds shipped are to be used for meat, a large number may be shipped together; but when they are birds of high value to be used for breeders, a small number only should be put in one case.

Construct a crate 30 inches wide by 40 inches long, divide it into partitions out of 1 × 2 scantling and laths. Make it 12 inches high, and provide it with a movable door. When finished band the edges with $\frac{1}{2}$ inch galvanized iron strapping to strengthen. Such a crate can be used for many shipments, the express company returning the same empty for ten cents per crate.

Before shipment feed the birds liberally with water, corn, and wheat; if they are to travel a long distance, whole grain and water should be provided in the crate.

DRESSED POULTRY

Before packing be sure that the birds are dry and cold, with all of the animal heat removed. Wash the feet, remove any clotted blood from the mouth, and wash the head; also sew up any bad tears in the skin, using fine white thread. Packages for the shipping of dressed poultry vary greatly in size.

When shipping single birds direct to the consumer, each bird should be wrapped in waxed paper and placed in pasteboard boxes which are of sizes suitable to hold one bird or a pair, as the case may demand.

When shipping to commission merchants, boxes or barrels holding from one hundred to two hundred pounds are desirable; when shipping without ice, pack the birds in clean cases lined with fresh wrapping paper. Wrap each bird's head with paper. Why?

For a high-class trade each bird should be wrapped in a waxed paper. What are the advantages of so doing? Pack the birds tight

to prevent bruising. Barrels are especially desirable for shipping in warm weather when ice is used. In the bottom bore holes to provide drainage, and place excelsior to the depth of two inches. Pack the birds closely with alternate layers of fine cracked ice, the bottom and top layers always being ice. Straighten out the bodies and legs so that they will not arrive bent and twisted out of their normal shape. Upon the top place a good-sized cake of ice, and cover the barrel with white wrapping paper and burlap, fastening the latter with a hoop. Cases may be packed in the same manner, but whenever ice is used the top should be covered with burlap, for by so doing the package will be kept right side up.

Mark all packages with the name of the shipper, kind, quality, and number of birds, also the net weight.

Dressed and live poultry should always be shipped by express and marked perishable. Never use colored wrapping paper in packing. Why?

EXERCISE XXVII

POULTRY BOOK-KEEPING

Either single or double entry may be used, the single entry system being very simple and in many cases the most advisable. It consists of a day book in which is recorded all money spent for supplies, help, repairs, feed, etc., and all money taken in for sales of eggs, live poultry, dressed poultry, feathers, etc.; credits and debits are kept.

If the business is large and many cash and credit sales are made, it is advisable to keep an order book, sales book, cash book, and ledger, which are filled out every evening.

When the business reaches large proportions and is divided into many departments, it is necessary to keep a double entry system of books which will show at any time the exact status of any branch of the business. It may be well to divide the account as follows: laying stock, breeding stock, young stock, incubation, brooding, etc.

The poultry business is a business of details, and anything which enables us to find the leaks and stop the losses will go just so much farther towards making it a success.

In the above outlined system of double entry the debits and credits will be placed somewhat as follows.

Debit the laying stock with the following items: —

Stock purchased or received from the young stock department.

Food purchased.

Labor.

Supplies.

Credit laying stock with the following: —

Eggs sold.

Live stock sold.

Meat and feathers sold.

Debit the breeding stock with the following: —

Stock purchased and received from the young stock department.

Food purchased.

Labor.

Supplies.

Advertising, etc.

Credit the breeding stock with the following: —

Eggs sold to outside sources and to incubation department.

Live poultry sold for breeding stock.

Debit the incubation account with the following:—

- Eggs received from the breeding stock.
- Oil consumed.
- Labor.

Credit the incubation account with the following:—

- All vigorous chicks turned to the brooding department.
- Day-old chicks sold to outside sources.

Debit the brooding department with the following:—

- Chicks received from the incubators.
- Food purchased.
- Fuel.
- Labor.

Credit the brooding department with the following:—

- Chicks sold as broilers.
- Chicks turned on the range in the young stock department.

Debit the young stock account with the following:—

- Birds received from the brooding department.
- Food consumed.
- Labor, etc.

Credit the young stock department as follows:—

All stock sold or turned to the laying and breeding stock department.

All young birds sold to outside sources, whether alive or dressed.

The above system, while requiring considerable time to keep right, is absolutely necessary on a large plant where the owner must be able to tell at a few moments' notice just what each branch of his business is doing. The books should be balanced at least monthly, and oftener if desired.

Make an outline for a system of single and double entry book-keeping for a medium-sized poultry plant.

EXERCISE XXVIII

CONVENIENT POULTRY RECORDS

The following blanks have been used by the author for many years and have proved very satisfactory. The idea in keeping records is to enable the owner or the manager of the poultry plant to tell at any time just what any branch of the business is doing; they make a valuable asset to a complete system of book-keeping and

can be easily filed away and referred to at any time.

A complete set of records, if accurately and faithfully kept, will do away with the necessity of keeping an elaborate set of books.

The table on page 92 is an egg record for trap-nested stock, and it should be posted in the pen where the birds are kept.

The table on page 93 is a feeding record and should always be kept where exact records as regards the cost of feeding and care are desired.

The table on page 94 is a record showing cost of egg production, profit, etc.

The above is a combination of records I and II, grouping them in such a way as to show at a glance the exact egg yield, food consumed, selling price, and profit per hen.

The tables on pages 95 and 96 are a yearly egg record showing number of hens and eggs laid daily by each pen. This record should be posted in the pen, and is especially desirable where only the egg yield is kept.

NOTE. — See incubation and brooder records, Exercises Nos. 8 and 16.

FEEDING RECORD

BREED, _____ PEN, _____
 No. of fowls, _____ From _____ to _____

DAY OF WEEK	1	2	3	4	5	6	7	TOTAL
A. M. . . .								
Corn								
Wheat								
Oats								
Vegetables								
Mixture I . .								
Mixture II . .								
Mixture III .								
NOON								
Corn								
Wheat								
Oats								
Vegetables . .								
Mixture I . .								
Mixture II . .								
Mixture III .								
P. M.								
Corn								
Wheat								
Oats								
Vegetables . .								
Mixture I . . .								
Mixture II . . .								
Mixture III . .								

TOTAL AMOUNT OF		Cost
Corn	consumed, _____	_____
Wheat	consumed, _____	_____
Oats	consumed, _____	_____
Vegetables	consumed, _____	_____
Mixture I	consumed, _____	_____
Mixture II	consumed, _____	_____
Mixture III	consumed, _____	_____
Total amount in pounds	_____	Total cost _____
Nutritive Ratio, _____ Potential Energy, _____ T. D. Matter, _____		

EXERCISE XXIX

FIGURING POULTRY PROFITS

Once a year, preferably about the first of January, a complete inventory of the plant should be taken, fixing the inventory values on service values of the various birds, bearing in mind as well the cost and selling price values. When the inventory is complete, take the books which have been balanced for the year and prepare a financial statement for the year as follows :

INVENTORY	CURRENT YEAR	PAST YEAR
Farm 30 acres at \$50.00	\$1500.00	\$1500.00
Barn with root cellar	500.00	For 1200] 500.00
Henhouses for 2000 birds . . .	3600.00	birds 2400.00
Incubator cellar, feed, and cook room. . .	560.00	560.00
15 colony houses at \$10.00 each	150.00	10 houses 100.00
Fencing	270.00	250.00
Incubators	200.00	180.00
Brooder house and equipment	700.00	700.00
Team and tools	500.00	500.00
Plows and harrows	20.00	20.00
Small tools and supplies	60.00	50.00
2000 fowls at \$1.25 each	2500.00	1200 fowls 1500.00
Total	\$10560.00	\$8260.00

DIVISION OF LAND

Woodland and buildings	5 acres
Range for laying stock set with fruit	10 acres
Range for young stock set with fruit	8 acres
Clover and pea and oat hay	5 acres
Cabbage, beets, etc.	<u>2 acres</u>
Total	30 acres

EXPENSES OF MANAGEMENT

Interest on \$10,560.00 at 5 %	\$ 528.00
Depreciation, repairs and insurance on buildings at 5 %	247.50
Depreciation on team, tools, and fencing at 10 %	105.00
Taxes	50.00
Help, two men and one boy	1000.00
Advertising	100.00
Miscellaneous supplies and incidentals	500.00
Feed for 2000 hens and young stock	3250.00
Improvement to buildings	246.00
New poultry houses	<u>1000.00</u>
Total	\$7027.00

PROBABLE RETURNS

Eggs sold for market, 20,000 dozen at 30 cts.	\$6000.00
Eggs sold for hatching	600.00
Day-old chicks sold	500.00
Market broilers	900.00
Meat and breeding stock sold	1000.00
Fruit, feathers, etc.	<u>800.00</u>
Total	\$9800.00

From the preceding figures make a balance for the year's work as follows:—

Total cash and credit sales	\$9800.00
Increase in valuation	<u>2300.00</u>
Total increase	\$12,100.00
Total expense	<u>7027.00</u>
Total profit	\$5073.00

Of this \$5073, \$2300 has gone into permanent improvements and increasing the productive capacity of the plant. The remaining \$2773 can be considered as the farmer's salary for the year. This pays the farmer 26 per cent interest on the money invested above the five per cent charged in the expense account. The above figures are used more to show the method, rather than as regards their absolute accuracy, although the results here pictured are known by the author to have been greatly excelled in many much more modest poultry plants.

The price of grain and the market value of eggs and dressed poultry vary so often and to such a great extent that it is impossible to say for any long period of time the exact cost of keeping a hen, the value of the eggs, and therefore the profit per head.

Using the above as an outline, work out the

income and expenditures under different conditions, locations, equipment, and capital invested, and try to determine the influence which these factors have on the net profits of the business. In making the above estimate use the current prices of all products bought and sold.

EXERCISE XXX

ADVERTISING

Advertising pays when the business is large, when the products are plentiful, and when customers are wanted. Advertising may be carried on and made effective in any of the following ways: —

- I. General appearance of the farm and buildings.
- II. Appearance of the team and wagons when on the road.
- III. An attractive name for the farm.
- IV. Farm bulletin board.
- V. Records of heavy egg production.
- VI. The exhibition and winning of prizes in pure-bred stock.
- VII. Stencilling of all shipping packages.
- VIII. Printed letter heads.
- IX. Printed envelopes.

X. Printed circulars and cards.

XI. Printed blotters.

XII. Advertising in magazines and newspapers.

The latter is the most expensive, and should be employed with care and judgment. The printed circulars, cards, etc., should follow inquiries from advertisements appearing in periodicals, and should explain the products for sale and in detail.

Prepare a complete line of advertising material containing representatives of the above for a poultry farm which has for sale eggs and stock of a heavy egg strain, also for a poultry farm having for sale birds of high scoring and exhibition qualities.

EXERCISE XXXI

WRITING TO PROSPECTIVE CUSTOMERS

Prepare a letter for a prospective customer containing facts with variations to suit the circumstances.

FOR FANCY EGG TRADE

We aim to sell the best grade of strictly fresh eggs which can be purchased. We earnestly solicit your patronage, and wish to call your attention to the following facts:—

I. Our birds are fed only on pure, wholesome food, none being given which would in any way give the egg a disagreeable taste.

II. Our eggs are collected three times a day, and so kept clean and fresh.

III. All eggs are stamped with our name and the date when laid.

IV. All eggs are graded, and only those weighing over two pounds to the dozen are sold as first grade.

V. Our entire output of eggs is crated in small pasteboard cartons, one dozen in each package.

VI. All eggs are shipped the same day as laid.

VII. Every shipment of eggs from our farm is made by express. All orders will receive prompt and careful attention.

FOR UTILITY AND FANCY STOCK

We wish to call your attention to the fact that we have an extra fine line of heavy producing, high scoring Barred Plymouth Rocks from which we are selling eggs for hatching as well as birds for breeders. The following facts may be of interest to you:—

I. Our birds are all in excellent health and

have always been entirely free from any contagious disease.

II. Our males are exceptionally vigorous, producing a high percentage of fertile eggs. We guarantee eighty-five per cent to be fertile.

III. Our birds are of unusually fine shape, and their color is nearly perfection.

IV. Our entire flock last year averaged one hundred and sixty-eight eggs. Pen No. four, our heaviest producers, averaged two hundred and ten eggs last year as pullets, and mated to them are two males, one whose mother laid two hundred and thirty-six eggs, and the other comes from a line of heavy producers.

V. Our birds took (here mention any prizes which may have been taken recently).

VI. We guarantee our birds to satisfy.

All orders will be shipped promptly and will receive our most careful consideration.

EXERCISE XXXII

SCORING AND GRADING OF EGGS

Secure a dozen eggs of as many breeds as possible, and apply the following score card. In doing so it must be remembered that the color of an egg governs to a certain extent the price on the market, and that market requirements in

regard to color differ greatly in various localities; for instance, the New York market demands an egg with a clear white shell, and the Boston market pays a premium for a dark brown shell.

The size of the air cell must be determined by candling and is the safest test of freshness. In a strictly fresh egg it is about half an inch in diameter, and constantly grows larger as evaporation takes place.

In scoring for weight of total sample deduct two points for every one quarter pound under perfect weight. It is very desirable that the entire sample should be uniform with reference to weight, color, and shape; any defects in this uniformity clause should be severely cut.

Grade a large number of eggs into the following classes, which form the requirements of the Boston market:—

Extra. Large, brown, and fresh in every way.

Weight two pounds or more per dozen.

Firsts. Good eggs as regards color (brown).

Fair size. Weight one and three quarters pounds per dozen.

Ordinary. Mixed, weight one and one half pounds per dozen.

The New York market has for many years regarded the eggs of the White Leghorn as the

SCORE CARD FOR EGGS

		SCALE OF POINTS	CUTS
Freshness	30.	Size of air cell	20
		Striking shell lustre	10
Weight	20.	Of total sample	10
		(perfection being 2 lbs. or more per dozen).	
		Uniformity	10
Color	20.	Of total sample	10
		(pure white or brown is perfec- tion).	
		Uniformity	10
Shape	10.	Egg shape	5
		(the ratio between the large and the small diameter is about one to one and one fifth; this varies slightly in different breeds).	
		Uniformity	5
Appearance	10.	Clean	5
		(free from dirt and blood stains). Not cracked or broken.	5
Condition of shell	5.	Smooth	2
		Hard	3
Package	5.	Neat	3
		Light	1
		Durable	1
TOTAL 100.			100

Kind of eggs _____ Date _____ Scorer _____

POULTRY DEPARTMENT

BARON DE HIRSCH AGRICULTURAL SCHOOL, WOODBINE, N. J.

STUDENTS' OFFICIAL SCORE CARD

CLASS No. I—American Breeds

Date _____
 Entry No. _____ Coop No. _____ Band No. _____
 Owner _____ Breed _____ Sex _____
 Estimated Weight _____ Corrected Weight _____
 Student's Name _____ Section _____

SCALE OF POINTS

PERFECTION				STUDENT'S ESTIMATE		CORRECTED	
Shape	Color	Total		Shape	Color	Shape	Color
		8	Symmetry				
		6	Weight or Size				
		4	Condition				
3	3	6	Head { Beak				
			{ Eyes				
		8	Comb				
2	4	6	Wattles and Ear-Lobes				
3	6	9	Neck				
4	6	10	Wings				
6	6	12	Back				
4	5	9	Tail				
5	5	10	Breast				
3	3	6	Body and Fluff				
3	3	6	Legs and Toes				

TOTAL _____ 100 TOTAL CUTS _____

Score _____

_____ Instructor

standard of excellence. These eggs are of good size, of fine shape, and are chalky white in color.

EXERCISE XXXIII

SCORING POULTRY PLANTS

Score the college plant according to the score card on page 109.

EXERCISE XXXIV

JUDGING POULTRY FOR FANCY POINTS

There are two methods used in determining the respective merits of different birds as regards their fancy qualities.

The first method is the score card system, which is the comparing of the specimen to be judged with a standard of excellence and cutting the perfect score in the part which falls below standard requirement.

On page 106 is the official scale of points of the American Poultry Association for the American classes, arranged in a suitable manner for student scoring.

The Standard of Perfection published by the American Poultry Association, which gives the standard requirements for all classes of birds in

STUDENTS' SCORE CARD FOR UTILITY SCORING

GENERAL APPEARANCE.	25	Cuts
Form		10
Compact and symmetrical, with no undue development in any portion, as heavy breast or fat behind the legs.		
Quality		7
Comb fine in texture, skin and flesh soft but not fat, skin of medium thickness and mellow.		
Temperament		8
Nervous, active, vigorous, not lazy.		
HEAD AND NECK.	15	
Size of head medium, broad		3
Eyes bright and full		3
Comb and wattles medium size and bright red (Single Comb White Leghorns' comb should be large and drooping to one side.)		5
Neck of medium length, full		4
(Birds with long, rangy necks rarely prove good layers.)		
BODY.	50	
Breast moderately full, but very wide. . .		4
Back wide and fairly long, with great depth from back to keel		5
Hind quarters greatly developed, with the heaviest part of the body carried back of the hock joint		15
Fluff abundant, fine, and carried close to the body		3
Lay bones soft, pliable, and widespread . .		16
Tail set high and well spread		2
Feathers soft and held close to the body . .		2
Wings held well up and close to the body .		3
LEGS.	10	
Well spread and set wide apart at the hock joint		5
Length medium to short		2
Color of shank yellow or white		1
Shank free from feathers		2
TOTAL		<u>100</u>

POULTRY SCORE CARD

		SCALE OF POINTS	CUTS
Location	20	Nearness to market	3
		Means of transportation	4
		Means of rapid communication	3
		Soil conditions	3
		Climatic conditions	4
		Shade	3
General appearance of entire plant	20	Efficiency	8
		Driveway, walks, and grounds	3
		Buildings	3
		Painting	3
		Fences	3
Situation and construction of poultry houses and fences	20	Labor required	4
		Light	3
		Ventilation	2
		Internal equipment	2
		Floor construction	2
		Sanitary condition	3
		State of repairs	2
Durability	2		
Incubation equipment	20	Location of cellar	3
		Ventilation	4
		Moisture	4
		Internal arrangement	3
		Efficiency and sufficiency	6
Brooding equipment	20	Location	2
		Light	3
		Ventilation	2
		Sanitary conditions	5
		Labor saving devices	2
		System of heating	2
		Efficiency	4
TOTAL	100	100	

Name of plant _____

Post Office _____ County _____ State _____

Date _____ Judge _____

regard to shape, weight, and color, must be used with the score card.

The second method of determining the relative merits of two or more specimens is by comparison judging. This is the system of placing birds which is employed at most of our large poultry shows and consists simply in determining the birds which come nearest to the ideal in every respect and placing them in the order of their excellence, giving the best bird first place, next bird second place, etc.

A thorough knowledge of the Standard of Perfection must be acquired before one can become expert in comparison judging. This knowledge can best be attained by a large amount of practice in the scoring and placing of specimens, and if one desires to become an expert judge, it is necessary to memorize a large part of the Standard.

Secure a number of specimens and apply the above score card, together with the Standard of Perfection.

EXERCISE XXXV

JUDGING POULTRY FOR UTILITY POINTS

The scale of points on page 108 has been found very useful in calling attention to the main

characteristics which usually go with heavy egg production, regardless of breed. It is, as well, a means of finding the utility value of one bird over another.

Secure a number of specimens which are known to be good egg-layers and a few which are not, and apply the scale of points on page 108.

In most cases good layers may be selected by observing the points outlined above. The trap nest, however, is the only sure way unless each hen tested can be kept with a flock of another breed laying eggs of different color.

EXERCISE XXXVI

SYSTEMS OF HEATING BROODER HOUSES AND ART OF FIRING

Make a study of the heating which is installed at the college brooder plant. Note the kind of system ; whether it is hot water, hot air, or steam. Hot water is most generally used.

Note the location of the heater. Is it below the level of the pipe runs? If so, why? Note its shape, size of fire box, also the water jacket or tubes. Determine whether it is put together in sections by means of collars, or nipples, or is the body made in one piece. With small circular heaters the latter is usually the case. Note the

size of the chimney, its location, and the dampers which control the draft. Is there any method of cleaning the heat flues? Examine the grate construction, also the method of shaking. Is it clinker proof?

Find the point at which the cold water is taken into the system, also the point at which the hot water leaves the boiler, as well as the point where it enters on returning. Also notice the presence of a thermometer if it is a hot water system, to determine the temperature of the water. If steam, note the presence of a pressure gauge.

Follow the course of the heated water through the various coils, noting the presence of valves controlling same, also the presence at the highest point in each coil of a small pet cock to allow the escape of steam and compressed air which often forms at these points.

Note the presence of an expansion pipe and tank which keeps a constant supply of water in the pipes all the time, emptying or filling up as the water cools or becomes hotter. Do the hot water or flow pipes run level on leaving the boiler, or do they slope? If so, which way and why? Measure the size of pipes and determine the radiating surface required.

In firing a hot water heater, observe the following facts.

Before starting a fire make sure that the system is filled with water so that it shows on the bottom part of the glass in the expansion tank ; if not full, allow water to flow into same until it is full, being sure to open valves and pet cocks in the highest part of each coil to let out air which will gather there.

Start a good wood fire, and get it well under way before putting on any coal. To cause the heater to burn freely open the pipe damper, shut the door to the fire box, and open the lower ash pit door. When a good bed of coals is obtained and the water is at the desired temperature, it may be checked from rising higher by partly closing the pipe damper, shutting or partly shutting the bottom door, and leaving the upper door ajar. The exact position to leave each door and damper will have to be determined by practice, and will vary as regards height and size of chimney ; also it will vary greatly every day as regards temperature, wind velocity, etc. When it is desired to cause more heat to be radiated into the house, it is necessary to heat the water in the boiler to a higher temperature, and this can be accomplished by opening the pipe damper, also the lower door, and closing the door to the fire box. If it is desired to cool the water, the reverse is the rule.

Should the water ever go over 212 degrees, steam will be formed and it will be necessary to at once lower the temperature of the water, and this can most quickly be accomplished by stopping all draft and banking the fire. Whenever steam forms, it is necessary to immediately open the pet cocks in each coil to allow the same to escape.

Hard coal makes the best fuel; soft coal will, however, give satisfactory results, but it will require much more attention. With hard coal the fire should rarely be poked from above, all poking being done from below; with soft coal the reverse is the rule.

Take care to keep all ashes removed from the ash pit, since if allowed to accumulate in great numbers they will burn the grate out as well as spoil the draft.

Be sure at all times that there is an abundance of water in the system. If for any reason it should get very low, do not admit more immediately, but bank or draw out the fire and allow the boiler to cool off before letting in cold water; if this precaution is not followed, a cracked heater will be the result.

EXERCISE XXXVII

REPAIRING DAMAGED HEATING SYSTEMS

Repair any broken places in the asbestos covering to pipes on heater by mixing the pulp asbestos with warm water until it is a little thicker than cream, and apply with a smooth trowel, rubbing in thoroughly and leaving the surface smooth.

Look over all pipes and joints carefully, and see that there are no leaks; if so, repair same as follows:—

First examine the coils and determine the way in which they are joined to the headers at each end. This is usually accomplished by means of a union or a right and left nipple. Loosen these on the pipe or pipes to be repaired and disconnect the leaking joints; if the threads are injured, run the die over them to cut deeper; if not injured, replace the pipes, placing white lead on the threads before screwing up.

In studying the piping learn to distinguish the following fittings: elbows, tees, reducers, couplings, nipples, unions, etc.

Measure the diameter of the various pipes, both inside and outside; which of these dimensions is the standard size of the pipe?

Repair any worn or leaking valves by grinding and repacking.

Replace all broken hangers with new ones, and see that all others are firmly fastened to the brackets.

Try all pet cocks to see if they will open easily and are not choked with sediment. See that all unions are properly packed and screwed tight.

Lastly give all exposed pipes a good coat of mica paint, which entirely prevents rusting and greatly improves the appearance.

EXERCISE XXXVIII

MISCELLANEOUS APPLIANCES

An electric fan in the incubator cellar to keep the air cool and fresh. It must be regulated to a slow speed and not turned toward the machine but upward toward the ceiling.

A large dial spring balance for the weighing of feed, eggs, etc.

A thermostatic arrangement connected with the heater drafts to regulate the brooder house temperature.

An automatic float attached to the cold water inlet in the expansion tank, which gives assurance of an abundance of water in the system at all times.

Maximum and minimum thermometers in incubator cellar and brooder houses.

Transom arrangement for opening and closing all chick doors in the brooder house at once.

Ropes and pulleys for the raising and lowering of covers for inspection, cleaning, and airing.

Light, quick action springs upon doors to the brooder pens, shutting them immediately upon entry and keeping them closed.

Muslin frames in brooder and incubator cellar windows, which are hinged and may be raised inside by cord and pulley when it is desired to shut the sash.

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