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BY JAMES E. RICE

AND

HAROLD E. BOTSFORD

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FOURTH EDITION

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PRACTICAL POULTRY MANAGEMENT
THE WILEY FARM SERIES

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PRACTICAL POULTRY MANAGEMENT. By J. E. Rice and H. E. Botsford.
PREFACE TO THE FOURTH EDITION

Probably no branch of agriculture has made greater progress than poultry husbandry during the fifteen years since the first edition of this book was published. An increasing knowledge of the role of vitamins and of better feeding in general has greatly changed the seasonal operations in the poultry business. New research in incubation and brooding has brought the latest discoveries in the fields of physics and chemistry to bear upon these problems. Greater knowledge of the cause and prevention of poultry diseases has brought greater safety to the industry. The principles of breeding have been applied in such a way as greatly to increase the productivity of our laying strains and to bring some resistance to disease and physiological breakdown.*

As results of the wide adoption of some of these newer methods, a higher egg production and a much more uniform distribution of the production throughout the year have been made possible. Better care of eggs at the farm is yielding dividends to poultrymen in the form of higher prices.

This fourth edition of Practical Poultry Management has assembled the latest and most up-to-date discoveries of poultry science. In it are discussed the accepted modern practices of the most progressive poultrymen.

The authors desire to express their appreciation to many associates and colleagues who have helped by furnishing new materials or by examining the manuscript critically. They would particularly thank Dr. Alexis L. Romanoff for reviewing the chapters on incubation and embryology, Dr. G. O. Hall for making suggestions for the chapter on breeding, Dr. E. L. Brunett for his helpfulness in the discussion on dis-
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THE AUTHORS AND THE EDITORS

CORNELL UNIVERSITY
March, 1940
PREFACE TO THE FIRST EDITION

POULTRY HUSBANDRY is both a science and an art. As a science, it deals with the facts, principles, and natural laws underlying the successful management of poultry. Many of the scientific principles set forth in this book are comparatively new, although numerous practices based upon them have been followed for centuries with good results.

The art of Poultry Husbandry is the skill needed to put these principles into practice. One may imitate his neighbor's practice and thus unconsciously use scientific principles. In order to practice the true art of Poultry Husbandry, however, one must have a knowledge of these basic principles coupled with the skill to apply them successfully.

This book is prepared as a guide to vocational school pupils and poultrymen, whether they keep poultry on a commercial scale or in small flocks. The suggestions have been carefully tested through research and experience. The chapters are organized about the major activities in conducting the poultry enterprise. Where operative activity is involved, specific directions have been included for performing each job. Under the caption "General Information" or in separate chapters, explanations of principles and practices related to these activities have been included. For the most part, those activities dealing with managerial or local business decisions have been left for the development of individual teachers, to meet the needs of local groups of pupils and local enterprise and market practices. The community surveys at the close of many chapters, and particularly the study outlined on page 491, will serve as a guide to pupils and teachers in studying such managerial activities.

The essential key-factor in the successful management of a poultry enterprise is efficient stock. Because of the importance
of this phase of the business, the operations of culling have been included as Chapter I. In the remaining chapters an effort has been made to pursue a seasonal sequence of activities throughout the year. In this connection, however, it will be noted that many operations are conducted throughout all seasons.

The authors desire to express their appreciation to the following members of the Poultry Department at Cornell University who read and improved portions of the manuscript in their special subject-matter fields: Mr. R. C. Bradley, Sanitation; Mr. G. O. Hall, Breeds, Breeding and Culling; Dr. G. F. Heuser, Feeding; Mr. J. C. Huttar, Caponizing; Dr. L. C. Norris, Feeding; Dr. C. K. Powell, Marketing; and Professor L. E. Weaver, Incubation and Brooding; also to Mr. W. G. Krum, who read the entire manuscript, and Messrs. F. E. Andrews, L. M. Hurd, and R. C. Ogle, each of whom contributed in many ways to the book.

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Grateful appreciation is tendered Mrs. Harold E. Botsford, who gave many days to the development of this book.

Chapter IX is almost entirely from Cornell Bulletin 90, by Professor F. L. Fairbanks, Department of Rural Engineering, Cornell University.

The great majority of the pictures were especially taken by the authors to illustrate the text, and a number are from the Poultry Department at Cornell University.

In several instances illustrations from books and experiment station bulletins and educational material from commercial firms have been used, for which the authors express their appreciation. Credit has been given in all cases.

The Authors and Editors.
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PRACTICAL POULTRY MANAGEMENT

CHAPTER I

CULLING THE FLOCK

One of the most useful, satisfying, instructive, and inspiring types of work with poultry is culling the flock.

Culling is useful because it gives the good producers more room at feeding time, less crowded perches, and cooler quarters at night. It is satisfying because it enables the poultryman to eliminate the poor producers, saves feeding them when no return for eggs can be expected, and places them on the market at the time of higher prices. It is instructive because the observing person will learn much about poultry by handling the birds individually. Finally, culling is inspiring because this particular work opens up a field in which one can quickly see results. It leads one to form the habit of observing daily the quality and condition of the stock. It creates a desire to see better birds and to so handle and breed them that there is continual improvement in the flock.

Operations:
1. Deciding when to cull.
2. Deciding upon the culling method to use.
3. Preparing to cull.
4. Catching and holding the bird.
5. Culling the birds that are not laying.
6. Continuing the examination.
8. Selecting pullets for the laying pens.
10. Discarding old males.

General information:
Types of culling.
1. Deciding when to cull

Culling may be done throughout the year by removing birds that appear to be out of condition or not laying.

Culling low producers is best accomplished during the summer. A few birds cease laying in May or June and should be removed. Later in the summer, larger numbers will cease to lay and may be removed by carefully separating them from the flock and catching them while in the pen, with hook or net. This is sometimes the most practical way to cull. If, however,

![Image of culling the flock](image)

The birds were driven into a small pen at the end of the house, caught from there, and examined. The culls were thrown into a small yard and the good hens into another. Note the jar of blue ointment with which the birds were treated at the time of culling. (See Chapter XII.)

2. Deciding upon the culling method to use

Two methods of systematic culling are practiced: (a) Culling by trapnest or laying-cage records; and (b) culling by external characters.

The trapnest method of culling involves trapping the flock and removing from the pen any birds that are not recorded as laying, or that are otherwise undesirable. Trapnesting requires a great deal of labor and is an expensive way of culling.
An individual egg record can be kept of birds in laying cages, and culling can be practiced when they cease to lay. A knowledge of the external characters is always desirable. Trap-nests or laying cages should not be used for the sole purpose of culling.

3. Preparing to cull

(a) Become acquainted with the conditions under which the flock has been kept. Culling cannot be accurate unless the feeding, housing, and sanitary conditions have been such that good birds could lay. (See Chapter XXIV for the summer care of poultry.)

Many hens do not lay simply because they cannot under existing conditions, even though they may be naturally productive. If all unproductive birds were removed at this time, some valuable hens might be culled. In this event, they should be culled less severely.

If birds have been properly cared for, they may be culled at any time. If not, they should be placed under desirable conditions at once and culling should proceed after a month or six weeks.

(b) Provide a place in which to put the culled birds.

(c) Confine the hens to their house or pens the night before they are to be culled. All the birds should be handled, to save time and to avoid the possibility of overlooking individuals.

(d) Prepare the equipment for catching and confining the birds.

4. Catching and holding the bird

The best method is to place a catching and carrying crate (Fig. 2) at the exit door, on the outside or between pens. (The
exit door should be in a corner of the pen, to facilitate driving.) Drive twenty to thirty birds into the crate, depending upon the size of the crate.

The net may be used to advantage when one wishes to catch a few birds rather than handle the entire flock. The bird desired may be carefully separated from the rest of the flock and caught without disturbing the others (Figs. 3 and 4). Some prefer the catching hook (Fig. 7).

A fish landing net is ideal for catching birds.

Bird is caught and is neither harmed nor disturbed.

**Fig. 3.**

*Approach the hen quietly and with a quick movement slip the mouth of the net over her head.*

**Fig. 4—** Catching wild or frightened birds.

*Start the bird running beside a fence or building and . . . suddenly thrust the net in front of the bird, which runs into it.*
Rounding up with wire screen or panel is quite a satisfactory method. Take 10 feet of 2-inch mesh poultry fencing, 5 to 6 feet high, with a 1- by 3-inch wooden strip fastened at each end, and three 2- by 4-inch strips, each 3 feet long, tacked at the bottom. Fasten one end to the wall 4 or 5 feet from a corner, and hold the other end out into the room.

Drive twenty to twenty-five birds into the corner, and carry the loose end of the fencing around them. The person operating the fencing should be inside the pen as the fencing is drawn closer. Fasten the end to the wall when the space inside is small enough. Pick up the birds and pass them over the wire to the person culling.

Pens may be arranged outside, by using catching crates or wire.

The following manner of holding the birds will be found convenient for right-handed persons. A left-handed person may desire to do just the opposite.

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Fig. 5—The three parts of a desirable catching hook.

A, Handle with hole bored in the end and with hole in the side for the nut; B, Nut; C, Hook which enters the hole and screws into the nut. The wire found in roofing paper makes a satisfactory hook.

Fig. 6—Catching hook assembled.

Fig. 7—Using the catching hook. The hook is slipped around the shank. The foot prevents the leg from slipping through.

Fig. 8—Lifting a bird from a catching crate.
Lift the bird to be examined, from the floor or catching crate by grasping the wing close to the body (Fig. 8). Hold the left hand flat in front of the body with the back of the hand toward the ground, thumb pointing away from the body, fingers together and at right angles to the thumb.

With the bird's head toward you and the legs straight out behind, place the legs in your left hand so that the hock joint
rests just at the edge of the hand near the forefinger. Grasp the legs with the thumb and fingers (Fig. 9).

Support the bird by placing the fingers of the right hand on its breast. If the left hand is too far down toward the feet or above the hock joint, the bird can bend its legs and may flop and cause trouble in holding; but when it is held as described, the legs are kept straight by the use of the forefinger and cannot be bent enough to become unwieldy (Fig. 9).

The bird may now be turned in any direction for examination without releasing the left hand, the right hand being used to help turn and hold the bird’s body (Fig. 9).

5. Culling the birds that are not laying

A hen that has recently been broody, although perhaps not laying, should not be culled at this time, unless she has been broody several times. (See Chapter XXIV for method of marking broody hens.)
Sick birds should be culled. In most cases they will not be laying.

Examine the hen, whether separating individuals on the floor or handling every bird, looking for the characters described in the following paragraphs, in the order in which they are given. These characters indicate a hen that is definitely out of production. If any character is not as pronounced as here indicated, and if there is any doubt whether the hen is laying or not laying, check it with the other characters mentioned.

**Examining the comb, vent, and plumage.** When the comb is shriveled and dry, it is a sign that the bird is either out of production or is slacking up in her laying (Fig. 11).

Still holding the legs, place the back of the bird against you and, with the fingers of the right hand, part the feathers until the vent is exposed. In most cases when the comb is as described above, the vent will be dry, puckered, and yellow ¹ (Figs. 12, 13), indicating that the hen is not laying.

Now look among the neck and body feathers for signs of a molt, and see if there are pinfeathers or if there are unmistakable signs that the old feathers are being dropped and new ones growing in. New feathers are bright, and in many of the newer ones there will be bloody liquid in the quill at the base. Old

¹ This applies to yellow-skinned varieties. For white-skinned varieties, such as Orpingtons, Minorcas, etc., the yellow test does not apply.
leathers are usually worn, soiled, and perfectly dry at the base. A bird shedding her coat early in the summer is likely to be out of laying. (See page 21, “Molt.”)

Hens that appear as just described are not laying and may be removed from the flock.

In many cases, however, these characters may not be clearly marked; and when one is not sure whether the bird is laying, it is well to check further.

6. Continuing the examination
(See Chapter II for the principles governing these changes.)

The following characters indicate that a bird has not recently laid heavily:

A. Beak. Pale yellow or deep yellow color at the base or corner of the beak, on the skin that joins the upper and lower mandibles, and extending with no break in color, part or all of the way toward the tip.

B. Eyering. Pale yellow or deep yellow on the eyering or the inner edge of the eyelid next to the eyeball.

C. Earlobe. Pale yellow or deep yellow on the earlobes of white-earlobed breeds.

D. Pubic bones. Thick, blunt pubic bones which are close together. (These are the two bones just below and on either side of the vent.)

E. Abdomen (Fig. 16). A shrunken “tucked up” abdomen or one filled with a hard material.

7. Comparing good and poor laying hens

Because many hens do not show these characters as definitely or in as advanced a form as just described, further study may be desirable.

Culling poultry is a balancing of characters; one should be
checked with another. Except in extreme or unmistakable cases, and until one has had considerable experience, hens should not be culled on the basis of any one character alone.

When learning to cull, it is well to practice studying each character. Later, one should take in several characters at a glance, weigh them mentally, and arrive quickly at a decision.

It is well also for beginners to keep the birds a week or so while learning to test the accuracy of the work.

The following characters, as found on a good and on a poor layer during the summer, are arranged for quick reference. The longer the hen is out of production, the more these will be intensified.

The beginner should work through the characters as given under Section 5, "Culling the birds that are not laying," until they are clearly in mind.

**Good Layer**

Large, full, plump, smooth, waxy. If the comb is cold, but of good size and full, she is laying regularly.

**Poor Layer**

Limp (if laying slightly). May be covered with white scales.
SELECTING PULLETS FOR THE LAYING PENS

<table>
<thead>
<tr>
<th>Good Layer</th>
<th>Beak</th>
<th>Poor Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>White or well bleached.</td>
<td>All or partly yellow. Yellow color at the base of the beak, and extending out toward the tip.</td>
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</tbody>
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**Eyering and Earlobe**

| White or well bleached. | Yellow or tinted. |

**Vent**

| White or well bleached. Large, soft, moist, oval. Sometimes its fullness causes the upper part to appear overhanging. | Yellow or tinted. Small, hard, dry, round. Sometimes appears contracted. |

**Molt**

| Sheds late and rapidly. | Sheds early or before September and usually slowly. |

**Pubic Bones**

| Thin, pliable, and relatively wide apart. | Thick, blunt, and relatively close together. |

**Abdomen**

| Loose, pliable, soft. Full when in laying condition. Deep from the pubic bones to the rear of the keel. | Tight, hard, tucked up. Rear end of the keel rather close to the pubic bones. |

(For selecting birds while in laying condition or when both good and poor hens are laying or not laying, see Chapter XVI.)

8. Selecting pullets for the laying pens

Pullets that have been properly culled and handled while being reared will need little culling at maturity except to remove the few undersized, slow-maturing birds nearly always present (Chapter XXV).

Flocks of pullets that are to be held over the winter should be examined and selected on the basis of the following points:

A. Size and health.
B. Pigmentation.
C. Type of head and body.
D. Freedom from serious breed defects.
A. Size and health. Pullets that are well fleshed, large for their age and breed, active, and of good vitality are likely to give best results. Pullets that are undersized, thin, droopy, indolent, loose-feathered, or crowheaded should be culled. At best, they are likely to prove very low producers.

B. Pigmentation. It is desirable to have pullets which have been reared under conditions conducive to health and deep pigmentation. Strongly pigmented birds usually have the greatest vitality and staying powers.

C. Type of head and body. The head should be well proportioned and distinctly feminine, and the eyes well set and prominent. The feathers of the head should lie close, rather than stand outward or upward.

The head should be wider at the top of the skull than at the bottom, but not so wide as to overhang the eyes. When the head is viewed from the front or rear, the eyes should be seen standing out from the face.

The head, from top to bottom, on a line drawn through the eyes, should be fairly deep; and a line drawn at right angles from this line to the beak should not show the head so long, proportionately as to give the bird a crowheaded appearance.

The face should be clean and free from feathers; the eyelids should be large and slightly oval. The eye should have a fearless, alert expression. As an indication of temperament, the eye is important.

Considerable study of many pullets of different laying characteristics as they use trapnests may be necessary to fix in the mind the difference in the heads possessed by good and poor birds.

The body should be well proportioned and deep, from back to keel, both front and rear. The small, shallow-bodied pullet, especially when approaching laying, is not desirable.

D. Freedom from serious breed defects. For a discussion of breed defects, see page 333.
9. Finding the laying pullets

From time to time after the pullets have been housed, it is desirable to cull any which may not be performing satisfactorily. Any which are weak or sick should be removed when noticed. Culling pullets which have started to lay may be based on:

**Early sexual maturity.** Other things being equal, the pullets that are well developed usually begin to lay earliest. A bird is said to be sexually mature when she starts to lay. Sexual maturity and physical maturity (maximum body weight) do not necessarily occur at the same time. Pullets reach physical maturity at about 10 months of age, but sexual maturity may be reached much earlier in life.

For several months, pullets which have reached sexual maturity early are producing eggs and growing at the same time.

Leghorns should reach sexual maturity between 5 and 6½ months or 150 to 195 days. Certain strains are bred to lay earlier or later than other strains. When purchasing eggs, chicks, or stock, it is desirable to inquire concerning the usual age at which sexual maturity in the strain is reached. Ordinarily birds reaching sexual maturity early are heavier than those not yet laying. The lighter-weight birds in any given flock, therefore, are likely to be the latest ones to reach sexual maturity.

Birds reaching sexual maturity late are more likely, at that time, to be heavier and lay larger eggs, but Leghorns not reaching sexual maturity at 7½ to 8 months are less likely to be profitable.

Heavier varieties should reach sexual maturity at 6 to 7½ months of age, or 180 to 225 days. They are less likely to be profitable if sexual maturity has not been reached by 8½ to 9 months.

It is not necessary to handle all the pullets to find the non-producers at any age. The comb condition helps one to observe a doubtful bird on the floor. Such a bird should be caught and examined.
The development of the comb, size and condition of the vent, fullness of abdomen, and amount of pigmentation help one to decide. The pigmentation of a bird just starting to lay is exactly the reverse of that found in a high-producing hen ceasing to lay.

The eyerings, earlobes, and vent will begin to bleach. Examine the beak at the base. If the pullet is laying, and has laid several eggs, that section of the beak will be pale. The longer she has been laying, the lighter the beak will be and the nearer the tip the white part will extend. The degree of bleaching present depends on the number and size of eggs, the rapidity of laying, and the kind of feed given.

10. Discarding old males

At the close of the breeding season all males should be removed from the flock (see page 299) and all males developing defects should be sent to market. The culling will be based on vitality and standard disqualifications.

GENERAL INFORMATION

Types of culling. There are at least three types of culling with which the expert culler is concerned. Each is somewhat more difficult than the preceding one.

The easiest kind of culling is that required in well-cared-for flocks, which may be culled several times a season. Hens that are not laying, and are not broody or have not recently been broody, may be culled. Any sick birds or birds in poor condition should be removed. This type or grade of culling is the easiest, in that it is mainly necessary to be able to determine whether or not a hen is laying. For this type of culling, the methods described in this chapter may be used.

The second type consists in culling the hens of a flock mainly according to their laying value, where but one examination is possible during the season. It becomes necessary to remove hens that are not laying and also those that may be laying but are poor producers at best.
The third type consists in culling a flock which obviously has been mismanaged at some time during the season and contains hens laying and not laying, good hens and poor hens, with only one culling possible. This is extremely difficult, and there are few who feel that they can cull a flock under such circumstances and be perfectly satisfied when the job is done. In such a situation, it is best to place the birds under correct conditions for several weeks before culling.

The last two types of culling should not be attempted until the student is thoroughly familiar with Chapters II and XVI.

COMMUNITY SURVEY

1. How many poultrymen in the community cull birds the year around?
2. In which months is heaviest culling done?
3. Visit several poultry keepers and fill out the following form. Use it as a basis for class discussion.
   (a) Number of hens, November 1? Number of males, November 1?
   (b) When does summer culling start?
   (c) How often and when were the flocks culled?
   (d) Approximately how many were culled each time?
   (e) What price per pound was received for each lot of culled males?
   (f) What effect, if any, was noticed on the flock after culling?
   (g) What method of catching the birds is used?
   (h) What percentage of the entire flock was culled during the year?
4. How many poultry keepers examine each pullet before placing in winter quarters?
5. What percentage of the pullets are usually culled out?
6. What points are considered undesirable in the culled pullets?
7. How many flocks of pullets are examined later for precocity?
8. Are any local poultrymen practicing a system of marking which will help them later in determining when an individual pullet began to lay?
9. Describe the method of marking used.

REFERENCES

CHAPTER II

PRINCIPLES OF SELECTION

In the commercial culling of poultry, it is comparatively easy to recognize the extremes of laying quality. The difficulty arises in working with medium birds. With a knowledge of the reasons why the various characters are significant in the selection of birds for production, one is better able to form a correct judgment regarding the value of any particular character or group of characters.

In general these rules apply:
1. The pullet that began to lay late, stops early.
2. The pullet that starts to lay early, lays late.

The hen or pullet that begins to lay late in the fall or winter and ceases production early in the summer has had only a comparatively short time in which to produce eggs. Her length of laying period, i.e., the number of days from the time she began to lay until she ceased to lay, is short.

The hen or pullet that starts laying early and continues laying until late in the season has a long laying period. She, therefore, should be able to lay more eggs, and usually does so.

In a majority of cases, the bird having the short laying period does not lay as many eggs in a given week or month as the longer-laying hen; i.e., she is not as intensive a layer.

The principles of selection associated with the length of laying period are its related factors, persistency and precocity.

General information

1. Persistency.
   A. Pigmentation.
   B. Molt.
C. Condition of the comb.
D. Condition of the vent.
E. Condition of the abdomen.

2. Precocity.
3. Season of laying as an indication of egg production.

1. Persistency

Persistency refers to a bird’s ability to continue laying late in the fall at the end of her laying year. The greater persistency a bird has, the longer will be her laying period. To learn how persistent a layer the bird is, determine whether she is laying or not during the summer or fall. The sooner she ceases to lay in the summer, the less persistent she is. The characters denoting whether a hen is laying or not have been discussed (see Chapter I). They are pigmentation, molt, and condition of comb, vent and abdomen.

A. Pigmentation. Its use on pullets or hens starting to lay. Pigmentation is one of the first characters discovered and was used to tell whether hens were laying. It indicates what a fowl has done, rather than what she will do, except as the future is judged by the past. In other words, it may be used to estimate her past production and thus to form an opinion as to her probable future production.

On yellow-skinned varieties, the yellow color is given to the fat by a pigment called xanthophyll. This color is present wherever there is fat. It is found in a thin layer just beneath the skin, in the shanks, beak, and all parts of the body where the blood circulates.

When a bird starts laying, either as a pullet or after a rest period, this yellow pigment gradually disappears. The loss of pigment is more pronounced in the softer parts of the body and where the circulation of the blood is most rapid.

From observations which have been made, it is possible to estimate the approximate length of time required for the bleaching out of various parts of the body, and hence the time that has elapsed since the bird has laid.
(1) *Vent.* The vent loses color fast, because the blood is forced through the tissues rapidly, owing to the stretching of that part by laying. As a result, a marked paleness is noticed after two or three eggs have been laid.

(2) *Eyering.* The eyering bleaches almost as fast as the vent. On Leghorns, the eyering in most cases can be seen plainly, but in heavier varieties considerable red may make the yellow less visible.

(3) *Earlobe.* Since the earlobe has a larger surface and circulation takes place only moderately fast, a bleached earlobe usually denotes at least two or three weeks of laying.

(4) *Beak.* Soon after laying begins, the beak, at the corner of the mouth, starts to bleach. Circulation is quite rapid in the soft skin there. As the bird continues to lay, the color continues to disappear until the entire beak is bleached (Fig. 19, *B*). The lower mandible bleaches faster than the upper. The last place for the color to disappear is in the arch at the front of the upper mandible (Fig. 19, *E*).

A well-bleached beak usually indicates six to eight weeks of fairly heavy production.

(5) *Shanks.* Circulation in the scales of the shanks is very slow. Hence, a well-bleached shank shows good production for four to six months, depending upon the intensity of laying. The last places from which the yellow disappears are the scales just above the foot in front, and the rear of the shank at the hock.

Pigmentation, therefore, can be used to determine, not only whether the bird is laying, but also about how long she has been laying.

(6) *Use of pigmentation on hens during the summer culling.* When a hen ceases to lay, the yellow color is again deposited in the body as it was during the growing season. Fortunately, under normal conditions of feeding, it is deposited in the various parts of the body in the same order in which it was removed. It comes back slightly faster than it went out. Therefore, the pigment comes in first, as it went out first, where the circulation
is more rapid, in the softer parts and in the following order: (1) vent and corner of the beak; (2) eyering; (3) earlobes; (4) beak; (5) shanks.

In a very few days after laying ceases, yellow color may be seen at the corner of the beak and in the skin about the edges of the vent. As time goes on, the color pigment in any section deepens.

A yellow earlobe shows at least one to two weeks of non-laying, a yellow beak three to five weeks (Fig. 19, A), and yellow shanks two to three months.

As previously indicated, hens should not be culled on the basis of yellow beak or shanks alone. The color change in these parts is so slow that the immediate production activity of the hen is better indicated by other characters (page 8).

A hen with very yellow beak and shanks ordinarily has not been laying very heavily for several months.

The beak may be used to tell what a hen has done within a month or six weeks. Several combinations of pigmentation are possible:

(a) A beak that is yellow part of the way out from the corner of the mouth and light beyond to the tip (Fig. 19, F) shows that the hen laid enough to bleach the beak entirely but stopped laying recently.

(b) A beak that is light part way out and yellow the rest of the way (Fig. 19, C) indicates that the bird has been laying after a long rest period.

(c) A band of yellow around the beak, with light color at the tip and near the base (Fig. 19, D) shows that the hen has had a period of rest or a vacation recently.

(d) A band of light color, with yellow at the tip and at the base, shows that the bird began laying after a long rest, but has recently gone out of production.

(7) Conditions affecting pigmentation. The kind of feed given influences the condition of pigmentation. This fact must always be taken into consideration. Birds on grass range, or those fed a large amount of yellow corn, bleach out more slowly
Fig. 19—A study in pigmentation (see text).
than those kept on bare ground or given feeds which contain small amounts of pigment, such as white corn, buckwheat, and skim milk.

Thickness of skin affects pigmentation. A heavy, coarse skin bleaches out more slowly. The larger bird usually bleaches more slowly than the smaller bird.

The vitality of the bird is a factor. If ill, a hen frequently has little or no color. In this instance the absence of pigment is due to a failure to make pigment rather than to having laid it out. A strong, deep color is an indication of vigor. A naturally pale individual is less likely to have the staying power needed by a high-producing bird.

B. Molt. Molting is the act or process of shedding and renewing feathers. Hens usually molt in the following order: neck, breast, body, tail, and wing. Pinfeathers usually denote a vacation or at least a slacking up in production.

Birds inherit the tendency to shed their plumage annually. An early molter, under normal conditions, is a poor layer. A late molter, under normal conditions, is a good layer.

Hens seldom lay and shed feathers at the same time. A high-producing bird may, for a short time, molt and lay simultaneously; but usually she sheds more rapidly, and is declining in production when molting begins. When her wing feathers commence to drop, it is a sign that she is nearly or quite through laying. The fact that a hen sheds rapidly, though early, stamps her as being better than the common early molter that sheds slowly.

Molting and ceasing to lay indicate that a bird is going out of physical condition. Presumably, a hen does not stop laying because she molts, but rather molts or stops laying because her physical condition is such that she cannot support egg production and continued nourishment of the feathers.

Whether the cessation of production or the dying of the plumage occurs first depends probably upon the inherited tendency and the physical condition of the bird. If the bird has an inherited tendency to high production, molting probably
will precede cessation of production. If the bird has an abundance of vitality and an inherited tendency to low production, a cessation of production probably will precede molting. The body of the bird follows the line of least resistance. Heavy production beyond the normal strength of the bird, improper rations, irregularity of feeding, low vitality, and an inherited tendency to low production are conditions which may cause birds to molt before the normal time. Certain foods that are especially favorable to egg production and growth, the lengthening of the normal day by artificial light in the fall of the year in connection with stimulating rations, and an inherited tendency to high production are likely to cause the birds to continue production and consequently to postpone molting beyond the normal period.

Any program of selecting birds for production on the basis of the molting factor must take into consideration the environmental conditions and the time of hatching, and must not depend exclusively upon the molting of the birds at any particular fixed season of the year.

In general it may be said that there are three kinds of molters in the birds hatched during the usual spring season: early, medium, and late.

(1) Early molter. The early molter, or the bird that ceases to lay in June, July, or early August, shows that she has a short laying period, that she probably started late and lacks the vitality, laying capacity, or inherited tendency to continue.

The early molter sheds and grows feathers so gradually that a person may not observe the process unless the bird is handled. She is not only very slow in molting, but as a rule she is very slow in production, having a shorter laying period and laying fewer eggs per week than the late molter.

The early molter seldom completes her molt in less than three or four months. She then rests for a short time, frequently, not getting back into production any sooner than, and generally not as soon as, the hen that does not start to molt until several months later. In brief, she takes a longer vacation.
(2) **Medium molter.** Birds molting during late August or September are termed medium molters. If artificial illumination is to be used, birds molting in August may be segregated, allowed to recuperate under favorable conditions for renewing their plumage and recovering their body weight, and placed under lights in October or early November. If lights are not available, late August molters should be culled as soon as they cease laying.

Birds molting in September and otherwise desirable may be held as layers. They usually will be profitable without the use of illumination, although artificial lighting will help.

(3) **Late molter.** A hen molting in October or later is termed a late molter (Fig. 20). The feathers are dropped rapidly, and in a short time the plumage appears rough. There may be a few old feathers clinging to the bird, and her body will soon be covered with pin-feathers. Hens are rarely seen during July or August in this ragged condition. While molting, the late molter is quite timid and dislikes to be handled. This is due to the active circulation and sensitive nerve development in the feather follicles while new plumage is being grown. At this time the slightest touch hurts the bird.

The feathers grow in rapidly, so that the molt is over and the bird is back in production as soon as the early molters, or before most of them. Such a molt indicates that the bird has high vitality and therefore usually is a superior producer.

(4) **The wing molt. a. Primaries.** Because the wing primaries are molted in a certain definite order, they show how long it is since the bird stopped laying. This frequently proves valuable as a check upon the pigmentation of the beak and shanks, or as a factor by itself.
Each wing usually has ten primaries (Fig. 21). Leghorns nearly always have ten, but the heavy varieties occasionally have eleven. Very rarely, nine are found.

**Fig. 21.**

*Right:* The third feather from the axial feather is not full grown, denoting that three primaries were shed but that molting ceased at that point, perhaps at the time a resumption of laying occurred.

*Left:* Note the ten primary feathers on the outer part of the wing. The short feather (A) between the primaries and secondaries is the axial feather.

**Order of shedding wing primaries.** The primary next to the axial is the first one dropped (Fig. 21, 1).

It seems a precaution of nature that the wing should never be without feathers, to be used, if needed, as a means of escape. As a result, these quills are shed in regular order, about two weeks apart in the case of an early molter. Since the new quills start to grow immediately, and it requires six weeks for one to grow to its full size, it will be seen, on an early molter, that when the fourth feather is shed a new full-grown feather will be in the place of the first one shed (Fig. 22).

Assuming that the hen stopped laying when the first quill was dropped, we can, by allowing six weeks for the first feather, if full-grown, and two weeks for each additional full-grown feather, arrive at the approximate date when the hen stopped laying. Thus, the first two feathers being new and full-grown show an eight weeks’ molt (Fig. 22); three feathers complete, a ten weeks’ molt (Fig. 22); four feathers, a twelve weeks’ molt; and so on. Counting in this manner for the ten feathers, we find that twenty-four weeks are required to complete the molt
PERSISTENCY 25

(Fig. 22). This, however, presumably does not occur except in rare instances and in the case of birds whose vitality and production are very low.

The late molter may drop two, three, or even four primaries at about the same time, so rapidly does she molt. In this case,

Fig. 22—Egg production indicated by the length of time of molting as determined by the shedding of the primary feathers.

It takes about six weeks to renew completely the primary feather (P) next to the axial feather (A) and an additional two weeks for each subsequent primary feather (P'). Photographs taken on December 4.

Upper Left: A. A six-week molt. (Primary feather next to axial feather renewed.) Estimated date stopped laying, October 23. Second year record, 186 eggs.

Upper Right: B. An eight-week molt. (Two feathers completely renewed.) Estimated date stopped laying, October 9. Second year record, 164 eggs.

Lower Left: C. A ten-week molt. (Three feathers completely renewed.) Estimated date stopped laying, September 25. Second year record, 121 eggs.

Lower Right: D. A twenty-four week molt. (Ten feathers completely renewed.) Estimated date stopped laying, June 21. Second year record, 75 eggs.

Department of Poultry Husbandry, N. Y. State College of Agriculture, Cornell University, Ithaca, N. Y.

all the feathers dropped at the same time should be counted as one feather.

If a hen drops out of production during the summer because of adverse conditions, she often drops one or more primaries, then stops molting and resumes production. This is known as
26 PRINCIPLES OF SELECTION

a “vacation” molt, and not a regular molt (Fig. 21—right). Fortunately, when she goes into the regular annual molt, she will drop the next feather in sequence and molt in regular order the remaining primaries. Then she may start back with the primary next to the axial feather and molt again those which had been renewed during her vacation molt.

When a break in the lengths of the primaries is noted, we know that the bird has taken a rest period. If the vacation occurred recently, it can be verified by the appearance of the beak. If all the feathers of this “vacation” molt are full grown, it is not possible to tell just when the hen took the rest.

The molt, therefore, assists in determining the length of laying period by showing when the bird stopped laying.

b. Secondaries. Marble reports the following order of dropping secondary feathers, counting from the axial feather toward the body.

11, 12, 13, 14, 10, 2, 3, 4, 5, 6, 7, 8, 9, 1 (Fig. 23).

Secondaries may be used as an aid in determining persistency as birds are through or nearly so before the secondaries are dropped. All birds may be divided into two groups, the first which continues to lay after starting to molt and the second group which ceases to lay after starting to molt. The rate of shedding primaries and secondaries in these two groups is:

<table>
<thead>
<tr>
<th></th>
<th>Primary feathers</th>
<th>Secondary feathers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds molting while laying</td>
<td>2.1</td>
<td>0.45</td>
</tr>
<tr>
<td>Birds molting and not laying</td>
<td>4.2</td>
<td>6.6</td>
</tr>
</tbody>
</table>

C. Condition of the comb. The comb is a secondary sexual character. It tells what is going on in the ovary. It indicates the hen’s reproductive condition, and enables one to judge whether or not she is coming into or going out of production, or is laying. If the comb is dry, hard, and scaly, the hen may still be laying but she will soon stop.

Cornell, 1928.
Fig. 23—The weekly changes in a normal wing molt.

The primary feathers on the left are separated by the axial feather from the secondary feathers on the right in each of the twelve illustrations. The old feathers are shown in black and the new feathers in white. Cornell Ext. Bulletin 178.
If the hen has been out of laying but the ovaries are expanded and she is coming back into production, the comb indicates the fact. It begins to swell; the blood rushes to the tips of the points, and they become hot, soft, waxy, brighter in color, and full. The white scale on the comb breaks apart and pieces of the red comb show through.

The comb is reddest and hottest just before laying commences. As soon as laying starts, the comb gradually cools and becomes somewhat lighter in color.

D. Condition of the vent. When a hen is laying heavily the vent is greatly stretched during the expulsion of the egg. It is therefore much larger than when she is not laying.

A hen laying eggs is much like a cow about to give birth to a calf, in that the vagina of the cow, or vent in the case of the hen, enlarges and the bones and muscular tissues in the immediate section spread to allow easy passage of the young, or the egg. The hen is in a continuous state of reproduction, i.e., of pregnancy, while in laying condition, and it is because of this that the large, moist, dilated, and oblong vent is found on the best laying hens.

E. Condition of the abdomen. When the bird is laying heavily the abdomen is much larger than at other times. The intestines and oviduct are expanded in the laying hen because they are distended and stretched by large quantities of food and by eggs. It has also been found that the heart, gizzard, crop, etc., are much larger in a heavy layer than in a poor layer.¹

When the bird is laying heavily, the reproductive and supporting organs occupy a considerable amount of room, and they obtain additional room by pushing down the rear of the keel and pushing out the skin of the abdomen. Hence the full, soft feeling of the abdomen of a layer and the great depth between the pubic bones and rear of the keel (Fig. 24).

When the bird stops laying, the intestines are not so full, and the oviduct contracts because it has ceased to function. Hence, but very little room is occupied by these organs, as, in

¹ Unpublished records at Cornell University.
addition, a smaller amount of feed and water is consumed. The pubic bones come closer together and become covered with fat; the rear of the keel springs back toward the pubic bones; and the skin lies in loose folds across the abdomen. Later the skin of the abdomen may become shrunken and tightly drawn (Fig. 13).

2. Precocity.

Precocity refers to a pullet's ability to lay her first egg at an early age. It is spoken of as early sexual maturity.

Early sexual maturity is inherited and is an index of the ability of pullets as egg producers, because pullets possessing it are likely to lay more eggs in a month and to continue to lay longer near the end of the production year. That is, early sexual maturity is often associated with greater intensity of production and more persistent production.

Precocity is a valuable factor but a less reliable index of inheritance of production than persistency, because it may be influenced by rearing conditions, or by the management of the flock when placed in winter quarters.

Apparent early sexual maturity may occur when artificial illumination is used too soon on pullets. Pullets should come into production normally without the stimulating effect of illumination, that being resorted to only after the pullets are laying

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Fig. 24—Left: Poor layer. Right: Good layer.
Note greater depth, back to rear of keel in the good layer.
well and cold weather or other influences seem likely to reduce the amount of feed the birds are consuming. This practice permits both physical and sexual maturity to proceed normally.

If sexual maturity is stimulated in the immature pullet by artificial illumination, the body size may be temporarily or permanently kept smaller. The size of egg may also be smaller, depending on the body development.

Precocity is best used in selecting pullets for egg production when desirable rearing and laying house management has permitted them to develop normally, without the retarding effect of crowding and wrong feeding, or the stimulating effect of too early artificial illumination. The inherited ability of the pullet can then express itself better and the flock can be selected by the operator more satisfactorily.

3. Season of laying as an indication of egg production

The following table gives the results obtained with a group of fowls in a study of early sexual maturity or precocity and persistency.

To simplify the study, precocity is indicated by banding the pullets on the left shank with bands colored to represent the age at which each pullet started to lay. Persistency is indicated by banding on the right shank at the end of the laying year with bands colored to represent the approximate date the pullets ceased to lay.

In tabular form the plan for banding is:

<table>
<thead>
<tr>
<th><strong>Precocity</strong> Banded on Left Shank</th>
<th><strong>Persistency</strong> Banded on Right Shank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Banding</td>
<td>Color of Band</td>
</tr>
<tr>
<td>6 months</td>
<td>Blue</td>
</tr>
<tr>
<td>7 months</td>
<td>Red</td>
</tr>
<tr>
<td>8 months</td>
<td>Green</td>
</tr>
<tr>
<td>9 months</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

1 Cornell data, 1916.
## Season of Laying as an Indication of Egg Production

Results of Early Sexual Maturity (Precocity) and Persistency in 166 Birds Hatched in April and May, at Cornell University.

<table>
<thead>
<tr>
<th>Laid 1st egg</th>
<th>Leg band, left shank</th>
<th>Number of birds</th>
<th>Ceased laying</th>
<th>Leg band, right shank</th>
<th>Number of birds</th>
<th>Production 1st year</th>
<th>Production 2nd year</th>
<th>Production 3rd year</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 6 months</td>
<td>Blue</td>
<td>4</td>
<td>(Layers), before September</td>
<td>Yellow</td>
<td>3</td>
<td>154.33</td>
<td>122.33</td>
<td>114.33</td>
<td>133.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Breeders), after November 1</td>
<td>Blue</td>
<td>1</td>
<td>230.00</td>
<td>146.00</td>
<td>163.00</td>
<td>179.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group Average</td>
<td>Yellow</td>
<td>4</td>
<td>174.25</td>
<td>135.75</td>
<td>126.50</td>
<td>145.50</td>
</tr>
<tr>
<td>Between 6 and 7 months</td>
<td>Red</td>
<td>71</td>
<td>(Culls), before September</td>
<td>Yellow</td>
<td>22</td>
<td>124.45</td>
<td>110.91</td>
<td>99.23</td>
<td>111.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Layers), during September</td>
<td>Green</td>
<td>18</td>
<td>154.44</td>
<td>138.78</td>
<td>117.44</td>
<td>136.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Breeders), during October</td>
<td>Red</td>
<td>22</td>
<td>176.04</td>
<td>139.86</td>
<td>122.77</td>
<td>146.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Breeders), after November 1</td>
<td>Blue</td>
<td>9</td>
<td>195.22</td>
<td>164.33</td>
<td>142.33</td>
<td>167.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group Average</td>
<td>Red</td>
<td>71</td>
<td>157.01</td>
<td>133.72</td>
<td>116.60</td>
<td>135.78</td>
</tr>
<tr>
<td>Between 7 and 8 months</td>
<td>Green</td>
<td>50</td>
<td>(Culls), before September</td>
<td>Yellow</td>
<td>19</td>
<td>114.79</td>
<td>98.53</td>
<td>87.95</td>
<td>100.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Layers), during September</td>
<td>Green</td>
<td>15</td>
<td>150.73</td>
<td>128.00</td>
<td>115.33</td>
<td>131.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Breeders), during October</td>
<td>Red</td>
<td>11</td>
<td>100.18</td>
<td>142.82</td>
<td>130.36</td>
<td>144.45</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Breeders), after November 1</td>
<td>Blue</td>
<td>5</td>
<td>161.20</td>
<td>139.80</td>
<td>122.40</td>
<td>141.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group Average</td>
<td>Green</td>
<td>50</td>
<td>140.20</td>
<td>121.20</td>
<td>108.94</td>
<td>123.46</td>
</tr>
<tr>
<td>Between 8 and 9 months</td>
<td>Yellow</td>
<td>22</td>
<td>(Culls), before September</td>
<td>Yellow</td>
<td>18</td>
<td>98.06</td>
<td>116.33</td>
<td>106.78</td>
<td>107.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Layers), during October</td>
<td>Red</td>
<td>3</td>
<td>146.67</td>
<td>136.33</td>
<td>119.00</td>
<td>134.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Layers), after November 1</td>
<td>Blue</td>
<td>1</td>
<td>173.00</td>
<td>160.00</td>
<td>113.00</td>
<td>148.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group Average</td>
<td>Yellow</td>
<td>22</td>
<td>108.09</td>
<td>121.04</td>
<td>108.73</td>
<td>112.62</td>
</tr>
<tr>
<td>After 9 months</td>
<td>No band</td>
<td>19</td>
<td>(Culls), before September</td>
<td>Yellow</td>
<td>10</td>
<td>76.20</td>
<td>91.50</td>
<td>75.60</td>
<td>81.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Culls), during September</td>
<td>Green</td>
<td>6</td>
<td>81.83</td>
<td>122.67</td>
<td>110.00</td>
<td>104.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Layers), during October</td>
<td>Red</td>
<td>2</td>
<td>115.50</td>
<td>116.00</td>
<td>110.00</td>
<td>113.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Layers), after November 1</td>
<td>Blue</td>
<td>1</td>
<td>151.00</td>
<td>142.00</td>
<td>133.00</td>
<td>142.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group Average</td>
<td>Yellow</td>
<td>19</td>
<td>88.05</td>
<td>106.58</td>
<td>93.10</td>
<td>95.24</td>
</tr>
</tbody>
</table>
The chart on page 31 should be studied first for precocity, then for persistency, and finally for the two factors combined.

First, precocity. The average egg production for each of the five groups based on their age at first egg is 174, 157, 140, 108, and 86. Those starting before 6 months averaged most eggs, and those beginning to lay after 9 months averaged 86.

Each group averaged less than the preceding group in a rating based on precocity. Improvement in production ability resulting from breeding and from better environmental conditions would likely show higher individual records today. The relating performance of precocious and persistent birds, however, remains the same.

The most persistent birds are those laying after November. In the first group is one such bird that laid 230 eggs. She also was one of the first to start; therefore, whether the rating was based on persistency or precocity, her superiority would have been recognized.

In the second group, 9 birds were laying after November. These averaged 195. In the third group, 5 averaged 161. In the fourth group, one laid 173, and, in the last group, one laid 151.

All these most persistent birds were good layers. The birds banded with red, or those ceasing to lay in October, were better in nearly every case than those banded with green, which stopped laying a month earlier.

If all birds ceasing to lay before September 1 had been culled, only 3 good birds (first group) would have been culled. This speaks well for persistency.

If all birds that started to lay before they were 9 months old had been retained as pullets, there would have been a number of rather poor layers. This indicates that precocity is a less reliable guide than persistency.

A combination of the two, however, gives the correct length of laying period and provides a fairly accurate means of culling.
REFERENCES


CHAPTER III

HOUSING THE LAYING AND BREEDING STOCK

Operations:

1. Preparing the houses for winter.
2. Placing the birds in winter quarters.
3. Operating the house during fall and winter.
4. Constructing a laying house.
5. Installing poultry house fixtures.

1. Preparing the houses for winter

A building that is to be used for the winter housing of poultry, and that has been occupied the previous year, needs some very important preparations for the reception of the new flock which is to occupy it.

A. Insure a parasite-free and disease-free house. With hoe and broom, scrape and sweep clean the interior fixtures. Scrape the nests, droppings boards, equipment, and floors free of all material. Sweep the ceiling, walls, windows, equipment, and floors of cobwebs, dust, and other debris. Remove the dirt and litter thus accumulated. If water pressure is available, use a hose to wash the complete interior and sweep out the surplus water. Allow the moisture to dry out partially and then spray the complete interior with any approved disinfectant. (See under “Spray Materials.”) Apply the disinfectant by means of a spray pump which has sufficient power to force it into all the cracks and crevices. This work should be done carefully.

Spray all fixtures thoroughly or dip them into a tank or receptacle containing the disinfectant. Scalding water is one of the most effective disinfectant agents.
PREPARING THE HOUSES FOR WINTER

Then paint the roosts and nests, making them mite-proof. One of the best materials for this purpose is carbolineum.

Apply carbolineum with a brush, painting the perches, supports, and the inside of the nests. These should be allowed to dry for at least twenty-four hours before they are occupied by the birds, to avoid injury due to blistering the skin or breathing the fumes. Care must be exercised by the one who applies carbolineum, to avoid irritation to the eyes, nose, and hands. If carbolineum cannot be secured, apply some good coal-tar disinfectant, full strength.

When the house is kept clean as outlined in this chapter, the amount of work required for cleaning at any one time is very much reduced.

B. Provide interior fixtures. Certain interior fixtures are necessary at the start to make the house suitable for pullets.1

(1) One nest for each five or six birds should be provided.
(2) A droppings board may be placed 10 or 12 inches beneath the perches and fitted close against the back and sides of the house. It should be moved forward during the summer to provide better circulation of air.
(3) Allow about 7 inches of perch room for the Mediterranean varieties and 8 or 9 inches for the heavier varieties.
(4) Supply receptacles for water, grit, and shell.
(5) A hopper or trough for dry mash should be placed on a stand or the wall above the floor.

C. Repair and clean windows. If cloth curtains are used, repair them if necessary with cheesecloth or muslin. Burlap is less desirable, as dust collects readily on it, thus preventing good air movement.

Glass windows should be repaired, cleaned, and stored until cold weather arrives.

D. Provide proper litter and nest materials. Put 3 to 4 inches of clean litter on the floor. The common straws for

1A more detailed discussion will be found in a later section. These directions are given here in order that the house may be put in shape quickly and that the necessary equipment may be present.
litter, in the order of their desirability, are wheat, rye, oat, and buckwheat. Shredded or cut cornstalks or shavings may be used if straw is not available. Straw or cut cornstalks mixed with shavings make a fluffy, loose litter. The ideal litter is one which is durable, does not pack readily, and permits moisture to evaporate quickly. Leaves pack, and they, therefore, are less desirable.

Be particularly careful that the litter used is free from mustiness, mold, or decay, as serious trouble may develop in a flock where this precaution is not heeded. (See page 233.)

Nesting material should consist of 4 to 5 inches of shavings, oat or buckwheat hulls, or cut straw.

The house should now be ready for the birds, and if the back, roof, sides, and floor are tight, and the front permits a good circulation of air without draft upon the birds, it should be comfortable.

2. Placing the birds in winter quarters

When the first pullets commence to lay, all the promising, vigorous birds of essentially similar development should be placed in permanent laying quarters. There the pullets should continue their development and come into production with no setback because of changes in environment or management. Pullets should not be put in and confined to the houses too early, as they will develop better while on range; nor should very many be laying before they are put in unless nests similar to those in the laying house have been provided on the range. A change in type of nests and method of feeding and environment may check production and a partial or complete molt may follow. House the large, the average, and the undersized pullets separately when possible.

The guides that help to determine the time to move to winter quarters are (1) laying maturity and (2) climatic conditions.

(1) The age at which pullets begin to lay will vary with the region, the altitude, the method of feeding, the variety, and the
strain. It will usually occur between five and seven and one-half months.

(2) The pullets should be well settled in winter quarters before very cold weather arrives. At about this time the old birds should be moved to the quarters they will occupy as breeders or layers.

Mark a dozen pullets in each house with easily seen leg bands, or otherwise, and weigh and record the weight. Weigh the same birds every two weeks as a guide to the condition of the flock.

If pullets are not gaining in weight, or at least maintaining their weight, resort to one or all of the following:

(a) Provide artificial light to make a 13- or 14-hour day.
(b) Increase the amount of grain fed.
(c) Feed a moist mash.

Treat pullets for lice. Every pullet and cockerel brought in from the range should be treated for lice before being placed in winter quarters, unless found to be free of these parasites. This may be done as they are being transferred. Blue ointment or sodium fluoride is recommended (see page 252).
If preferred, two streams of Black Leaf 40 may be applied to the top of each perch from an oil can. It may be necessary to repeat this in two or three days.

![Floor Plan]

**Fig. 28—The Cornell Laying House with Units 20' x 20'.**

This house is adapted to flocks of 100 or more. Several units may be connected to hold 500-1000 birds, in which case the partitions may extend entirely across the pen, or two-thirds or three-quarters of the way as desired. Perches may extend lengthwise as shown here or cross-wise as in Fig. 27.

Plans of the 20' x 20' house furnished by the Agricultural Engineering Dept., Cornell University.

3. Operating the house during fall and winter.

The main points to watch are cleanliness, dryness, and purity of air.

A. Renew litter. (See page 265.)
B. Clean. (See page 264.)

C. Ventilate.

Leave the houses open in the front for several weeks, if possible, in order to continue range open-air conditions.

For single-story buildings a type of ventilation similar to that shown in Figs. 27 to 30 is desirable.

As cold or windy weather approaches close both front and rear ventilator boards and put the windows in place. The shortened ventilator board (Fig. 28, C) in front insures an air out-take when the board is raised. On days when storms blow
a. Door framing detail.  b. The curtain is set away from the house one inch. This leaves an inch opening at the bottom for an air intake in a tightly constructed house.  c. The front ventilator door should be open in summer. In winter it may be closed. The one-inch opening provides sufficient outtake.  d. The rear ventilator door should be closed in winter and opened in summer.
into the house, or the temperature approaches zero, it may be necessary to close the curtains for a short time. At all other times, leave the curtains down. This should allow plenty of fresh air and sunshine, provided there is sufficient cloth space for the size of pen and number of birds. (See page 90.)

The opening under the eaves in the rear is almost a necessity during hot weather (Fig. 28d). This opening should extend the full length. Both front and rear ventilators are usually kept open all summer, and closed in winter.

**BILL OF MATERIALS: FOR 20' X 20' LAYING HOUSE**

The framing may be of yellow pine, hemlock, spruce, or fir, depending on availability and price.

Ventilator boards, casing, window sills, cornice, etc., may be of white pine.

Siding and roofing may be of a cheap grade of white pine, spruce, hemlock, fir, or yellow pine.

Concrete................. Wall—1.5 cu. yd. 1 : 2 : 4
Floor—3.7 cu. yd. 1 : 2 : 4

5.2 cu. yd (26 bags cement; 2.5 cu. yd. sand; 5 cu. yd. crushed stone or washed gravel)

<table>
<thead>
<tr>
<th>Item</th>
<th>No. Pieces</th>
<th>Size</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sill</td>
<td>8</td>
<td>2&quot; X 4&quot;</td>
<td>10'</td>
</tr>
<tr>
<td>Plate</td>
<td>4</td>
<td>2&quot; X 4&quot;</td>
<td>12'</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>2&quot; X 4&quot;</td>
<td>8'</td>
</tr>
<tr>
<td>Studding</td>
<td>9</td>
<td>2&quot; X 4&quot;</td>
<td>7'-6&quot; (8')</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2&quot; X 4&quot;</td>
<td>7&quot; (8')</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2&quot; X 4&quot;</td>
<td>6&quot;-6&quot;  (1 2&quot; X 4&quot;-14')</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>2&quot; X 4&quot;</td>
<td>5&quot;-6&quot;  (3 2&quot; X 4&quot;-12')</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2&quot; X 4&quot;</td>
<td>6'    (1 2&quot; X 4&quot;-12')</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>2&quot; X 4&quot;</td>
<td>4'-6&quot;  (7 2&quot; X 4&quot;-10')</td>
</tr>
<tr>
<td>Rear window frame.....</td>
<td>1</td>
<td>2&quot; X 4&quot;</td>
<td>10'</td>
</tr>
<tr>
<td>Front window frame.....</td>
<td>2</td>
<td>2&quot; X 4&quot;</td>
<td>10'</td>
</tr>
</tbody>
</table>
Post..................... 1 2" × 4" 12'
Rafters.................... 18 2" × 6" 12'
Girder..................... 2 2" × 6" 12'
2 2" × 6" 10'
Siding—diagonal sheathing. ....516 bd. ft.
1" × 6" novelty......516 bd. ft.
Roofers....................551 bd. ft. 1" × 6" roofers—6 rolls' roofing
Trim.........................237 lineal ft. 1" × 4" for corner boards, doors and window trim, etc.
Rafter ventilator......... 42 lineal ft. 1" × 8" cornice
20 lineal ft. 1" × 6" \(\text{Front}\)
20 lineal ft. 1" × 5" \(\text{Rear}\)
20 lineal ft. 1" × 4" \(\text{Front}\)
Door......................... 25 bd. ft. 1" × 4" matched flooring
1 1" × 6"—12' nailing cleats
1 pr. 6" hinges
1 door latch and hasp
1 1" × 4"—3'
Windows.................... 4 9 It. 8" × 10" sash, plain rail for front windows
2 3 It. 8" × 10" cellar sash for rear windows
34 lineal ft. ½" × ½" stop bead
Curtains and frames...... 18 ft. 1" × 2"—guides 6' or 12' lengths
18 ft. ¾" × 4" guides
18 ft. 1" × 4" guides
12 ft. ¾" × 2"—frames, 3' or 6' lengths
20 ft. ¾" × 2"—frames, 5' or 10' lengths
4 yd. 36" cheese cloth
7 yd. 2" mesh, 36" poultry wire
4'-1" single pulleys
Door and window sills.... 1 2" × 6"—10'
Drop.......................... 1 ½" × 5"—12'
Stop bead for window.... 34 ft. ½" × ½"
<table>
<thead>
<tr>
<th>Items</th>
<th>Quantities</th>
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</thead>
<tbody>
<tr>
<td>Perches</td>
<td>2 2&quot; x 4&quot; - 10' perch supports</td>
</tr>
<tr>
<td></td>
<td>2 2&quot; x 4&quot; - 12' perch supports</td>
</tr>
<tr>
<td></td>
<td>10 2&quot; x 4&quot; - 10' perch and droppings board supports</td>
</tr>
<tr>
<td></td>
<td>8 2&quot; x 2&quot; - 10' perches</td>
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<td></td>
<td>125 ft. 1&quot; x 6&quot; matched flooring</td>
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<td>2 1&quot; x 5&quot; - 10' bds.</td>
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<tr>
<td></td>
<td>2 1&quot; x 3&quot; - 10' stop</td>
</tr>
<tr>
<td></td>
<td>20 ft. 5' wide - 2&quot; mesh poultry wire</td>
</tr>
<tr>
<td></td>
<td>16 ft. ½&quot; chain to suspend perches</td>
</tr>
<tr>
<td></td>
<td>10 heavy screw eyes</td>
</tr>
<tr>
<td></td>
<td>6 sheets 4&quot; x 8&quot; insulating boards</td>
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<tr>
<td></td>
<td>30 ft. 24&quot; wire cloth</td>
</tr>
<tr>
<td></td>
<td>4 2&quot; butts</td>
</tr>
<tr>
<td></td>
<td>2 heavy iron hooks to hook up perches</td>
</tr>
<tr>
<td>Nests and broody coops</td>
<td>20 lineal ft. 1&quot; x 3&quot;</td>
</tr>
<tr>
<td></td>
<td>170 lineal ft. 1&quot; x 2&quot;</td>
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<td>40 lineal ft. 1&quot; x 8&quot;</td>
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<td>20 lineal ft. 1&quot; x 14&quot;</td>
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<td>30 lineal ft. 1&quot; x 12&quot;</td>
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<td></td>
<td>40 lineal ft. 1&quot; x 4&quot;</td>
</tr>
<tr>
<td></td>
<td>25 bd. ft. matched 1&quot; x 4&quot; flooring</td>
</tr>
<tr>
<td></td>
<td>9 pr. 3&quot; T hinges</td>
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<tr>
<td></td>
<td>5 yd. 2&quot; mesh 5 ft. poultry wire</td>
</tr>
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<td></td>
<td>4 yd. 1&quot; mesh 30 ft. poultry wire</td>
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<tr>
<td>Hardware</td>
<td>4 pr. 3&quot; strap hinges - rafter ventilator</td>
</tr>
<tr>
<td></td>
<td>4 single 1&quot; pulleys</td>
</tr>
<tr>
<td></td>
<td>8 2&quot; iron buttons</td>
</tr>
<tr>
<td></td>
<td>1 roll sash cord</td>
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<tr>
<td></td>
<td>8 lb. 10D common nails</td>
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<td></td>
<td>25 lb. 8D common nails</td>
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<tr>
<td></td>
<td>4 lb. 6D common nails</td>
</tr>
<tr>
<td></td>
<td>5 lb. 16D common nails</td>
</tr>
</tbody>
</table>

**Bill of Material for 30' x 50' Laying House**

**Foundation Walls**
- **Cement**, 78 sacks
- **Sand**, 7 cubic yards
- **Gravel**, 15 cubic yards

**Piers**
- **Cement**, 2 sacks
- **Sand**, ½ cubic yard
- **Gravel**, ¼ cubic yard

**Floor**
- **Cement**, 83 sacks
- **Sand**, 7½ cubic yards
- **Gravel**, 16 cubic yards

**Sub-Base**
- Gravel or cinders, 22 cubic yards
### Bill of Material for 30' x 50' Laying House—Continued

**Aprons**
- Cement, 9 sacks
- Sand, $\frac{2}{3}$ cubic yard
- Gravel, 1\frac{1}{4} cubic yards

**Anchor Bolts**
- 45-\(\frac{1}{2}\)" bolts, 18"

**Form Lumber**
- 1300 square feet, \(\frac{3}{4}\)" boarding
- 72-2" x 4" x 12' studding

<table>
<thead>
<tr>
<th>Framing</th>
<th>Studding</th>
<th>Elevation</th>
</tr>
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<tbody>
<tr>
<td>Sills</td>
<td>31-2&quot; x 6&quot; x 16'</td>
<td>south</td>
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<tr>
<td></td>
<td>13-2&quot; x 6&quot; x 10'</td>
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</tr>
<tr>
<td></td>
<td>2-2&quot; x 6&quot; x 8'</td>
<td></td>
</tr>
<tr>
<td>Posts (Free Standing)</td>
<td>37-2&quot; x 6&quot; x 14'</td>
<td>north</td>
</tr>
<tr>
<td></td>
<td>4-2&quot; x 6&quot; x 18'</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-2&quot; x 6&quot; x 16'</td>
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<tr>
<td></td>
<td>2-2&quot; x 6&quot; x 14'</td>
<td>west</td>
</tr>
<tr>
<td></td>
<td>4-2&quot; x 6&quot; x 10'</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3-2&quot; x 6&quot; x 8'</td>
<td></td>
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<tr>
<td>Girders</td>
<td>5-2&quot; x 6&quot; x 18'</td>
<td>east</td>
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<td>5-2&quot; x 6&quot; x 16'</td>
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<td>2-2&quot; x 6&quot; x 14'</td>
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<td>4-2&quot; x 6&quot; x 10'</td>
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</tr>
<tr>
<td>Joists</td>
<td>3-2&quot; x 6&quot; x 8'</td>
<td></td>
</tr>
<tr>
<td>Ribbons</td>
<td>4-2&quot; x 6&quot; x 18'</td>
<td></td>
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<tr>
<td></td>
<td>5-2&quot; x 6&quot; x 16'</td>
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<td>2-2&quot; x 6&quot; x 14'</td>
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<td>4-2&quot; x 6&quot; x 10'</td>
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<tr>
<td>Plates</td>
<td>3-2&quot; x 6&quot; x 8'</td>
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</tr>
<tr>
<td></td>
<td>5-2&quot; x 6&quot; x 16'</td>
<td>partition wall, west section</td>
</tr>
<tr>
<td></td>
<td>2-2&quot; x 6&quot; x 14'</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4-2&quot; x 6&quot; x 10'</td>
<td></td>
</tr>
<tr>
<td>Ridges</td>
<td>3-2&quot; x 6&quot; x 8'</td>
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<tr>
<td>Headers</td>
<td>6-2&quot; x 4&quot; x 8'</td>
<td>partition wall at center</td>
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<tr>
<td></td>
<td>2-2&quot; x 4&quot; x 6'</td>
<td></td>
</tr>
</tbody>
</table>

**Insulating Board (Ceiling, Second Floor)**
- 3-2" x 4" x 14'
- 9-2" x 4" x 12'

**Wood Ceiling over Perches**
- 3-2" x 4" x 14'
- 9-2" x 4" x 12'

**More than 3', listed under Studding**
- 2" x 4" stock salvaged from forms

**Less than 3', 2" x 4" stock salvaged from forms**
BILL OF MATERIAL

SIDING AND BOARDING

EXTERNAL SIDING
2400 square feet—½" X 6" cove siding

ROOF
2400 square feet, ½" boarding required, consisting of:
1100 square feet, new, and 1300 square feet, salvaged from forms

PARTITIONS
367 square feet—⅛" T & G boarding (west section)
145 square feet—⅛" T & G boarding (at nests)

SHEATHING
1000 square feet—⅛" T & G boarding (at rear and over perches)

VENTILATOR OPENINGS (EXTERIOR)
100 lineal feet—⅞" X 14" boarding
50 lineal feet—⅞" X 12" boarding
50 lineal feet—⅞" X 9" boarding
178 lineal feet—⅞" X 7" boarding
100 lineal feet—⅞" X 6" boarding

CORNER BOARDS
2—⅛" X 4" X 16" boarding
2—⅛" X 4" X 14" boarding
2—⅛" X 3½" X 16" boarding
2—⅛" X 3½" X 14" boarding

INSULATING BOARD CEILING
26—⅛" X 4' X 12'
13—⅛" X 4' X 10'
13—⅛" X 4' X 8'

EXTERNAL TRIM AT DOORS
AND WINDOWS
550 lineal feet—⅛" X 4"
140 lineal feet—⅛" X 6"

FLOORING
1450 square feet—⅛" T & G flooring

SASH, DOORS, STAIRS

SASH, 1⅛" THICK (GLAZED)
.40—9-light, 8" X 10" glass
12—3-light, 8½ X 10" glass

DOORS *
486 square feet—⅛" T & G boarding
243 square feet—2-ply building paper

DOOR AND SASH STOPS
1500 lineal feet—⅛" X 1¼" stripping

STAIRS (OPEN RISERS)
Treads (13, each 4' long)
1—2½" X 10" X 16'
3—2½" X 10" X 12'

Stringers
2—2½" X 10" X 14'

Railing
1—2½" X 14" X 12'
3—2½" X 3" X 10'

MISCELLANEOUS
5 rolls 3-ply roofing paper
6 rolls 2-ply roofing paper
15 yards 48" cheesecloth
40 lineal feet—14" mesh, 48" poultry wire

* Doors to be built of two thicknesses of ⅛-inch T & G boarding with one layer of 2-ply paper between.
† One thickness.


### Perches (12 Units)

- **7**—2" × 2" × 6' beveled two corners
- **2**—2" × 4" × 8' frame
- **1**—2" × 4" × 14' legs
- **2**—3" × 3" × 8' boarding
- **1**—4" × 6" × 10' boarding
- **2**—5" × 6" × 8' boarding

- 96 lineal feet—2" mesh 6' poultry wire, No. 16 gauge
- 60 square feet—\( \frac{1}{2} \)" T & G boarding (droppings boards)

### Nesting Boom *

- **5**—2" × 2" × 14'
- **5**—2" × 2" × 12'
- 3—\( \frac{1}{4} \)" × 14" × 14'
- 2—\( \frac{3}{4} \)" × 14" × 12'
- 1—\( \frac{1}{2} \)" × 14" × 10'
- 10—\( \frac{3}{4} \)" × 14" × 10'
- 4—\( \frac{1}{2} \)" × 8" × 10'
- **2**—\( \frac{1}{2} \)" × 8" × 8'
- 10—\( \frac{1}{2} \)" × 6½" × 10'
- 12—\( \frac{1}{2} \)" × 6" × 10'
- 10—\( \frac{3}{4} \)" × 3½" × 10'
- 20—\( \frac{3}{4} \)" × 3" × 10'
- 3—\( \frac{3}{4} \)" × 3" × 14'

- 115 square feet—\( \frac{1}{2} \)" T & G boarding
- 6 lineal feet—\( \frac{1}{2} \)" quarter-round molding

### Hardware

#### Doors

**Driveway (2 pairs)**

- 2—barn-door thumb-latch sets
- 3 pairs 8" T-hinge (heavy)
- 2—8" top bolts
- 2—12" bottom bolts
- 2—6" barrel bolts

**Small exterior door (first floor)**

- 1 pair 8" T-hinges (light)
- 1—barn-door thumb-latch set
- 1—cylinder lock with keys

**Exterior to storage (second floor)**

- 1 pair 8" T-hinges (light)
- 1—4" gate hook and eye

**Storage to pen (second floor)**

- 2 pairs 6" T-hinges (light)
- 2—barn-door thumb-latch sets

**Storage to pen (first floor)**

- 20 lineal feet—sliding-door track
- 2—door hangers (truck type)

**Trap doors (second floor)**

- 2 pairs 6" T-hinges (light)
- 2—2½" ring lifts

#### Nesting Rooms

- 76 pairs 2½" × 2½" butts (fixed-pin type)
- 46—2" gate hooks and eyes
- 20—wood turn buttons
- 1—light-weight double-action spring butt
- 1—light-weight double-action blank butt

---

* Material listed is for one unit only; two units required.
TWO-STORY LAYING HOUSE

ELECTRIC WORK

300 lineal feet—3" rigid conduit
20—4" round outlet boxes
4—single-switch outlet boxes
20—porcelain outlets, each 4"
round with shade holders

20—10" to 12" metal reflectors
20—40-watt lamps
4—single-pole switches

GENERAL

The following items are not listed in this bill of materials owing to variable conditions:

- Water supply and fittings
- Electric-light cable and line switch
- Nails of various sizes
- Roofing cement

DESCRIPTION AND PLANS OF A TWO-STORY LAYING HOUSE

(30' × 50')

The plan for the two-story poultry house incorporates the ideas found in the standard Cornell 20 by 20-foot laying house and adapts them to the changes in width and ceiling.

The essential features are: provision for a driveway through the house which facilitates cleaning; the combination roof with shed-roof ceiling for the upper floor, thus providing economical construction for the wide house, reduced air space, and proper vertical air movement; the front-rafter ventilation for year-around use and the rear-rafter ventilation for summer use; the perches perpendicular to the rear wall; the portable droppings boards which may be moved away from the rear wall for better summer air movement; the 12-foot storage room; and the nesting room.

The house is 30 by 50 feet, with a 12-foot storage room, making the entire building 30 by 62 feet. The capacity is 500 birds to each floor, or 1000 birds for the entire building. Several units for 1000 birds may be added.

The house should have tight windproof walls. A single layer of matched boards with a two-ply roofing paper outside, or the equivalent, is the least expensive kind of wall.
For those desiring a better-insulated house, the wall construction described on page 79 may be used, with the same front construction called for in the plan, or the curtains may be replaced by sliding glass windows or other solid material. Construct the windows so they may be opened on good days, and provide intakes under the windows (page 80). Operate the out-takes at the ceiling as described for the 20 by 20.

Four mash feeders, each 12 or 13 feet long, are needed on each floor, together with watering equipment. Neither is included in this plan.

The roosts are portable and rest on the droppings boards. Both are constructed in sections. If desired, the droppings boards may be removed and the perches lowered somewhat
and suspended by chains or wires over a space on the floor 6½ feet wide and as long as the perches. A plank on edge will

confine the droppings to this space. No. 14, 15, or 16 wire netting may be used to cover the space.
HOUSING THE LAYING AND BREEDING STOCK

Fig. 31—30' x 50' laying house. Second-floor plan.

The first-floor plan provides for driving through on the inside from end to end.
CONSTRUCTING A LAYING HOUSE

The panel above the perches on the first floor should be fastened with screws. According to the location of the house, this panel in some instances may be placed flat against the joists instead of sloping as shown in Fig. 30, first floor. It is suggested that it be constructed as indicated with the idea of changing it later if it seems desirable.

4. Constructing a laying house

A. Lay out the foundation. Locate a corner on the highest point of the ground on which the proposed building is to stand, and about this corner drive three stakes, as a–b–c in diagram, Fig. 36, approximately 3 feet apart.

Guided by a spirit level, nail boards on these stakes as shown, with the upper edge just 6 inches above the ground at the corner (D). With the steel square as a guide, lay a line from (F) to (E) which will be the direction of the desired frontage, and another line (G–H) which will represent one side. Measure off the desired length and width of the house on these lines, and drive stakes about the corners. By means of the spirit level and straight edge, determine the level at E–I–H–J

Fig. 32—A Cornell 30'-wide house constructed 150' long, with a storage room at each end. Total length, 174'. Capacity, 3000 birds.

1 In the poultry enterprise the costs for buildings constitute a large percentage of the total poultry inventory. It is frequently desirable to remodel a shed, barn, or other building or a poultry house with too high a roof, which gives considerable trouble from dampness on the walls or in the litter, or which is otherwise unsatisfactory.
Fig. 33—A two-story house with the flue type ventilation shown in Fig. 54.

Fig. 34—Two methods of housing pullets and layers which are confined until late summer.

Upper buildings hold 400 birds each, which are easily serviced by a truck passing along the road to the right. The lower method shows a barn remodeled for poultry, which is housed on two floors. An incubator cellar is in the basement. Both methods make prominent use of the open front.
and nail boards to the posts at this level. In the same manner, find points $K-L$ on the other corner. Lines may now be stretched between these points. As an aid, when the points are far apart, stakes may be driven in at intervals and boards nailed on at the correct level, as at $M-N$.

The 6-8-10 rule will assist in checking the square corners. Measure 6 feet in one direction and 8 in the other. If the two
points thus determined are 10 feet apart, the angle formed is a right angle (Fig. 36).

B. Construct the foundation. (Fig. 37, A, B, C, D.) When digging the foundation trenches, dig below the frost line. This may be 15 or 18 inches in light soil, or 2½ to 3 feet in heavy soil. The width of the trench should be about 15 inches. A drain tile may be placed in the bottom of the trench and arranged to carry water out at the lowest level. Fill with cobblestones or cinders to within 6 or 8 inches of the surface. Tamp, if cinders are used. On this material place the forms for the concrete, making sure that the top of the form is level and coincides with the lines as previously laid out. These forms should be 6 inches apart, inside measurement. Fasten the forms at intervals to keep them from spreading after the concrete is poured. Nail cleats across the corners to prevent bulging.

Fill the forms with concrete. While the concrete is still soft, place ½-inch by 8-inch bolts every 5 feet, with the heads down and extending about 3 inches above the concrete. These are to hold the sills in place. After two or three days, remove the forms and place on the foundation wall a 2" by 4" sill with

1 See Chapter IV, "Concrete Foundations," for kinds and amounts of material to use and method of estimating.
holes bored in it to take the bolts. The outer edge of the sill should be flush with the corresponding edge of the wall. Fasten the sills down firmly with a washer and nut.

C. Build a floor. A concrete floor may be laid after the siding and roof are on, or before the framework is erected. Six to 8 inches of gravel or cinders should be placed below the floor and thoroughly tamped. A 2-inch layer of concrete should next be added and the upper surface troweled to make smooth. (If there is danger of water rising through the coarse fill and the concrete to the surface of the floor, a layer of tar building paper or thin layer of coal tar, applied hot, may be laid or spread over the coarse fill before the cement floor is added.)

5. Installing poultry house fixtures

A. Perches. The perches are usually placed at the rear of the house, parallel or perpendicular to the rear wall (Figs. 26 and 31). This permits a maximum amount of light on the floor beneath them when droppings boards are used. They are out of the way, in a protected position, and are in the best place to take advantage of the roof in the construction of the roosting closet.

(1) Distance and space required (Figs. 26 and 31). Perches should be on the same level, or nearly so, and at least 8 inches above the droppings board. The rear or end perch should be 9 inches on centers from the wall and the remaining perches 14 inches apart, for birds of the Mediterranean varieties. Birds of the Leghorn type require 6 or 7 inches of perch room; the heavier varieties need 8 to 12 inches.

(2) Material and construction. For long perches, 2"-by 3" or 2" by 4" material may be used, set edgewise and with upper corners rounded. For short perches use 2" by 2" pieces. Poles are sometimes used. They should be straight, stout, rounded, and about 2 or 3 inches in diameter.

To keep the birds from the droppings, No. 15 or 16 gauge 1½-inch mesh wire may be fastened beneath the perches.
Fig. 37—(Legend on opposite page.)
Fig. 37—Constructing a Laying House.

A, note guide timbers and trench. First operation is preparing for the foundation. B, Trench partly filled with stones which act as the base for the wall. Part of the forms in place. C, A concrete mixing platform. Conveniently located for rapid placing of the concrete after being mixed. Water, sand, cement, and aggregate near by. D, A piece of a 2×4 may be used to determine the height the bolts should extend above the wall. Anchoring bolt placed head down while cement is soft. E, Sills bolted to the wall and placed on the outer edge of the wall. Corner post erected. A second 2×4 will be added, resulting in a 4×4 for the corner post. F, Framing nearly completed. G, Note front plate on edge and stud cut to fit. Rafter is notched to rest squarely on the stud and plate. H, Rafters resting on center stringer. Both rafters should project beyond the stringer, thus making stronger construction. I, Note rear plate on edge and rafter notched to rest on plate. J, The roof boards are nailed on and the ends evened later by sawing along a chalk line.

Fig. 38.

K, Roofing is laid from the rear toward the front. L, The front framework. M, A rear window opening and part of the roosting space ceiled. N, Two-ply roofing paper laid on outside of the siding; aids in keeping the house warm in winter. O and P, The completed house, front and rear.
B. Droppings boards. These should be removable and made in sections. They should extend beyond the outer perch and fit tightly against the rear and end studs. Place the boards perpendicular to the rear, thus making them easier to clean, and 2½ to 3 feet above the floor.

A droppings pit may also be used. One type is described on page 49.
C. Roosting closet. In the northern sections of the United States, a protected roosting space should be provided. To prevent the wind from sweeping along the perches, in long pens having open or curtain fronts, there should be partitions, extending from the floor to the ceiling and from the rear forward to a point about 1 foot beyond the edge of the droppings board, and not more than 20 feet apart.

Matched boards should be nailed against the rear studs from the droppings board to the rafters, and out along the rafters to a point over the outer edge of the droppings board (Figs. 27, 38, M). The rear plate, a single 2" by 4", is placed on edge. This construction gives double protection from the outside but allows complete circulation around the roosting closet, thus preventing pockets of stagnant air.

D. Nests. At least one nest to each five layers is needed during the heavy laying season.

Nests should be roomy, easily cleaned and sprayed. Nest partitions may or may not be used as desired. The birds appear to use the small nest or the long box (4' or 6' in length) equally well. Nests preferably should be slightly darkened.
Fig. 41—Metal nests with traps used in pedigree work.

Fig. 42—An open type of trap-nest, which is airy. The door is easily fastened up out of the way when not needed for trapping purposes.
They should be placed where they can be easily reached by both the hens and the operator (Figs. 26 and 31).

(1) Size (Fig. 40). For light birds, the nest should be 11 by 12 inches by at least 7 inches deep. Heavier birds require a slightly larger nest.

(2) Location. Nests may be located under the droppings board or against walls or partitions, or may be built into a nesting room.

Placing nests under the droppings platform lowers the cost of construction slightly, but interferes somewhat with the work of cleaning out litter and catching birds.

Nesting rooms may be used with large flocks. They are easily accessible for birds and attendant. Nests may be cleaned and eggs gathered from either inside or outside the egg room. The birds enter the nests from inside the nesting room. A room 10 feet by 6½ feet with five tiers of nests on each 10-foot side will service 500 birds of the lighter breeds (Fig. 44).

(3) Means of closing. It is highly desirable to keep the nest closed to prevent pullets from roosting on the edge of the nest or birds from entering it when one is trying to catch them. A sliding door may be placed on the battery ends; or, if the nests are beneath the perches, the alighting boards may be hinged to raise when necessary.

(4) Trapnests.¹ The trapnest is designed to trap or hold the bird in the nest until the attendant releases her. Usually, the bird releases the door either by her weight or by lifting the door slightly with her back as she enters, thus letting a trigger

¹ For the use of trapnest in pedigree work, see Chapter XIX.
drop away, allowing the door to fall in place or dropping part of the door itself. This prevents other birds from entering as well as herself from escaping. A daily trapnest record, if kept, shows which hen lays each egg and is of great value in pedigree breeding. The operator can keep well informed as to the weight of his birds through constantly handling them.

A trapnest should embody certain essentials if it is to prove successful.

- The nest should be:
  (a) Efficient, that is, it should prevent certain birds from acquiring the trick of slipping in and out without being trapped.
  (b) Quick and convenient to operate.
  (c) Economical to construct or buy.
  (d) Provide sufficient ventilation and light. An abundance of air lessens the danger of injuring valuable birds during warm weather.
  (e) Easy to keep clean and sanitary.
  (f) Proof against injury to the bird.
E. Broody coop. Usually it is well to provide each pen with one broody coop, as it is needed to break up broody hens (see page 499), to hold surplus stock when culling, or to hold injured or sick birds until the attendant can care for them. The coop should be of wire or slats with a bottom of 1-inch mesh wire or slats. A platform beneath the bottom, to catch the droppings, is desirable.

In a small house, a coop may be placed at one end of the roosting closet. This is an inexpensive arrangement and af-

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**Fig. 45—Cornell Grain and Mash Feeder.**

When both are hopper fed the lower trough holds grain. To feed grain, the trough is lowered to the position shown by releasing the knobs at both ends of the feeder.
fords an out-of-the-way place for the coop; but it takes up roosting space.

As most broodiness occurs during the warmer part of the year, light, airy quarters are desirable. A good location for the coop is over the nest batteries against the wall (Fig. 40).

![Coop with chickens](image)

**Fig. 46**—A two-trough feeder with reel to prevent birds from standing on the side. It may be used as a single trough feeder by removing the lower trough.

Coops may be suspended with chains. Outdoor coops or pens are frequently used, but should be located where the least amount of walking is required.

![Bins with chickens](image)

**Fig. 47**—Bins for storing mash and grain in the 20' × 20' house when small feeders are used.

The feed is removed with a pail. The hinged front allows one to reach bottom easily. The door in the center is used when cleaning the inside of the bin.
F. Feed hoppers. The ideal dry mash hopper is one combining four points in addition to the general essentials for all fixtures, mentioned on page 92.

It should:

1. Hold several days' supply.
2. Provide a constantly available supply.
3. Prevent waste.
4. Be sanitary.

The hopper combining all these qualities satisfactorily has not yet been designed.

Large reservoir-type hoppers have been in use a great many years and are designed to hold several bushels of mash. The birds feed from the bottom, and, as they eat the mash away, other mash drops in place. These large hoppers are being used less and less, owing to the tendency of the mash to clog or to drop down too plentifully and be wasted.
Open-trough feeders are coming more and more into general use and are quite satisfactory, since the mash is easily obtained by the birds and is difficult to waste. Such feeders increase mash consumption, insure a constant supply of mash, and do not waste when filled properly. They should be filled to within 2 or 3 inches of the top (Figs. 45-46).

Small feeders, when accompanied by a large storage bin, come near reaching the ideal.

At least one foot of feeding space is required for each five hens.

Grit and shell hoppers. Receptacles must be provided for grit and shell. For small flocks, these may be small hoppers hung on nails against the wall or posts, or an end partitioned off in the hopper or feeder. For large flocks three or four such hoppers should be provided in each pen.

The space between the studding can be used most effectively and economically by boarding from stud to stud to form the front and bottom of a hopper. The bottom should be removable.

G. Storage bins. These bins may be in pairs, one for mash and one for grain. The storage bin should hold feed enough to last one to four weeks. A bin of this capacity makes but little more labor than the large reservoir type of hopper, and is more satisfactory.

Heavy barrels and ash cans with covers serve the purpose very satisfactorily and in many cases at less expense if kept where the birds cannot get on them or the weather spoil the feed (Fig. 49).

H. Water stands and receptacles. The aim should be to provide sufficient water and to keep it reasonably clean and
cool in summer and clean and unfrozen in winter. Ordinary 10- or 12-quart pails present a small surface, are deep, and keep the water cooler in summer and warmer in winter than a shallow pan. At least one pail to each fifty hens should be provided.

Long metal troughs are commonly used. A trough 4 feet by 7 inches by 7 inches holds enough water for 100 birds. To prevent the water from dropping into the litter provide a stand with wire top and shelf beneath to catch the water or a container of larger diameter than the water receptacle (Fig. 51).

To prevent the drip from getting into the litter the water receptacle is placed over a tub larger in diameter, which catches any drip from the bird's beak while drinking. Another method consists of placing the water dish on an enclosed frame with wire top.

I. Dust wallows. Birds enjoy the dust bath. It affords some exercise and assists in freeing the fowls of lice. It is probable, however, that both enjoyment and exercise may be obtained in other ways; and it is a fact that the dust wallow, whether inside or just outside the house, increases the amount of dust in the house and may be detrimental to both the attendant and the fowls, unless the dust is damp. A clean sand wallow is preferable if one is used.
J. Track and car. In a long house, a track and car facilitate cleaning, feeding, watering, and gathering of eggs. They add to the expense, which is made up, however, in the saving of labor. A barn door track and rollers, and a frame of strap iron supporting a box or car which can be turned over and dumped, will be found serviceable. Instead of a car, long wire hooks may be suspended from the bar on which the rollers are fastened. Pails, baskets, etc., may be swung on these hooks, and feed or water carried in this way.

K. Caution against expensive appliances. There are on the market a great many utensils and fixtures. Some of these have considerable value, and some are impracticable or too expensive. In most cases, fixtures may be constructed at the plant at much less cost. Care must be taken not to add to the investment more than is necessary for conducting a profitable business. The fixtures should not be elaborate and should be designed to save labor and to be sanitary and serviceable.

L. Hen batteries. The individual hen battery has been in use for several years. Each hen is kept in an individual cage or compartment about 12 inches by 18 inches by 17 inches high. The cages are built in batteries 18 to 24 cages long and 3 to 4 cages high. There is still a question whether the advantages can overcome the disadvantages and thus bring the batteries into more permanent use. They appear best adapted to restricted communities, such as those in or near cities where land is high in price and select retail trade possible. Laying battery rooms may be constructed in barns, stables, or other out-
buildings or in any unused rooms. The necessity for artificial heat and forced ventilation, together with better nutritional information, makes the venture more nearly possible in such rooms than the usual floor method might be. If battery rearing is followed, less land is required than if rearing on range.

The need for nests, feed hoppers, droppings boards, and litter is eliminated. The vice of cannibalism among birds is not a problem. Egg records can easily be kept on individuals. Thus the laying batteries do have value in providing the opportunity to learn the quality of birds individually and to do early culling. It is probable, however, that the skill of the poultryman in observation and in physical examination of the birds will accomplish culling in a floor flock at less cost.

Cannibalism in a floor flock is much less of a problem than it was a few years ago (Chapter XII).

That the use of laying batteries has its unfavorable side is well known. Overhead costs involved in more expensive buildings and in the batteries place a greater financial burden on the business. The depreciation and upkeep costs on certain makes of batteries are high. Special ventilation in rooms accommodating several hundred birds is required to change the air several times an hour. The rooms must be warmed in cold weather to 40 to 45 degrees F. and be insulated to conserve heat in winter and keep the birds cool in summer. The usual method is to move the air with electrically operated fans located in walls or shafts and construct double, insulated walls and air intakes. In such construction the air may become too dry for poultry. A relative humidity of 50 to 55 per cent should be maintained.

The following remarks and summary were made after a careful study.¹

High mortality and removal of many birds because of poor laying have an important bearing on the successful use of laying batteries.

¹ Cornell Poultry Farm Service letter by L. M. Hurd. The authors have changed the original wording slightly.
Every empty cage represents a loss of eggs and increased overhead expense unless a new bird can be found immediately to occupy it. Instead of eggs per hen, it is a matter of eggs per cage. At the Ohio Experiment Station, where records were kept, it was found that the eggs produced per cage yearly, when replacements were made promptly, were 206. The production per cage without replacements was 141. The total replacements for the year amounted to 63 per cent, of which 42 per cent were culls and 21 per cent were dead birds. It is obvious from the above figures that the successful operation of laying batteries necessitates a continuous supply of pullets for prompt replacements. This problem is one which every poultry keeper contemplating the installation of batteries on a large scale should consider seriously.

**Good Management Necessary**

It was first supposed that batteries would make unnecessary much of the care and skill in feeding and management required for layers in floor pens. Experience has shown that layers in batteries require even greater skill in feeding than floor layers. Good management requires that the birds be given frequent attention and individual observation. This may seem a simple, easy procedure, but in actual practice few will be able to meet the requirements of time, persistence, and patience needed. An indifferent and careless person will have less success with cages than with floor management of layers.

The reduction in mortality has been featured by some battery enthusiasts, but this has not been borne out in every instance by the evidence available. In most cases it is a vain hope to expect a significant reduction in mortality by the installation of this equipment. The mortality problem is more than a matter of change of environment and sanitation. It must be attacked from the standpoint of breeding, brooding, rearing, feeding, and management.

We may sum up the present status of laying batteries as follows:

1. Equal or better egg production with equal or less mortality.
2. Feed consumption about the same, or somewhat less, than for layers in floor pens. Rations and formulas are essentially the same.
3. Both Leghorns and heavier breeds respond favorably in laying batteries.
4. Nutrition requirements much the same as for those in floor pens, except for vitamin D and fiber, which are generally greater.
5. Labor requirements for feeding and watering layers in batteries considerably greater than for floor pens equipped with labor-saving equipment.
6. About one-third less floor space required for layers in batteries.
(7) Greater skill and care in feeding required for layers in batteries.

(8) The battery operator to be successful must be more alert as a caretaker and as a business man than his competitor who manages hens under floor conditions.

COMMUNITY SURVEY

1. Ask a carpenter to show you how to mark out rafters with a steel square. Record each detail.

2. What determines the time of year, among local poultrymen, when pullets are placed in winter quarters?

3. Ask several poultrymen what cleaning or overhauling they give the buildings before pullets are placed in winter quarters.

4. When a poultry house is being constructed in your locality visit it each day, if possible, and note the order in which the carpenter proceeds.
   (a) When are the sills put in place?
   (b) When are the corner posts and studs erected?
   (c) When is the floor laid?
   (d) When is the roof constructed?
   (e) When is the siding put on?
   (f) At what point in the construction are the windows, ventilators, and other openings finished?

5. Visit several poultry houses and obtain the following information in regard to each:

   (a) Perches:
      Amount of perch space per hen.
      Size of perches.
      How are the perches supported?

   (b) Droppings boards:
      Are droppings boards used? Why or why not?
      Is there a roosting closet? Is the construction at the rear plate such as will permit circulation completely around the roosting closet?

   (c) Nests:
      Are the nests provided with partitions?
      What is the ratio of nests to hens?
      Does this seem sufficient?
      Where are the nests placed?
      Are trapnests used? What type? Are they satisfactory?
(d) Broody coop:
Is a broody coop used, and where placed?
Is it sufficiently large to care for the broody birds?

(e) Feed hoppers:
What type is used? Where placed? What size is it, and how many hens does it accommodate?
Does the operator prefer an open feeder or one of the large so-called self-feeding types, and why?
Does it waste feed or clog?

(f) Water receptacles:
What type of watering equipment is used?
Are any of the buildings supplied with running water? If so, sketch the system, if satisfactory.

(g) Dust wallow:
How many poultry houses are equipped with a dust wallow?
What material is used for a wallow?

(h) Track and car:
In what part of the house is the track hung?
What is the chief use of the car?
Does it pay interest on the investment?

6. Visit a laying battery plant if possible. How many more birds can the poultryman keep by the battery method? Are there any empty cages? Is the house more expensive than the usual laying house? How much more per bird? Is more or less labor required for a similar number of birds?

REFERENCES

Write your own state college for bulletins and plans on housing poultry recommended for your state.

CHAPTER IV

PRINCIPLES OF HOUSING POULTRY

General information:
1. Why we house poultry. 11. The comparative merits of types of roofs for laying houses.
2. The hen home. 12. Roofing material.
3. The necessity for pure air. 13. Foundation.
5. Air movement. 15. Front.
7. Moisture.
8. Direct sunshine.

1. Why we house poultry
We often hear it said that we cannot improve on nature. From nature's standpoint we probably cannot; but from the human business point of view and for the purpose we have in mind, we often can improve on nature.

For example, nature's object, with poultry, is to cause the hen to reproduce herself and maintain the race to which she belongs. In accomplishing this, the hen is required, under natural conditions, to live an exceptionally healthy and vigorous life, as only by so doing can she produce offspring possessed of the qualities necessary for existence in the wild state.

The hen in her natural or wild state is required to lay but very few eggs, and these, only in the spring of the year. She maintains her vigor by roosting where there is an abundance of pure air, and where conditions are such that only the birds endowed with the greatest amount of vitality survive. Although the bird that survives is very high in vigor, she loses decidedly
in egg production by being exposed to severe climatic conditions and because there is no need to produce eggs and attempt to rear chicks during seasons of natural food shortage and severe weather.

The modern business hen is required to lay many eggs, and the effort to make her do so frequently results in a weakened and pampered hen, from nature's standpoint. The natural vigor of the hen is likely to be sacrificed somewhat, in the effort to secure heavier production, unless special precautions are taken to safeguard her health by methods of feeding and management. Other things being equal, the higher-producing bird is by nature the more vigorous one, and is the better layer and the better breeder.

It is necessary to provide a comfortable poultry house in order to secure a satisfactory yearly distribution of egg production. The real problem in poultry housing is to determine how to balance the conditions that make for nature's method of maintaining health and vigor, and the conditions that produce man's commercially profitable hen.

2. The hen home

The best egg production is secured from birds that are comfortable and happy. The meaning of comfort to the hen carries with it all the factors which make the ideal environment. Environment includes all phases of management that have to do with the care of the hen.

To a large extent, the comfort of the hen is directly dependent upon the kind of house she occupies. A major part of her time is spent there and it is there that she receives most care. The word "home" usually suggests "comfort." The hen home should be a place of comfort, safety, contentment, cheerfulness, and happiness. Given these, the hen responds. The man who provides them shows that he recognizes the fundamentals of egg production. Egg production is based on a contented mind, and not merely on a satisfied stomach.

We should think, then, in terms of a "hen home," rather
TEMPERATURE

than a "hen house." There is too often a vast difference between the two. The home we construct is to be rented to the birds. Our rent must be paid in eggs if it is paid at all, and it will bring revenue according to the way it provides comfort for the birds. The hen's attitude toward her surroundings will go far in egg production. The hen does not "will" to lay, nor a seed to germinate, but, if given the proper environment, both will respond.

3. The necessity for pure air

Perhaps the most important factor in securing comfort for the birds is an ample supply of pure air. When the amount of pure air is limited, a loss in vigor results. Protection from wind and storm is necessary, but a constant supply of pure air is absolutely essential for egg production. The hen breathes very rapidly, thus using much more air in proportion to her size than other domestic animals. King gives the following figures on the amount of air per 1000 pounds live weight each 24 hours.

Cow .................................. 2804 cubic feet
Horse ................................. 3401 cubic feet
Hen ................................. 8278 cubic feet

As a disease preventive, a health promoter, and a factor in good production, pure air stands high in importance. Nothing used by poultrymen in the attempt to secure good production is cheaper.

4. Temperature

Birds should be kept comfortable in the sense that they are protected from extreme cold and wind in winter and extreme
heat in summer. Either extreme tends to retard production. While birds undoubtedly would be benefited if the temperature were not allowed to go below zero, or even below freezing, provided the supply of pure air were not diminished, there are no figures available, in connection with any present methods of applying heat, that show a profitable increased production as a direct result.

The most practical method yet devised to keep the temperature from falling much below freezing and the supply of fresh air in no sense reduced is to construct insulated walls. Proper house insulation and ventilation also largely reduce the difficulty from summer heat.

Involving somewhat greater observation and skill by the operator but less costly is the practice of using a small stove, such as a brooder or chunk wood stove, while a severe cold period is under way.

Experience is needed to determine when to start and stop the stove, how to operate it while maintaining the normal intake of fresh air, and not to raise the temperature much above 35 to 40 degrees F. Its proper use for a few days at such times may assist the birds to adjust themselves more easily to severe temperature changes.

It has been found that temperatures down to 10 degrees F. (above zero) in the Cornell 20' by 20' poultry house do not affect production, and that temperatures lower than 10 degrees F. (above zero) cause comb frosting and may temporarily affect the production of the flock. However, no serious ill effects from low temperatures were experienced in the experimental poultry houses at Cornell over a period of seven years when provision was made for the free egress of the warm moist air given off by the birds.

5. Air movement

Air flow, or movement of air through the pen, is a most important factor. It is caused by the heat given off by the birds, and is affected by the wind.
The warmth inside the house causes the air to expand and become lighter. This lighter air is urged upward by the incoming air, which is colder and which pushes underneath. Thus an air movement is set up.

During the day when the birds are on the floor, the heat from their bodies is fairly well distributed over the area. The air that comes in through the intakes passes down to the floor and up to the ceiling as it becomes warmed. When the birds are on the perches, the air that enters falls to the floor and moves across the floor to the perches, where the air near the birds' bodies is lighter. It then passes to the ceiling.

Further movements of the air depend on the type of wall construction and the method of ventilation employed.

Along with the vertical air movement just described there is another important movement in open or curtained front pens. This is a horizontal movement due to the wind entering the house, going in at one end and out the other, depending upon the direction of the wind. The air makes a long sweep, or swing, to the back of the house, and from one end of the pen to the other. If the pens are not too long, the swing will be of moderate intensity; but, if long houses are not partitioned, the velocity of this air movement will become so high as to be objectionable. (See "Partitions," page 84.)

6. Siding and walls

A tightly constructed wall is desirable in the northern section of this country to protect from strong prevailing winds. Whether the wall should be of the simple or low-insulation type or well insulated will depend on the interior house condition desired and the cost involved. The type of air movement or ventilation is also dependent upon the wall construction.

Walls of low insulation are in most common use today. They cost less but give a colder house and one more quickly susceptible to outside temperature changes. In such a house, air should move through steadily and without coming to rest.
against walls or ceiling long enough to permit cooling the air and condensing the moisture. The air outlet should open at the ceiling, if flat, or at the highest point in the house, if of the shed type (Figs. 28 and 54).

A layer of matched boards of good-quality North Carolina pine, fir, hemlock, or spruce, well laid and covered on the outside with a layer of two-ply roofing paper, is a satisfactory low-insulation wall. The paper should not be placed on the inside, exposed to the birds, as it may be torn.

Insulated walls are increasing in popularity where a more uniform and warmer interior is desired. They are more expensive. In such houses the air movement may be less rapid and the change of air slower. The air outlet may be through restricted front ceiling or rafter openings or through flues opening within 18 inches of the floor (Figs. 55 and 61).

Fowls will destroy certain types of insulation board. When used on the inside, they may be protected by painting with a
mixture of cement and water for 2½ feet above the floor or by covering the same area with metal or fine mesh wire.

*For warm climates.* In many southern states where the temperature seldom goes to zero, a single thickness of cove or novelty siding is all that is required.

![Diagram of floor outtake-flue system](image-url)

Fig. 55—The floor outtake-flue system of ventilation for warm or well-insulated poultry houses. A 4" wall filled with wood shavings gives good insulation. Add 1 lb. lime to each 100 lb. shavings to repel rats.

In both ceiling or floor outtake flues, 1 square foot of opening is required for each 300 sq. ft. of floor space. From Cornell Ext. Bul. 315.

Siding should be thoroughly dry when it is put on; otherwise cracks are likely to open up between the boards when wind and sun have dried them out.

7. Moisture

The amount of moisture in the pen depends on the ventilation and the management of the pen. Excessive moisture may be a warning that the ventilation is inadequate. A large amount of moisture is expelled from a hen's body through voidings and breath, because of her large consumption of water and her rapid breathing. From these two sources, assuming
the water receptacles are properly protected, the air in the house becomes quickly saturated, if improperly ventilated.

The outside of the flues, whether one flue or several, is of two layers of boards with paper between. The common side between flues is of one layer of boards. Note construction of the second (left) flue against the first.

The ventilator head consists of the ceiling and the roof. The ceiling may be insulated with several inches of shavings before the gable roof is completed. The bottom of the opening (A) should be at least two feet above the ridge of the roof. From Cornell Exp. Bul. 315.

Fig. 56—Constructing the flue and window intake.

The condition of the litter and the temperature of the air in the house determine the rate of evaporation of moisture. The ventilation system is called upon to remove it.
8. Direct sunshine

The discovery of the importance of ultra-violet rays in the sunlight has given added weight to the sunshine factor in house construction. Sunlight contains something still undiscovered by man that is important in affecting hatchability. Unfiltered direct sunshine is an essential in modern poultry-house construction. Space in the front and ends should be so placed and used as to permit sunlight to shine upon the fowls to give them vigor and to quicken their vital life processes. These sunshine openings should be provided with adjustable windows of glass and good glass substitute or cloth for use during short periods of unfavorable wind or weather (Fig. 29). The greatest possible opportunity should be provided for breeders to go outside.

*Sunshine and shade porches* of concrete or wire 2 feet or more wide are being used by some breeders. These may be placed either in the front or end for sunshine and at the rear for shade. They may even be suspended for second-story use. They provide additional floor space and access to outside air and sunshine for birds kept under confinement.

*Exposure.* East or southeast, south, southwest, and west are the exposures in their usual order of preference. If winds and storms are common from the south, the house should face east or in one of the other directions where the least disturbance to the air movement within the house may be expected.

9. Size of flock

Small flocks usually increase the cost of labor, equipment, and buildings. *Larger flocks are more common on commercial*
plants. Units of 100 to 500 hens per flock are desirable, although larger units may be successfully handled.

Larger flocks may be housed in single-story buildings, but multiple-story houses provide lower cost per bird and frequently more favorable working conditions.

Since more laying flocks are being kept in confinement through the laying year, the colony system is being used but little, except on some poultry-breeding farms. Under the colony system the flocks are usually smaller and more widely scattered.

A. Floor space. The smaller the flock, the more floor space is required per hen. Ten hens might need 6 to 8 square feet per bird. 125 Leghorn hens may be kept profitably with an allowance of 3.2 square feet per hen; and for larger flocks, 3 square feet. For heavier varieties, 4 square feet per bird is the usual figure. It is always well not to overcrowd.

B. Air space. Experiments at the Wye (England) Agricultural College indicate that about 40 cubic feet of air is necessary per hen per hour. These experiments showed that a pen could be constructed in which the air would change four times per hour, and led to the conclusion that 10 cubic feet of air space per pound live weight was sufficient.

It is difficult to construct a large house and have much less than 15 to 20 cubic feet of air space per hen in the pen, unless the floor space per bird is greatly reduced, or the ceiling is so low that the attendant cannot work to advantage. Either fault would show disappointing results. We may conclude, therefore, that the air space will be sufficient if the pen is made as low as is commensurate with the height of the person who is to do the interior work.

C. Shape. A study of Fig. 58 will show that the distance around a given area is less in a round poultry house than in one of any other shape. The expense of construction makes the round or octagonal house impracticable. Of the other types, the more nearly square the house is, the less material is required to construct it and the cheaper will be the cost per hen.
D. Width. The deep house has certain advantages over the narrow one. Modern ventilation, insulation, and feeding make the house that is wider than 15 or 20 feet practical, where formerly it was seldom used.

Width is governed by the purpose for which the house is to be used, whether new construction is necessary or existing buildings are to be made over, the cost, the possible future use, and the location.

A breeding farm doing individual pedigree or progeny testing work may find the longer, relatively narrow house more easily made into pens. Pens can be constructed in larger houses, however. Laying units of 100 to 125 are economically housed in a 20 by 20 pen. Five hundred layers do well in a 20-foot house of the proper length or in a 30-foot house 50 to 65 feet long, depending on the variety.
Lumber may cut with less waste for one width of house than for another. Desirable widths are 12, 16, 20, 24, 30, and 36 feet and wider.

Buildings 36 to 40 feet wide, when properly ventilated and lighted, are satisfactory and may be more readily used for other kinds of stock at some future time, if desired.

The wide house is usually cheaper.

The space available may determine the width and length.

E. Length. It is usually better to determine the width first, considering the number of birds to be housed, and make the house as long as necessary and practicable.

F. Height. While the pen should be low, the house may be several stories high when large numbers of birds are kept. The heavier framing cost required is offset by the saving in roof and foundation. The labor involved in feeding and watering must be considered. Constructing on uneven land may permit unloading feed on the second or third floor or an elevator may service all floors.

10. Partitions

The main uses of partitions in laying houses are to prevent drafts, or a sweep of wind from one end of the house to the other, and to keep flocks segregated. Every 20 or 30 feet in a long curtain-front house 20 feet wide, a partition from the floor to the ceiling, and from the back two-thirds or three-fourths of the distance toward the front, is desirable.

Well-insulated houses with closed fronts and with rafter or flue ventilation will need partitions only for keeping flocks of any certain size separate by pens.

Partitions should be solid for at least 2½ feet above the floor, and a less drafty construction results when they are built solid to the roof. Matched boards are usually preferred. Wall board or similar material may be utilized. Insulation boards of coarse construction must be protected from the birds by painting or covering with mosquito netting wherever the birds
can reach them. Wire partitions may be used where draft prevention is unnecessary.

11. The comparative merits of types of roofs for laying houses

A. Monitor. The full monitor dates back to the time when a tight house, with sunlight reaching all parts, was thought to be ideal. Windows were placed on each side of the monitor at the peak, and also along the side walls. It is not a practical laying house roof. There may be too much air space. It is cool in summer but much too cold and uncomfortable in winter. Such a building may be remodeled by the use of a straw loft or by ceiling across at the plates, using the rafter or flue outtake, or by ceiling from rafter to rafter above the plates, using the flue outtake.

B. Semi-monitor. This should not be used on narrow houses in cold climates. For single-story buildings over 25 feet deep, it is sometimes satisfactory, particularly when double-boarded. It is difficult to ventilate during cold weather. The warm air tends to collect in the peak, and when the peak is opened a draft may be caused on the floor, which is serious during the day. It is expensive to construct.

C. A-shape. This is usually built with sides from 1½ to 2 feet high. It covers a given floor space at reasonable expense.

![Fig. 59—Types of roofs.](image-url)
Headroom is lacking and light is unevenly distributed over the floor. One house seldom accommodates over 150 birds.

D. Gable, or even span. A house with this roof has too much air space for comfort. Often it can be improved by ceiling and installing either the rafter or flue ventilation or a straw loft. Either results in a cooler house in summer and a better-protected pen in winter.

To construct a straw loft, lay poles from plate to plate or across the building, about 6½ or 7 feet above the floor, and place boards on the poles, 1 or 2 inches apart. Two feet of straw should be placed on the boards, pressed firmly around the sides, and the rest allowed to be rather loose. A window or opening is cut in each gable, and air circulates above the straw. The warm, moist air from the room below works slowly through the straw, which absorbs the moisture, while the circulation above dries the straw and removes the foul air. This method of ventilation provides an abundance of constantly changing air.

Old sheds and buildings may be remodeled into comfortable laying houses by constructing a straw loft (Fig. 60).

Gable roof construction is expensive, and front eaves troughs are required to avoid muddy conditions on certain types of soil. The straw is dusty and a possible breeding place for vermin.

E. Combination. Next to the shed roof, the combination is perhaps most widely used, with one-third of the roof toward
the front and two-thirds toward the rear. On a deep house it cuts down the air space by eliminating the high peak in front, but it is likely to cause trouble by the banking of air at the peak and the condensation of moisture there. Ventilators at the peak, or boarding across the peak from the front plate to a point on the rear rafters 5 feet above the floor, may eliminate the trouble.

F. Shed. This type is most widely used.

A very low pitch may be used, a rise of 1 foot in a run of 5 or 7 feet being sufficient. With proper front ventilation, this is just enough slope to give a circulation which forces the warm air up along the roof and out. This movement is not rapid enough to cause a draft, but helps to keep the house dry and in better condition for the birds. In the summer, front and rear ventilators give more rapid movement and keep the house cooler. Having all the roof slope to the rear provides a cooler house in summer, since the roof does not receive the direct rays of the sun. The shed roof is simple to construct, and the cost of construction is low.

G. Flat. The flat roof is new in poultry-house construction. It is likely to gain popularity, as it reduces the air space and siding required. It is well adapted to the rafter, flue, or slot method of ventilation.

12. Roofing material

 Prepared roofing is usually lower in price, moisture-proof, and easily and quickly laid and repaired. It should be laid on a day when the sun will soften the tar in the paper and thus cause it to lie flat and bend without cracking.

Shingles require a steeper roof than paper and should not be used for a shed roof.

Metal roofing may be used above roof insulation or when an air space is between the roof and the room below. (See Fig. 30.)

The flat roof calls for a new type of roofing. The “built-up” roof is described in Bulletin 94, Ohio State University, and
Bulletin 284, University of Connecticut. It consists of alternate layers of roofing paper and hot asphalt on wood sheathing, the first layer of paper being nailed down, with large tin caps, and each layer thereafter being spread on hot asphalt. Just enough asphalt is applied with a long-handled brush to be covered by the width of the paper, and it should be spread only as fast as it can be covered by the roofing.

13. Foundation

The foundation walls should be:

1. Deep enough to prevent heaving by frost.
2. High enough to keep surface water out.
3. Heavy enough to support the building.
4. Economical.
5. Rat-proof.

A. Concrete. Concrete has no particular disadvantage except possibly the labor cost. A "1-2½-5" mixture is desirable. This means 1 part of cement, 2½ parts of sand, and 5 parts of

1 See Chapter III for details of constructing a concrete foundation.
grout or coarse gravel. In figuring the amount of these ingredients, the following example will prove helpful.

![Image of a type of front common on the Pacific Coast. Note the rolled curtain which may be dropped, if desired.]

**Example**

Given a wall $10 \times 3 \times 1$ foot.

Total space to be filled, 30 cubic feet, = the amount of coarse gravel or grout required.

Mixture used $1-2\frac{1}{2}-5$

\[
\frac{2\frac{1}{2}}{5} \text{ or } \frac{1}{3} \text{ of } 30 \text{ cubic feet } = 15 \text{ cubic feet sand required.}
\]

\[
\frac{1}{5} \text{ of } 30 \text{ cubic feet } = 6 \text{ cubic feet cement required.}
\]

A bag of cement holds about 1 cubic foot.

**B. Stone.** Stone may be used as a base for the concrete wall (Fig. 27).

**C. Posts.** Wood posts are cheap in certain cases. They may settle, do not keep out rats, and are less durable. When it is desired to raise the house considerably, posts may be used. Although they have the disadvantages mentioned, they give a cheaper foundation than certain other materials. It is desirable to set posts in a concrete base to prevent settling and decay.

Cinder blocks $8'' \times 8'' \times 16''$ may be used as posts.
14. Floor

A desirable floor should be:

1. Moisture-proof.
2. Rat-proof.
3. Durable.
4. Economical.
5. Smooth for cleaning.
7. Comfortable for the birds.

A. Earth. It is impossible to secure all these essentials with an earth floor. Except in gravelly soils, capillary moisture may cause trouble. An earth floor is difficult to disinfect properly, and does not prevent rats from getting into the house. The top 4 to 6 inches of soil should be renewed each year, and this makes a high labor cost. The interior of the house is much more dusty than with other types of floors. There are times, however, when the type of soil, the location of the house, and the low first cost make the earth floor desirable. The earth floor should be filled in until several inches higher than the outside, as an aid to dryness.

B. Board. Floors above the first are most often of wood. The first floor when of wood should be protected from ground to sill by planks or earth or both to prevent the wind from blowing beneath. An opening should be left on one side for air to circulate and to prevent rotting. Two layers of boards, with paper between, make a protected but more expensive floor. A board floor may not be rat-proof.

C. Concrete. The concrete floor, when properly constructed, meets all the requirements of an ideal floor. Water or disinfectant may be used freely for cleaning and will soon dry out. It is durable, rat-proof, and dry. It is preferred for the first floor.

15. Front

The front of the house may be open, or partly enclosed by glass or a good glass-substitute curtain, or a combination of these.
A. Glass front. Glass helps to light the floor on dark days and to offer some protection from storm. It is a poor screen. Through glass the interior of the house warms quickly during the day and cools readily at night. This may result in too great extremes of temperature in twenty-four hours in a house with an uninsulated wall. With good ventilation and better wall insulation, some of the objections to glass appear less important.

![Fig. 63—A poultry plant in Florida, 30 miles from Palm Beach.]

Note shed roof houses with mosquito netting fronts. This serves as protection against these pests. Note the structures for shade in the yards.

Glass is expensive to build and maintain and, unless it is cleaned frequently, the dust shuts out the light.

Another disadvantage is that ordinary window glass prevents the passage of the ultra-violet rays in the sunshine. To secure the benefits of these rays when the birds are confined, arrange the windows to open easily on sunny winter days if no curtains are used.

Some glass usually is provided. A good proportion in curtain-front houses seems to be 1 square foot of glass to each 16 or 20 square feet of floor space for conditions in the northern part of the United States. For insulated wall houses and no open space or cloth, 1 square foot of glass to each 11 to 15 square feet of floor space may be used.
B. Open front. This type of front admits a maximum of air and sunlight but allows storms to blow in. For this reason many poultrymen use cloth curtains.

C. Cloth curtains. Where correctly used, curtains give the advantages of the open front without its disadvantages. In the event of storms or winds from the front, they may be put in the openings and the birds protected, while allowing air movement through the cloth. A good grade of cheesecloth can be used. About 1 square foot of cheesecloth or light muslin to 13 square feet of floor space suits northern United States conditions. More cloth or more open front is used, depending on the climate.

Cloth frames may be 1- by 2-inch material. The frames may be hinged at the top to swing in and up, or arranged to slide down on the inside or outside between cleats. The latter is desirable, as less dust collects and the opening may be left at any size.

D. Glass substitutes. Many products of wide difference in durability and efficiency in permitting the passage of light, heat, and ultra-violet rays are for sale. The best of these can be used to advantage in the place of glass, all or in part. Air does not pass through most glass substitutes. They must be used with caution as part of a ventilation scheme.

16. Four essentials for arranging interior fixtures

The following points should be borne in mind in planning poultry-house fixtures.

A. Convenience of the caretaker and birds. It is possible to place the fixtures where they will be convenient in doing the work and at the same time be excellently located for the hens. Convenience in operation means a saving in time and more effective care: When work is convenient it is more likely to be well done.

Most hens are naturally inclined to be a trifle lazy. Although hens will roost on the topmost point in the hen house if allowed to do so, it is also a fact that many birds, if com-
COMMUNITY SURVEY

culled to make too great an effort in taking a drink of water or
eating dry mash, will put off doing so for too long a period.
Water stands and feed hoppers should not be more than 18
inches above the floor.

B. Portability. Unless the fixture is very open and will
permit practically all parts to be reached by spray materials,
ought should be removable to permit the rest to be thoroughly
cleaned.

C. Unobstructed floor space. If boxes, pails, etc., rest on
the floor, the capacity for hens is reduced. Fixtures should be
placed on low stands or racks.

D. Simplicity and economy of construction. The cost of
the fixtures is a large item of expense. The simpler ones are
less expensive and less likely to get out of order.

COMMUNITY SURVEY

1. Which type of poultry house is most popular in the community, the
open- or curtain-front, or a closed type?
2. How many houses do you know that are ventilated by the rafter
method? Wooden flue? Metal flue?
3. Sketch the air movement in each method of ventilation.
4. What types of wall construction are used?
5. What percentage of the poultry houses are troubled with dampness?
6. What is the apparent reason for dampness in these buildings?
7. How would you remodel one or more of these houses to make them
better?
8. How much floor space do local poultrymen allow for layers? For
breeders?
9. What depth of house is most popular, and why?
10. How far apart are partitions placed in a long house?
11. Is there a long house in the community which does not have
partitions?
12. How do the birds act in such a house on a windy day?
13. What type of poultry-house roof is most common in the county?
14. What reasons are given for its popularity?
15. Do the poultrymen prefer concrete or board floors, and why?
16. What concrete mixture is used for the foundation? Floor?
CHAPTER V

FEEDING THE LAYING AND BREEDING STOCK

A high degree of skill is required to secure the best results in feeding the domestic fowl. Feeding poultry differs from feeding other stock in that we must feed to suit the needs of the majority, or the average, of the flock, and not the needs of a particular individual. Hens are like machines. The feeder supplies the raw material and the hen takes it and manufactures a portion of it into eggs. The hens that receive the best selection of raw materials can manufacture most efficiently and turn out the largest quantity of high-quality product.

Hens show by their actions, their appearance, and the eggs they produce, whether or not the feed is suitable. The successful feeder must study his birds, be quick to note trouble, and cater to their appetites. No set rule can be given as to the exact amount which is best. At all times, one should endeavor to feed all the birds will eat.

With the large expansion in the size of poultry flocks and the necessity of reducing the amount of labor involved in egg production, easier short-cut methods of feeding have been evolved. These methods are becoming more popular on account of reducing to a minimum the hazard of the human factor. They rely more upon the instinct of the hen in choosing the feeds best suited to her daily needs and to the knowledge of the feeder in selecting the most perfect formulas for producing efficient results consistent with cost.

1 For summer feeding, see Chapter XXIV.
Operations:

1. Essentials in feeding.
2. The Cornell Laying Ration.
4. Feeding grain.
5. Feeding mash.
7. Feeding green feed.
8. Feeding grit, shell, salt and manganese.
10. Supplying the water.
11. Cooking feed.
12. Feeding the different breeds.
13. Feeding breeders.
14. Feeding birds under illumination.

General information:

Grain used for poultry.
Mash feeds used for poultry.
Animal feeds used for poultry.
Green feeds used for poultry.
Germinated oats.
Roots and tubers.
Miscellaneous feeds.

1. Essentials in feeding

The successful feeder, as a rule, attempts to observe the following essentials in flock feeding:

1. Feed to secure a high total food intake.
2. Provide ample water, grit, shell, and dry mash (pages 103-106).
3. Feed grain regularly and according to the plan of feeding being followed.
4. Send the birds to roost with full crops.
5. Make any change in feeding gradually, either in the ration or the method of feeding it. Efficient feeding of a flock depends upon two factors of nearly equal importance, namely, the feed and the feeder.

There is no best-ration for all conditions. There are many good rations for each special purpose.
2. The Cornell Laying Ration

The Cornell ration for laying hens, which has given excellent results for many years, is composed as follows:

<table>
<thead>
<tr>
<th>Scratch Grain</th>
<th>Mash Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 pounds cracked yellow corn</td>
<td>400 pounds yellow corn meal</td>
</tr>
<tr>
<td>1000 pounds wheat</td>
<td>400 pounds wheat bran</td>
</tr>
<tr>
<td>400 pounds flour wheat middlings</td>
<td>400 pounds flour wheat middlings</td>
</tr>
<tr>
<td>350 pounds ground heavy oats or ground barley</td>
<td>350 pounds ground heavy oats or ground barley</td>
</tr>
<tr>
<td>300 pounds meat scrap (50 to 55 per cent protein)</td>
<td>300 pounds meat scrap (50 to 55 per cent protein)</td>
</tr>
<tr>
<td>100 pounds dried skim milk or dried buttermilk</td>
<td>100 pounds dried skim milk or dried buttermilk</td>
</tr>
<tr>
<td>100 pounds limestone or oyster shell flour</td>
<td>100 pounds limestone or oyster shell flour</td>
</tr>
<tr>
<td>30 to 40 pounds fish oil</td>
<td>30 to 40 pounds fish oil</td>
</tr>
</tbody>
</table>

Many flocks of pullets prefer somewhat more wheat than corn, whereas molting hens and older birds often prefer more corn than wheat. They may be fed according to their preferences.

Whole corn may be fed instead of cracked corn. Barley and buckwheat may each be substituted for 5 to 10 per cent of the corn and wheat.

If these suggestions are followed, the grain ration for pullet layers might be:

600 or 800 pounds whole yellow corn
1000 or 800 pounds wheat
200 pounds oats
100 pounds barley
100 pounds buckwheat

A mixture of corn, wheat, and oats is most commonly used.

1 From 5 to 20 per cent of oats may be included in the grain mixture; see page 109.
2 If feeding “free choice” (page 99), a total of 2.8 per cent of oil should be added to the mash or 1 pint of 85 A.O.A.C. unit oil added to each 100 pounds of grain (page 105).
# Suggested Changes in the Cornell Laying-Mash-Mixture *

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Modified laying mash mixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. 1</td>
</tr>
<tr>
<td></td>
<td>Pounds</td>
</tr>
<tr>
<td>Yellow cornmeal</td>
<td>400</td>
</tr>
<tr>
<td>Flour wheat middlings</td>
<td>400</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>400</td>
</tr>
<tr>
<td>Ground heavy oats</td>
<td>250</td>
</tr>
<tr>
<td>Alfalfa meal, low fiber</td>
<td>100</td>
</tr>
<tr>
<td>Dried skimmilk or dried buttermilk</td>
<td></td>
</tr>
<tr>
<td>Meat scrap (50 to 55% protein)</td>
<td>350</td>
</tr>
<tr>
<td>Fish meal</td>
<td></td>
</tr>
<tr>
<td>Soybean oil meal</td>
<td></td>
</tr>
<tr>
<td>Corn gluten meal</td>
<td></td>
</tr>
<tr>
<td>Limestone or oyster-shell flour</td>
<td>40</td>
</tr>
<tr>
<td>Salt</td>
<td>10</td>
</tr>
</tbody>
</table>

* From Cornell Extension Bulletin 46.

† Because of the use of corn gluten meal in the modified laying mash mixture No. 5, it is necessary to limit the quantity of corn fed in order to maintain superior protein quality.

‡ If the limestone or oyster-shell flour and salt are not included in the ton mixture, the ground oats should be increased by 50 pounds.

The proportions of cornmeal, wheat by-products, and ground oats can be varied to some extent. Coarse ground wheat can replace at least part of the wheat by-products. Ground buckwheat can be substituted for the ground oats.

Liquid buttermilk or skim milk, when supplied at the rate of 1 gallon a day for 100 hens, may be used in place of the dried milk in the mash. When the milk is available at the rate of 10 to 12 quarts a day for 100 hens, it is necessary to use only 200 pounds of meat scrap or its equivalent in the mash mixture. If all the milk is available that the hens will drink, it may nearly or entirely replace the meat scrap and fish scrap in the ration. On the other hand, when milk, dry or liquid, is scarce, give preference to its use to breeder and chick rations.

Condensed buttermilk or skim milk can be used to advantage as a
supplement, at the rate of 2 pounds a day for 100 hens. When so used, the dried milk in the mash can be omitted.

Protein concentrates. Fish meal, soybean oilmeal, or corn gluten meal, singly or in combination, can replace one-half of the meat protein.

3. Methods of feeding

Feeding grain and mash in hoppers or troughs has much to commend it. It is made possible by the discovery of better-balanced feeding formulas. It aims to furnish the food nutrients in the most attractive form with regard to composition and mechanical conditions. It is prepared to meet the requirements of the average bird in the flock. This “self-service cafeteria” plan of feeding poultry also works best when the birds are well endowed with the “urge to lay.” The inherited urge to lay stimulates the appetite for the particular food nutrients which are required by the body to make eggs. Birds that are not well endowed with the urge to lay may be more likely to gain in weight instead of egg production under the trough method of feeding grain. This is an advantage in that the poor layers in the flock will be in excellent body condition for marketing.

The particular advantage of the trough method of feeding is the fact that all are able to eat more freely because of access to an abundant supply of food, thus meeting individual body needs well and resulting in a high food consumption.

There are three principal methods of feeding grain, i.e., (A) restricted grain feeding by hand; (B) restricted grain feeding by trough; and (C) free choice. Each when properly done shows similar results in production, body weight, and egg weight.

A. Restricted grain feeding by hand. The following plan gives good results:

First: At the first trip to the laying house in the morning, measure out grain, about 1 or 2 quarts per 100 birds, and scatter it thoroughly over the floor.

Second: Immediately after this grain feeding, see that the
METHODS OF FEEDING

grit, shell, and mash hoppers are supplied with enough to last for the day.

Third: Empty, rinse, and fill the water receptacles.

Fourth: At noon, give about 5 pounds of green feed per 100 birds, unless there is alfalfa in the mash.

Fifth: At least one hour before dusk, scatter in the litter all the grain the birds will clean up. The amount consumed will vary with the season and according to the size and laying condition of the birds, but ordinarily it will be about 6 to 10 quarts per 100 birds.

This method of feeding grain requires the most skill. The feeder must be sure the birds have all they can eat.

B. Restricted grain feeding by trough. This plan is the same as (A), except at the night feeding, when the grain is placed in troughs or the covers of grain hoppers are raised. Troughs enough must be available so that nearly all the birds may eat at one time.

This method of feeding grain requires less skill since, if the birds have finished eating and there is still some grain left, their wants are supplied. Methods (A) and (B) result in 45 to 55 per cent of the food consumed being grain. The amount of mash consumed can be regulated by the length of time grain hoppers are left open.

C. Free choice. Both grain and mash are before the birds in open hoppers at all times. Double-deck hoppers are well adapted, grain in one hopper or trough and mash in the other. One double-deck hopper, 5 feet long, is sufficient for 50 birds.

This method requires the least skill, and consists merely of always keeping the hoppers supplied.

From 60 to 70 per cent of the food consumed is grain and should not exceed 75 per cent. Body weight is sometimes more easily sustained, the cost is slightly less, there is greater freedom in feeding, and individual birds often come closer to meeting individual needs.

1 Wet mash, to increase total food consumption, when desirable, may be used as in other methods of feeding (page 101).
Caution. The proper amount of fish oil must be provided, either in the mash or mixed in the grain; otherwise a lack of vitamin D may result.

Feeding grain

When the hand or trough method is used, knowledge of several facts about grain feeding may save considerable trouble and expense. Grain may be used to advantage to promote activity. Hens like grain, and giving them a scant amount of grain in the morning induces them to exercise and increases the food intake. This is especially helpful on cold days, regardless of the method of feeding grain.

The fondness of hens for grain is used by the successful feeder to promote their exercise, to keep their blood circulating rapidly, and their bodies warm in cold weather. Giving the morning supply in two feedings distributes the exercise better. When hand feeding grain, look under the litter occasionally before feeding to learn if the birds have been fed too much and feed according to their appetites. When grain is found and the birds are not working, it means that they are being fed too heavily and the grain may spoil, thus giving possible trouble. In this event, do not feed the birds for at least one period. Correct clean litter feeding helps keep the litter dry through constant stirring.

Send the birds to roost with a full crop of grain. If a little is left over in the litter it will do no harm, since it will start the birds working early the next morning.

If hens are losing weight as a result of heavy production, too little feed is being consumed to meet the needs of the birds. To correct this condition more grain may be fed.

Observation of these points, coupled with the use of good judgment, should help in keeping the flock in good laying condition, i.e., active and with normal body weight.

Since the average number of eggs laid each month by a flock varies, the proportion of grain to mash also varies. Give the birds all the grain they can consume at night. During the fall and winter give 2 to 3 lb. of grain in the morn-
FEEDING MASH

ing to each 100 layers. In the summer give wet mash and no grain in the forenoon.

When feeding free choice the birds will eat less grain in summer, when given one daily wet mash feeding.

5. Feeding mash

There are three forms in which mash is fed, i.e., (A) dry; (B) wet; and (C) as pellets.

A. Feed dry mash in hoppers open at all times to the birds. The hoppers may have a continuous supply of mash, or the mash may be eaten up clean once daily. The former is safer in most instances as the latter requires greater care and skill if a maximum food intake is to result.

The all-mash method is sometimes used (giving no feed in the form of whole or cracked grain) when the mash contains the amount and kind of nutrients of a grain and mash ration. Comparative tests indicate that an all-mash ration may give fewer eggs per bird than the grain and mash ration.

Ground feeds or mashes are necessary. Many of the mash ingredients contain more protein than does grain, and mash is more quickly digested and assimilated.

When mash is fed dry, hens eat little and often. They cannot eat and swallow mash as readily as grain, but they supplement the nutrients in the grain by consuming as much of the mash as their bodies demand. Dry-mash feeding requires less labor and less skill than wet-mash feeding.

B. Feeding wet mash increases the labor and skill required. It should be fed when it is necessary to increase food consumption. Fowls like it moist and will eat it even though other dry food is before them.

Its best use is on very cold days when the birds may not be eating the normal amount of food. Its use may be discontinued when the birds resume eating the usual amount of the regular ration. It may be fed and discontinued as needed.

During the summer it may be fed daily to maintain food consumption and egg production.

A very desirable way to feed moist mash, assuming suffi-
cient dry-mash troughs are in use, is to pour milk or water carefully and slowly on top of the dry mash, about 2 quarts to each 100 hens. No mixing is needed. The moisture soaks in, and the birds eat it readily. The moisture must not soak through to the woodwork or cause mold. The birds should clean up the moist part in one-half to three-fourths of an hour.

Moist mash may be fed between 8:00 and 11:30 a.m., or in the afternoon, before the night feeding of grain.

If the grain and marsh are fed free choice, the moist mash may be fed any time.

C. Pellets consist of mash compressed commercially under high pressure. Their exclusive use prevents the birds from varying the diet to meet individual needs, and either grain and mash or all mash have given better egg production. The best use for pellets appears to be as a supplementary feed in place of, or in addition to, the moist mash.

6. Feeding animal protein

Meat scrap, milk, or some other form of animal protein is a very essential part of the ration for the production of either eggs or meat. The hen is naturally a meat eater. Experiments show that production can be controlled to a marked degree by regulating the amount of animal protein fed.

From 8 to 10 per cent of the total ration should be animal protein feed. It is usually fed as part of the mash mixture and should be ground fairly fine to prevent the birds from sorting the mash over and picking out the pieces of scrap. Heavy feeding of animal protein may not be harmful, but may be less economical feeding. On the other hand, the scarcity of eggs in winter or summer is often traced directly to a lack of meat food.

All animal protein feeds such as meat scrap, meat meal, tankage, fish meal, and dried milk products are exceedingly variable in feeding value. Insist upon securing guaranteed analyses. A combination of high-quality meat scrap, fish meal, and dried milk is preferable to any one of these alone.
7. Feeding green feed

At all times of the year green feed is desirable. It is rich in vitamins and should supply any that are lacking in the other ration ingredients. In this sense it is a protective feed. A lack of it is often a cause of ill health and low production. It acts as a tonic, stimulating the appetite, and also aids the digestive tract in functioning properly, securing for the bird a larger utilization of the feed consumed. Too much succulent feed may decrease grain and mash consumption. Five to ten per cent of alfalfa leaf meal in the mash or 5 pounds of cabbage or other green feed (page 111) to 100 hens may be given per day at noon or late afternoon. See page 130 for feeds containing carotene and xanthophyll.

8. Feeding grit, shell, salt, and manganese

Grit and shell should always be before the birds, in hoppers or boxes.

Grit should be hard and angular. It is used to crush feed in the gizzard and is not itself a feed. Grit does for the hen what teeth do for other animals. Nothing passes through the bird's body that is not thoroughly ground and pulverized by the gizzard.

Several kinds of minerals are required, but most of them are supplied in sufficient amount in a proper ration. Phosphorus is present in wheat by-products, meat scrap, and milk. Sodium, calcium, and chlorine are needed minerals to be supplied.

Oyster shell contains calcium carbonate, thus supplying calcium, which is an egg-shell and bone-making material and a very important mineral in poultry feeding. Without a source of lime, soft-shelled eggs are likely to result, together with the habit of egg eating.

Salt aids digestion by rendering the feed more palatable. It supplies sodium and chlorine, two essential minerals present in insufficient amounts in common foodstuffs. Large amounts of salt may be injurious, and it is usually better to add the salt
to the mash. From 5 to 10 ounces per 100 pounds of mash may be safely given.

*Manganese* deficiency results in low egg production, slightly decreased fertility, and low hatchability. The addition of $\frac{1}{4}$ pound of anhydrous manganese sulfate or manganese carbonate, thoroughly mixed in each ton of mash for layers or breeders, usually corrects a deficiency of this mineral.

With the exception of shell and grit, much mineral is harmful. Judgment and precaution are as essential as in determining the other ration ingredients.

9. Feeding cod-liver oil

This is our present best source of supply of vitamin D for poultry feeding. For the importance of vitamin D, see page 131.

About November 1, in the latitude of New York State (elsewhere when the amount of sunshine is considerably lessened during the winter), feed cod-liver oil to the layers and breeders. Continue through the early spring.

Cod-liver oil may be fed either in the grain or the mash. The grain should always be trough or hopper fed when mixed with the oil, otherwise it will collect dirt if scattered in litter and some of the oil may be rubbed off on the litter and lost. The mash, of course, will be fed in hoppers.

*Amount to use.* If equal parts of grain and mash are fed, 2.4 per cent of oil containing 85 A.O.A.C. units of vitamin D per gram of oil should be mixed in the mash for layers or breeders. This is approximately 2½ pints per 100 pounds of mash.

If one-third grain and two-thirds mash are being consumed, 1.8 per cent of the oil should be added to the mash.

The *free-choice* method of feeding with resulting two-thirds grain and one-third mash consumption requires 3.5 per cent of the oil added to the mash.

Modern methods of concentration or “reinforcing” oils pro
vide varying amounts of A.O.A.C. units of vitamin D per gram of oil.

The table shows the number of units of D required in 1 pound of mash under these three methods of feeding, and for different unit oils, the percentage and the pounds of oil needed in the mash.

<table>
<thead>
<tr>
<th>Guaranteed A.O.A.C. * chick units vitamin D per gram of oil</th>
<th>Amount of oil to put in mash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ration ¼ gr., ½ mash</td>
<td>¼ gr., ½ mash</td>
</tr>
<tr>
<td>Units vitamin D per lb. mash—906</td>
<td>881</td>
</tr>
<tr>
<td>% oil in mash</td>
<td>Lb. per ton</td>
</tr>
<tr>
<td>25</td>
<td>2.4</td>
</tr>
<tr>
<td>180</td>
<td>1.34</td>
</tr>
<tr>
<td>250</td>
<td>.65</td>
</tr>
<tr>
<td>400</td>
<td>.5</td>
</tr>
</tbody>
</table>

* According to the vitamin D chick assay of the Association of Official Agricultural Chemists.

Most poultrymen when feeding free choice will probably use a mash containing 2.0 to 2.5 per cent of oil. This is insufficient. The proper amount will be provided, however, by adding 1 to 1½ pints of 85 A.O.A.C. unit oil to each 100 pounds of grain.

How to mix. Mix 1 to 2 pints of cod-liver oil in about 2 pounds of bran or of the mash mixture. Spread this over the lot to be mixed. Repeat for each 100 pounds. Shovel the entire lot thoroughly.

If mixed in the grain the required amount of oil may be spread over the entire pile and mixed.

Do not mix more than two weeks’ supply at any one time...
as the vitamins of cod-liver oil are subject to oxidation in the presence of air.

*Kind to use.* In experiments conducted at the Poultry Department of Cornell, excellent results have been obtained from the use of either red or yellow cod-liver oil. There are available a number of oils of different potency. The natural oils are standardized at 85 to 100 units and fortified oils at 400 units. Note the varying amounts needed to meet requirements, shown in the Table on page 105.

10. Supplying the water

The birds must have access to water during the entire day. Water softens the food in the crop and in other parts of the digestive tract, thereby making it ready for grinding and digesting. It serves as a carrier for transporting nutrients in the body, as blood. The hen's body is 55 per cent and eggs are 65 per cent water. A constant supply of water must be available, therefore, to keep up the composition in the body and to help make eggs. Water, coupled with rapid breathing, keeps the inside of the hen's body cool in summer and is the only means of cooling from the inside. As a result, birds use much more water on warm days and when laying heavily.

Water is as important as feed and must be supplied regularly and in sufficient quantities.

11. Cooking feed

It is not considered profitable commercially to cook feed. Cooking or exposing to high temperatures reduces the protein value of some feeds. However, the protein of ground soybeans is made more efficient by heating. When beans or potatoes are fed, cooking renders the starch more digestible.

12. Feeding the different breeds

When one is feeding for egg production, the practices outlined in this chapter may be applied to any breed. The heavier varieties may require somewhat more care on the attendant's
FEEDING BREEDERS

part and probably more restricted grain feeding to keep them active.

13. Feeding breeders

The ration on page 96 is suitable for breeders when the meat scrap and milk are changed to 200 pounds each. More milk is necessary, for the vitamin G content must be raised for breeders.

The same changes indicated on page 96 for layers apply to the grain feeding of the breeders.

Ten to twelve quarts of liquid skimmilk or buttermilk or 4 to 5 pounds of the condensed milk products a day for 100 hens will replace the dried milk in the mash.

**Suggested Changes in the Breeder-Mash-Mixture**

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Modified breeder mash mixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. 1</td>
</tr>
<tr>
<td></td>
<td>Pounds</td>
</tr>
<tr>
<td>Yellow cornmeal</td>
<td>400</td>
</tr>
<tr>
<td>Flour wheat middlings</td>
<td>400</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>400</td>
</tr>
<tr>
<td>Ground heavy oats</td>
<td>300</td>
</tr>
<tr>
<td>Alfalfa meal, low fiber</td>
<td>100</td>
</tr>
<tr>
<td>Dried skimmilk or dried buttermilk</td>
<td>150</td>
</tr>
<tr>
<td>Dried whey (milk-sugar feed)</td>
<td>...</td>
</tr>
<tr>
<td>Meat scrap (50 to 55 per cent protein)</td>
<td>200</td>
</tr>
<tr>
<td>Fish meal</td>
<td>...</td>
</tr>
<tr>
<td>Limestone or oyster-shell flour</td>
<td>40</td>
</tr>
<tr>
<td>Salt *</td>
<td>10</td>
</tr>
</tbody>
</table>

* If the limestone or oyster-shell flour and salt are not included in the ton mixture, the ground oats should be increased by 50 pounds.

When the breeders stop laying and molt, the amount of grain should be increased. (It may be hopper-fed at this time.)
Sixty to seventy per cent yellow corn and 30 to 40 per cent wheat is preferred by many flocks during this period. Green food and milk should be furnished in abundance.

Heavy grain feeding should be practiced during the winter. In the spring, the breeding flock can be handled in the same manner as the laying flock, both consuming a larger proportion of mash.

A small amount of artificial illumination (when this and daylight do not exceed 12 hours) can be used to advantage during the winter, and this may be increased just before the hatching season. (See page 170.)

14. Feeding birds under illumination

The simplest rule to observe in feeding under illumination is to allow the birds to fill their crops to the fullest capacity at night before going to roost. Many flocks of birds go to roost with their crops only partly filled. The directions laid down in this chapter should take care of this requirement.

GENERAL INFORMATION

Grain used for poultry feeding. Yellow corn is a desirable poultry feed, and one of which fowls are fond. It contains a large amount of digestible nutriment, is usually cheap, can be easily raised, transported, and stored, is unusually rich in vitamins, and fits well in a crop rotation. As a part of the grain mixture, it is generally fed cracked but it may be fed whole with equally good results, any time after the birds are large enough to eat it. It is a xanthophyll-bearing feed and imparts yellow color to the yolk, the domestic varieties less than the Argentine corn. Corn has a wide protein-energy ratio, i.e., it contains a large amount of carbohydrates in proportion to the protein content, and should be fed with other feeds which balance it.

Wheat is very palatable especially through the first laying year. It is adaptable to feeding fowls because of its size, color, and the large amount of nutriment which it contains.
It should be fed with other grains. Soft or hard wheats or shrunken wheat which is sweet and clean are desirable for poultry feeding.

Bulley is not so palatable as wheat but makes a fairly desirable ingredient for poultry rations.

Oats are a valuable poultry feed. The hull apparently possesses a factor which lessens the cannibalistic desire of poultry. From 5 to 30 per cent may be included in the grain ration. Some poultrymen provide free-choice hoppers of oats in the laying pens as a “pickout” preventive. Start feeding oats to chicks at 6 to 8 weeks of age and continue throughout life. They should not be fed as the only cereal.

Kafir corn has a composition much like wheat. The kernel is small. It is quite palatable. It is not quite equal to yellow corn in feeding value, but may replace it in part.

Buckwheat is an important feed in localities where it is grown. It is used especially in the winter ration. It has a heavy shuck, and should be fed in amounts not to exceed 30 per cent of the scratch grain. It produces a light-colored egg yolk. It may be used either whole or finely ground in the mash mixture.

Rye has an extremely hard kernel and apparently is unpalatable to poultry. Large quantities are likely to cause digestive troubles. It may be fed in quantities of 5 to 10 per cent of the grain ration.

Mash feeds used for poultry. Cornmeal is the clean, ground product of the entire corn kernel. It is an efficient and palatable feed. Generally it should form a part of the mash mixtures. The yellow cornmeal is more valuable than the white owing to its vitamin A potency, a factor white corn does not possess.

Red dog flour is a low-grade flour and is valuable as a feed, especially in fattening rations.

Ground heavy oats are a highly desirable constituent of the mash. They are rather bulky. They may comprise 25 per cent of the mash mixture.
Soybean-oil meal is a valuable source of vegetable protein. It can be used in the mash to replace one-half of the meat scrap or fish scrap.

Linseed oil meal is rather laxative in its effect. It is a high-protein feed, but is not palatable, probably owing to its sticky nature. It should not be fed in amounts exceeding 5 per cent of the mash.

Hominy may be used in the same way as cornmeal, the yellow variety being preferable to the white. It is not quite equal to yellow corn in feeding value.

Gluten meal is high in protein and vitamin A. It may replace one-half of the meat scrap in a laying ration.

Wheat bran is a bulky food, low in nutrient, slightly laxative, and contains considerable phosphorus. It is a very beneficial feed.

Wheat standard middlings are very similar to wheat bran but are ground more finely, and are less bulky and slightly more nutritious. Like flour middlings and wheat feed, they are rich in phosphorus.

Wheat flour middlings are somewhat more nutritious than the standard middlings. Although a more sticky feed, this stickiness is not a handicap in the usual mash mixture. It is valuable as a mash constituent.

Wheat feed is a mixture of wheat bran and middlings and is more or less variable in the proportion of these ingredients. Its composition is between the two, and it may be used in place of them.

Cottonseed meal is high in protein but may prove injurious if fed in large quantities.

Buckwheat middlings. (See "Buckwheat," page 109.)

Animal feeds used for poultry. Protein from animal feeds supplements proteins of vegetable origin and gives a better distribution of the essential amino acids. (See page 118.)

Meat scrap usually carries 45 to 60 per cent protein, and is one of the most desirable animal feeds. It is the most convenient and usually the cheapest form of meat. Meat scrap
should be wholesome and fresh. It is well to test it before using; if wholesome, when warmed it has the odor of scorched, fresh meat. Different samples of meat scrap vary considerably in the small amount of vitamin G contained.

Fish products in general are not so palatable as meat scrap. The protein content in fish scrap is about equal to that in meat scrap. When properly prepared, fish scrap is believed to be richer in vitamins than most meat products fed to poultry. There is wide variation in value.

Tankage is less suitable for poultry than are meat scraps. The birds do not like it so well as some other animal feeds. It is less uniform in quality and does not produce as good results as does meat scrap.

Dried-blood products are not suitable for poultry feeding. They are high in protein but are very unpalatable.

Green cut bone is exceedingly palatable and very desirable if fed fresh. It heats and spoils quickly unless special care is taken to keep it fresh and wholesome. Usually it is not available in quantities, and therefore cannot be fed regularly. If fed at the rate of one-half ounce a day to each hen, it may be used to replace one-half of the meat scrap.

Liquid or dried skim milk, buttermilk or whey, and the condensed milk products are valuable sources of vitamin G and animal protein. They are easily digested, palatable, and aid in the digestibility of the entire ration.

The inclusion of 7.5 per cent of dried skim milk or dried buttermilk or 5 per cent of dried whey in mash for chicks is adequate in supplying their need for this vitamin. Ten per cent of dried skim milk or 8 to 7 per cent of dried whey in the mash is sufficient for breeders while the need of layers, not used for breeding purposes, is satisfied when the laying mash contains 5 per cent of dried skim milk or 3.5 per cent of dried whey. Experience also indicates that if liquid skim milk or buttermilk is constantly available, the birds will receive sufficient vitamin G.

Green feeds used for poultry. Alfalfa meal is a valuable feed. Like clovers and some pasture grasses it is a good source
of vitamins, especially A and G. For this reason and because of its availability it is well adapted as a mash ingredient. On many poultry farms, 5 to 7½ per cent of alfalfa meal in the mash supplies the necessary green food without excessive yolk coloring. It is not a succulent feed. Sun-cured alfalfa is much less valuable as a source of vitamin A than is dehydrated alfalfa, although there is a slight loss by oxidation during dehydration and in outdoor wilting. Dehydrated alfalfa meal and ordinary alfalfa meal are about three-fourths and one-half as rich, respectively, in vitamin G as is dried skim milk.

Green pasture provides green food in the most natural form. Its use on range for breeding birds and for rearing is desirable because of its palatability, succulence, high digestible protein, mineral and vitamin content. A proper green range may reduce the food cost for rearing.

It is high in xanthophyll, which tends to darken the yolks, and for that reason birds producing eggs for market should not range. Five pounds per day for 100 laying hens may be fed.

Investigations indicate that Ladino white clover and rough-stalked meadow grass are of special value in poultry pasture mixtures.

Best feeding value is obtained when the pasture is closely grazed or kept mowed to a height of 3 to 4 inches.

A poultry pasture mixture suggested by Cornell:

- Kentucky bluegrass ............... 8 lb. per acre.
- Canada bluegrass ................ 2 lb. per acre.
- Rough-stalked meadow grass ...... 8 lb. per acre.
- Timothy .......................... 6 lb. per acre.
- Perennial rye grass ............... 5 lb. per acre.
- Yellow trefoil 1 .................. 2 lb. per acre.
- Wild white clover ............... 1 lb. per acre.
- Ladino white clover ............. 1 lb. per acre.

1 If the section where sown is likely to be affected by drought, substitute wild birds'-foot trefoil.

Six hundred to 800 pounds super-phosphate and 100 to 200 pounds muriate of potash should be added per acre, and lime if needed.
Corn silage may be used in small amounts.

Sprouted oats furnish a palatable succulent. As more is learned about the function of green food and of the vitamin content of feeds and their needs by poultry, the use of sprouted oats has diminished in some sections. The labor of preparing them does not always appear justified.

Sprouting. For those desiring to use sprouted oats the following directions are given. The grains will sprout best in a well-lighted room where a temperature of 60 to 70 degrees F. can be maintained. They will not sprout well and they will usually mold in a temperature below 60 degrees F. The room should also have provision for ventilation. The grain, before it is put into the sprouter, should be soaked and treated with formalin to prevent the development of molds. For each tray (2 by 2 feet), place in a pail 6 quarts of oats and 6 quarts of lukewarm water to which has been added one teaspoonful of formalin. Cover with an old bag or burlap and allow to soak for 36 to 48 hours. Then spread out on the trays from about $\frac{1}{2}$ to 1 inch deep.

Sprinkle thoroughly each day so as to keep the oats always moistened. Cover the tray with building paper to prevent too rapid evaporation, thus hastening the sprouting. Stir the oats daily until the sprouts are about $\frac{1}{2}$ inch long. The trays should be reversed occasionally so that all sides will have exposure to the light. The oats should be started on the bottom tray and the trays moved upward each day, the feeding being done from the top trays. This gives the growing oats at the top the most light, which is necessary.

Under favorable conditions, the oats should be ready to
feed in about a week or ten days. When the trays have been emptied, they should be disinfected with a 5-per cent solution of formalin to prevent the development of mold in the wet trays.

The oats usually are fed when the sprouts are 1 to 3 inches high. The sod is removed, broken into chunks, and fed in troughs or on clean litter. From 1 to 2 square inches for each hen should be fed regularly each noon.

Germinated oats. Many poultrymen prefer to feed the oats after germinating, or after they have been soaked, for 24 hours and allowed to stand in the rack, the pail, or in a heap on the floor for four or five days. They should be stirred daily.

Roots and tubers. In this group, yellow carrots are the most desirable. They are satisfactory substitutes for field-grown greens. Mangels are liked by the fowls but contain few if any vitamins. Turnips, rutabagas, and other roots may be used. They are not so well liked by the fowls.

Cabbage is an excellent succulent, especially for fall and early winter. Fowls prefer cabbage to most other vegetable feeds. The small, unmarketable heads may be used to advantage for poultry:

Any vegetable, such as lettuce, onions, spinach, kale, and the like, may be used as green food.

Miscellaneous feeds. Molasses may be used to replace some corn. Five per cent is satisfactory while 10 per cent may cause a temporary diarrhea. Molasses carries the antidermatosis vitamin but is too variable to be a dependable source. It has only slight growth properties and carries little or no vitamin G.

COMMUNITY SURVEY

1. Ask several local poultrymen what rations they are feeding laying hens.
2. What method of feeding grain and mash is followed?
3. What proportion of grain and mash are they feeding?
4. How many trips are made to the laying flock each day in winter?
5. What work is done on each trip?
6. Do they feed the grain by pounds or quarts?
7. How much is given per 100 hens?
8. What determines the amount of grain fed? What the amount of mash fed? What the form of animal protein fed?
9. Is green feed given to layers, breeders, growing birds?
10. What kind is fed to each?
11. How much is fed? What determines the kind and amount given?
12. How many hoppers for grit and shell are in each pen?
13. Is the water supply sufficient and clean?

REFERENCES


CHAPTER VI

PRINCIPLES OF FEEDING LAYERS AND BREEDERS

The laying flock uses feed for three purposes: first, for body maintenance; second, for increasing body weight; and third, for increasing and maintaining egg production.

*Maintenance* of the body is the first consideration in good feeding. About three-fourths of the total feed consumed goes for this purpose when the fowl is in laying condition. One hundred birds averaging 4 pounds will consume about 19 pounds of feed daily when not laying and 24 to 27 pounds when producing 50 per cent and above. The ration should provide sufficient nutrients that are in a palatable form and easily obtained by the birds. For the first several months of laying, pullets should increase in body weight. This adds importance to a proper and ample food supply. If the ration is not in the proper form to supply the needs of maintenance, growth, and production, maintenance is more likely to have the preference under normal circumstances, because self-preservation is the first law of nature, and eventually the constant wearing and breaking down of body tissues must be repaired. Birds that inherit exceptionally high productive capacity, if not given the proper amount and kind of a ration, are very likely to lay so heavily that they lose their body weight and lower their vitality. Often fall and winter molt results.

Under normal conditions, production follows after the body needs are supplied. It requires considerable feed to build up and maintain the body to the point of production. After this has been done, the actual production of eggs requires but a small part, comparatively, of the daily rations. No profit is
derived from merely maintaining the body. The profit comes from the production of meat or eggs. The skillful feeder handles the birds so as to enable them to make the best use of their ration. This results in the greatest production at least cost.

If, therefore, we can supply a ration which will furnish the material needed to build and maintain the body and produce the number of eggs which the fowl is capable of laying, and at the same time maintain good health, we shall have a balanced ration.

General information:

1. Definition of terms.
2. Composition of feeds.
3. A quick method of computing a ration for egg production.
4. How to calculate the composition and protein-energy ratio of rations in order to meet varying supply and price of feed.
5. The importance of vitamins in poultry feeding.

1. Definition of terms

There are a number of terms which should be defined before the principles of feeding are discussed further.

A balanced ration is one that consists of the proper nutrients in the right amounts for the purposes intended. These consist of protein, carbohydrates, fat, fiber, minerals, vitamins, and water.

A nutrient is any constituent of a feed that goes to produce heat or energy or to build body tissue.

Feeds are composed of water and dry matter. The amount of water in feeds varies greatly, but is not sufficient to supply the bird's needs; therefore, water must be furnished.

Dry matter is made up of inorganic and organic substances. The inorganic matter is composed of minerals or ash. The organic substances consist of combustible material, such as sugar, starch, fat, protein, and fiber.

The inorganic constituent, ash, is present in small quantities in all feeds and in all parts of the body, and is the non-
combustible material. It is used in the building-up of bone and in making egg shells. It is of more importance in the feeding of young stock than of mature stock, since large amounts are needed for building the framework of the growing body. Ash is usually present in feeds in sufficient quantity to supply the adult fowl's needs, with the exception of lime for making egg shells, which should be supplied in the form of oyster shell or limestone.

The principal function of protein is to make the lean meat, hair, nerves, and feathers in the fowl and the albumen or white of the egg. It is essential in the building up of tissue and in egg production. It consists of compounds which contain nitrogen, and it is an indispensable, and generally the most expensive, part of a ration. No nutrient will take the place of protein, but a part of the protein is sometimes used as fat-forming material or energy.

There is no specific disease due to a shortage in protein although stunting, or reduced production, may result.

An excess of protein may be used as energy. A larger amount may be thrown off by the birds through enlarging the kidneys and in time a whitish discharge will gather about the vent in high-producing birds.

Protein comes from both vegetable and animal sources. Both are necessary in the poultry ration.

The ultimate products of protein digestion are the amino acids. Proteins are fed because of the amino acids they contain. All proteins do not contain the same amino acids, nor are the amounts of similar amino acids the same in different feeds.

There are twenty-two known amino acids. Ten of these are said to be essential since the body cannot synthesize them. The others are classed as unessential since the body can manufacture them. It is not yet known which amino acids are essential for the various life functions, such as best egg production, for example. Neither is there complete data concerning the amount and kind of amino acids in various proteins.
DEFINITION OF TERMS

Since individual feeds may contain more than one protein, the problem is even more complicated. Many different proteins of varying amino acid relations make up the body. To balance a ration from the protein and amino acid standpoints, we should know the amount and kind of amino acids needed by the bird and their content in various proteins in the different feeds. This information is very incomplete. Hence, a poultry ration should consist of proteins from a variety of sources in the hope that the birds may get the amino acids they require.

It is known that animal proteins contain more of the essential amino acids. Hence, their very great importance in the ration.

Carbohydrates include two classes of substances, fiber and nitrogen-free extract.

Fiber is the woody portion or cellulose tissue of plants. In the fowl, the fiber is digested only in a slight degree and apparently in the caeca, probably the result of bacterial action. By distending the intestines it allows the digestive juices to act more readily.

Nitrogen-free extract is used by the body for fuel, which furnishes energy and heat. Any excess is stored as fat. Nitrogen-free extract is made up mostly of starches and sugars.

Fat has the same function as the nitrogen-free extract, in that it furnishes energy and heat, and in that, if more is supplied than is needed for this purpose, the excess is deposited as fatty tissue. Fats, however, are more effective than starches or sugars, and give 2\(\frac{3}{4}\) times as much energy for each unit of weight.

From these facts, it follows that the reader should not only know how to feed a ration, but also should be able to make up from a group of feeds, a ration which will contain the various food nutrients in as near the correct proportions as possible.

Protein-energy ratio. This term means the amount of protein in the feed or group of feeds as compared with the combined carbohydrates and fat. When we say a ration has a
## Average Composition of Common Poultry Feeds, 100 Pounds

<table>
<thead>
<tr>
<th>Feeds</th>
<th>Protein</th>
<th>Fat</th>
<th>Fiber</th>
<th>Nitrogen-free extract</th>
<th>Ash</th>
<th>Calcium</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Alfalfa, green</td>
<td>4.6</td>
<td>1.0</td>
<td>7.0</td>
<td>10.4</td>
<td>2.4</td>
<td>0.59</td>
<td>0.08</td>
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<tr>
<td>Alfalfa meal, good</td>
<td>15.2</td>
<td>1.9</td>
<td>28.4</td>
<td>37.9</td>
<td>8.5</td>
<td>2.11</td>
<td>0.28</td>
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<tr>
<td>Alfalfa leaf meal</td>
<td>19.6</td>
<td>2.6</td>
<td>19.8</td>
<td>40.0</td>
<td>10.1</td>
<td>2.50</td>
<td>0.33</td>
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<td>Barley</td>
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<td>68.0</td>
<td>2.9</td>
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<tr>
<td>Blood meal</td>
<td>82.2</td>
<td>1.2</td>
<td>1.3</td>
<td>4.7</td>
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<tr>
<td>Buckwheat</td>
<td>11.9</td>
<td>2.4</td>
<td>10.3</td>
<td>63.8</td>
<td>52.0</td>
<td></td>
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<tr>
<td>Buckwheat middlings</td>
<td>29.7</td>
<td>7.3</td>
<td>7.4</td>
<td>39.4</td>
<td>4.9</td>
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<td>Buttermilk</td>
<td>3.5</td>
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<td>0.8</td>
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<td>Buttermilk, condensed</td>
<td>11.3</td>
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<td>Buttermilk, dried</td>
<td>33.8</td>
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<td>41.9</td>
<td>10.5</td>
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<td>0.95</td>
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<td>3.9</td>
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<td>42.0</td>
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<td>0.21</td>
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<tr>
<td>Fish meal, menhaden</td>
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<td>0.2</td>
<td>0.9</td>
<td>5.2</td>
<td>20.2</td>
<td>6.97</td>
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<td>11.59</td>
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<td>4.8</td>
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<tr>
<td>Kafr grain</td>
<td>11.2</td>
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<td>2.3</td>
<td>70.3</td>
<td>1.7</td>
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<td>Linseed meal, old processes</td>
<td>35.2</td>
<td>6.3</td>
<td>-8.0</td>
<td>36.3</td>
<td>5.5</td>
<td>0.38</td>
<td>0.73</td>
</tr>
<tr>
<td>Meat scraps (55 per cent protein)</td>
<td>55.0</td>
<td>10.7</td>
<td>2.2</td>
<td>1.2</td>
<td>24.6</td>
<td>8.49</td>
<td>4.18</td>
</tr>
<tr>
<td>Meat and bone scraps (50-per-cent protein)</td>
<td>50.8</td>
<td>11.1</td>
<td>2.1</td>
<td>2.0</td>
<td>27.8</td>
<td>9.59</td>
<td>4.73</td>
</tr>
<tr>
<td>Oats</td>
<td>12.0</td>
<td>4.7</td>
<td>10.6</td>
<td>60.2</td>
<td>3.6</td>
<td>0.13</td>
<td>0.11</td>
</tr>
<tr>
<td>Oat kernels</td>
<td>16.2</td>
<td>6.4</td>
<td>1.9</td>
<td>65.8</td>
<td>1.9</td>
<td>0.06</td>
<td>0.42</td>
</tr>
<tr>
<td>Peas</td>
<td>23.8</td>
<td>1.2</td>
<td>6.2</td>
<td>66.2</td>
<td>3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peanut oil meal, old process</td>
<td>42.7</td>
<td>8.5</td>
<td>8.9</td>
<td>27.0</td>
<td>6.3</td>
<td>0.16</td>
<td>0.59</td>
</tr>
<tr>
<td>Rye</td>
<td>12.3</td>
<td>1.7</td>
<td>2.8</td>
<td>71.7</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skim milk, centrifugal</td>
<td>3.7</td>
<td>0.1</td>
<td>0.3</td>
<td>5.0</td>
<td>0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skim milk, dried</td>
<td>34.8</td>
<td>0.9</td>
<td>4.8</td>
<td>50.1</td>
<td>8.0</td>
<td>1.50</td>
<td>1.09</td>
</tr>
<tr>
<td>Soybeans</td>
<td>33.0</td>
<td>17.2</td>
<td>4.5</td>
<td>26.3</td>
<td>5.3</td>
<td>0.21</td>
<td>0.59</td>
</tr>
<tr>
<td>Soybean oil meal</td>
<td>44.3</td>
<td>5.7</td>
<td>5.6</td>
<td>30.3</td>
<td>5.7</td>
<td>0.26</td>
<td>0.64</td>
</tr>
<tr>
<td>Sunflower seeds</td>
<td>15.9</td>
<td>26.1</td>
<td>28.1</td>
<td>21.2</td>
<td>3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>13.1</td>
<td>1.7</td>
<td>3.0</td>
<td>70.0</td>
<td>2.0</td>
<td>0.06</td>
<td>0.45</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>15.8</td>
<td>5.0</td>
<td>9.5</td>
<td>54.3</td>
<td>6.0</td>
<td>0.14</td>
<td>1.28</td>
</tr>
<tr>
<td>Wheat flour middlings</td>
<td>17.0</td>
<td>4.9</td>
<td>4.4</td>
<td>59.9</td>
<td>3.4</td>
<td>0.08</td>
<td>0.80</td>
</tr>
<tr>
<td>Wheat standard middlings</td>
<td>17.4</td>
<td>5.5</td>
<td>6.8</td>
<td>56.1</td>
<td>4.2</td>
<td>0.12</td>
<td>0.87</td>
</tr>
<tr>
<td>Wheat red dog</td>
<td>16.9</td>
<td>4.0</td>
<td>2.4</td>
<td>63.3</td>
<td>2.6</td>
<td>0.04</td>
<td>0.36</td>
</tr>
<tr>
<td>Whey, dried</td>
<td>12.5</td>
<td>0.7</td>
<td>7.1</td>
<td>72.1</td>
<td>0.7</td>
<td>0.69</td>
<td>0.68</td>
</tr>
<tr>
<td>Steamed bone meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>81.3</td>
<td>26.12</td>
<td>14.01</td>
</tr>
<tr>
<td>Pulverized limestone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>37.95</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Oyster shells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>37.95</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

*The analyses except for calcium and phosphorus are taken from the twentieth edition of *Feeds and Feeding* by Morrison.

Table from Cornell Extension Bulletin 222.
protein-energy ratio of 1 to 5, we mean that it contains one part of protein to every five parts of carbohydrates and fat.

A ration with the correct protein-energy ratio is said to be balanced. For egg production a protein-energy ratio of 1:4.5 or 1:5.5 is desirable.

2. Composition of feeds

The table (page 120) gives the average composition of 100 pounds of feed for poultry.

3. A quick method of computing a ration for egg production

As an example the following mixture may be used:

<table>
<thead>
<tr>
<th>GRAIN</th>
<th>DRY MASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 pounds cracked corn</td>
<td>100 pounds cornmeal</td>
</tr>
<tr>
<td>100 pounds wheat</td>
<td>100 pounds wheat bran</td>
</tr>
<tr>
<td></td>
<td>100 pounds flour wheat middlings</td>
</tr>
<tr>
<td></td>
<td>100 pounds ground heavy oats</td>
</tr>
<tr>
<td></td>
<td>75 pounds meat scrap (55 percent protein)</td>
</tr>
<tr>
<td></td>
<td>25 pounds dried skimmilk</td>
</tr>
</tbody>
</table>

One hundred pounds of corn contains 2.2 pounds of fiber, 9.4 pounds of protein, 3.9 pounds of fat, and 68.4 pounds of nitrogen-free extract (Table, page 120).

To determine the composition for the other feeds in both the grain and mash mixtures, the amounts of fiber, protein, fat, and nitrogen-free extracts in the table on page 120 are used as a basis. From these it is found, therefore, that the mixtures will contain the relative proportions of fiber, protein, fat, and nitrogen-free extract indicated in the following tabular statements:

<table>
<thead>
<tr>
<th>GRAIN MIXTURE</th>
<th>Fiber</th>
<th>Protein</th>
<th>Fat</th>
<th>Nitrogen-free extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 pounds corn...</td>
<td>2.2</td>
<td>9.4</td>
<td>3.9</td>
<td>68.4</td>
</tr>
<tr>
<td>100 pounds wheat...</td>
<td>3.0</td>
<td>13.1</td>
<td>1.7</td>
<td>70.0</td>
</tr>
<tr>
<td>200 pounds grain mixture...</td>
<td>5.2</td>
<td>22.5</td>
<td>5.6</td>
<td>138.4</td>
</tr>
<tr>
<td>100 pounds grain mixture...</td>
<td>2.6</td>
<td>11.3</td>
<td>2.8</td>
<td>69.2</td>
</tr>
</tbody>
</table>
By adding the amounts of nutrients in the various feeds, it is found that 200 pounds of the grain mixture contains 5.2 pounds of fiber, 22.5 pounds of protein, 5.6 pounds of fat, and 138.4 pounds of nitrogen-free extract; by dividing these figures by 2, the respective amounts for 100 pounds of grain mixture are 2.6, 11.3, 2.8 and 69.2 pounds.

<table>
<thead>
<tr>
<th>Mash Mixture</th>
<th>Fiber</th>
<th>Protein</th>
<th>Fat</th>
<th>Nitrogen-free extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 pounds cornmeal</td>
<td>2.2</td>
<td>9.4</td>
<td>-3.9</td>
<td>88.4</td>
</tr>
<tr>
<td>100 pounds wheat bran</td>
<td>9.5</td>
<td>15.8</td>
<td>5.0</td>
<td>54.3</td>
</tr>
<tr>
<td>100 pounds flour wheat middlings</td>
<td>4.4</td>
<td>17.0</td>
<td>4.9</td>
<td>59.9</td>
</tr>
<tr>
<td>100 pounds ground oats</td>
<td>10.6</td>
<td>12.0</td>
<td>4.7</td>
<td>60.2</td>
</tr>
<tr>
<td>85 pounds meat scrap</td>
<td>1.7</td>
<td>41.3</td>
<td>8.0</td>
<td>0.9</td>
</tr>
<tr>
<td>25 pounds dried milk</td>
<td></td>
<td>8.7</td>
<td>0.2</td>
<td>12.5</td>
</tr>
<tr>
<td>500 pounds mash mixture</td>
<td>28.4</td>
<td>104.2</td>
<td>26.7</td>
<td>256.2</td>
</tr>
<tr>
<td>100 pounds mash mixture</td>
<td>5.7</td>
<td>20.8</td>
<td>5.3</td>
<td>51.2</td>
</tr>
</tbody>
</table>

By adding the amount of nutrients in the various feeds in the mash mixture, it is found that in 500 pounds of the mixture there are 284 pounds of fiber, 104.2 pounds of protein, 26.7 pounds of fat, and 258.2 pounds of nitrogen-free extract; or in 100 pounds of the mixture, the amounts are 5.7, 20.8, 5.3, and 51.2 pounds respectively.

Where hoppers are left open only during the afternoon, the hens will eat about 2 pounds of grain to every 1 pound of mash. Therefore, in order to get the correct protein-energy ratio, it must be computed on the basis of 200 pounds of grain and 100 pounds of mash.

The nutrients found in 200 pounds of grain must be added to those found in 100 pounds of mash, and the total divided by 3 in order that the nutrients in 100 pounds of the ration may be determined. If the ration is fed in the proportion of three parts of grain to two parts of mash, the nutrients in the 300 pounds of grain must be added to the nutrients in the 200 pounds of mash and the sum divided by 5 that the nutrients in 100 pounds of the ration may be obtained.
The nutrients for the ration given may be calculated as follows:

<table>
<thead>
<tr>
<th></th>
<th>Fiber</th>
<th>Protein</th>
<th>Fat</th>
<th>Nitrogen-free extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 pounds grain</td>
<td>2.6</td>
<td>11.3</td>
<td>2.3</td>
<td>69.2</td>
</tr>
<tr>
<td>100 pounds mash</td>
<td>5.7</td>
<td>20.8</td>
<td>5.3</td>
<td>51.2</td>
</tr>
<tr>
<td>200 pounds ration</td>
<td>8.3</td>
<td>32.1</td>
<td>8.1</td>
<td>120.4</td>
</tr>
<tr>
<td>100 pounds ration</td>
<td>4.2</td>
<td>16.1</td>
<td>4.2</td>
<td>60.2</td>
</tr>
</tbody>
</table>

This ration, then, has 4.2 pounds of fiber, 16.1 pounds of protein, 4.2 pounds of fat, and 60.2 pounds of nitrogen-free extract, for every 100 pounds of feed. Other combinations of grain and mash will suggest themselves.

It remains yet to compute the protein-energy ratio.

Rule for computing protein-energy ratio

Add the fat (4.2) multiplied by 21.5 (9.5) to the nitrogen-free extract (60.2), which gives the total energy nutrients (69.7). Total energy nutrients (69.7) divided by protein (16.1) equals protein-energy ratio (4.33). Therefore the protein-energy ratio of this ration is 1 : 4.33, which means that for each pound of protein the ration contains the equivalent of 4.33 pounds of energy nutrients (carbohydrates and fat).

1 If it is found that the protein-energy ratio is too wide (containing more than 5 parts carbohydrates and fat to 1 part of protein), the amounts of one or more feeds that have wide ratios (containing a large proportion of carbohydrates and fat) should be reduced, and one or more feeds that have narrower ratios (containing a larger proportion of protein) should be substituted. If, on the other hand, it is found that the protein-energy ratio is too narrow (containing less than 4 parts of carbohydrates and fat to 1 part of protein), the amount of one or more feeds that have narrow ratios should be reduced, and one or more feeds that have wider ratios should be substituted. After a few such trials it should be possible to formulate a ration that will contain all of the food nutrients in proper proportion and amounts.

From Cornell Extension Bulletin 222.
How to calculate the composition and protein-energy ratio of rations in order to meet varying supply and price of feed.

When making up and balancing rations best suited for specific purposes, i.e., for egg production, fattening, rearing, etc., several different combinations of the most economical and available feeds should be tried, the composition of food nutrients calculated, and the protein-energy ratio determined for each combination. Such change in amounts of certain feeds should then be made as will satisfy the theoretical requirements established in the standard feeding requirements for egg production, mentioned below.

A. Standard feeding requirements. There are not yet available such detailed standards of requirements for poultry as have been worked out for other animals.

As a result of the study of several successful rations for egg production, it seems probable that the standard requirements for laying hens, stated on a percentage basis of the total food consumed, fall within the range given below:

- **Fiber**, 3.5 to 7.5 per cent.
- **Protein**, 15 to 16 per cent, of which \( \frac{1}{6} \) to \( \frac{1}{3} \) should be animal protein.
- **Protein-energy ratio**, 1 : 4.5 to 1 : 5.5.
- **Minerals**, sodium and chlorine in the form of salt, 0.5 to 1 per cent in the mash or 0.3 to 0.5 per cent of the entire ration. Calcium, 1.8 to 2.2 per cent. Phosphorus, 0.7 to 0.9 per cent. Manganese, approximately .005 per cent. Manganese, in insufficient supply, is contained in many feed ingredients. For safety add \( \frac{1}{4} \) pound MnSO₄ per ton of mash.
- **Vitamin A**, 2500 U.S.P. units per pound of feed consumed (page 128).
- **Vitamin D**, 454 A.O.A.C. chick units per pound of feed consumed (pages 105 and 132).

1 According to the vitamin D chick assay of the Association of Official Agricultural Chemists.
Other vitamins are usually in sufficient quantity in ordinary feeds.

It is desirable that the mash mixture contain six or more ingredients, at least two of them being the source of the animal food. The grain mixture should contain at least two grains and preferably more. Oats, buckwheat, and other grains high in fiber should not make up more than 35 per cent of the grain mixture.

B. Further feed factors. (1) Palatability. It is well to pay considerable attention to the natural likes and dislikes of hens. Fowls are natural grain eaters, and we make use of this liking on the part of the bird in our feeding practice. Feeds must be palatable to insure a large consumption of them.

Hens like to eat corn, wheat, oats, cornmeal, ground oats, meat scrap, gluten feed, and milk; but such feeds as blood meal, cottonseed meal, alfalfa meal, and oil meal are less palatable and should be avoided or greatly restricted in the ration.

The feeds that are most palatable are usually most digestible, because of their greater stimulation of the digestive juices.

(2) Wholesomeness. Musty or decayed feeds may cause serious troubles. It is recommended that only high-grade, clean, wholesome feed be used, as the poultry keeper cannot afford to take chances with any other.

(3) Variety. Hens are creatures of habit, and although they prefer a variety of feed, they do not like sudden changes in the ration. To provide variety in feeds, thus stimulating the appetite and increasing the consumption, the most satisfactory rations are made up of several kinds of feeds.

(4) Mechanical condition. Fowls do not like very hard, extremely small, or very large kernels. They cannot consume enough of the too bulky feeds, because birds must have their feed in a fairly concentrated form.

Feeds that are sticky when mixed with water or milk should be limited in the ration so that, when used with bulkier feeds, they will be more readily consumed by the birds.

(5) Medicinal effect. Certain feeds are laxative and valuable in keeping the digestive tract open. Such feeds are
linseed-oil meal, milk, and wheat bran. Cottonseed meal is constipating and should be used sparingly, if at all.

(6) Effect on quality of product. Some feeds have an effect on the flavor, odor, and color of eggs or meat. Green legumes, kale, sprouted oats, and yellow cornmeal give a deep yellow color to the yolk of eggs; whereas wheat, oats, buckwheat, white corn, and beets tend to give a light-colored yolk.

The flavor of eggs is sometimes affected by onions or fish scrap, and occasionally by cabbage and rape.

The flavor of poultry flesh is affected by celery, onion, garlic, and fish.

(7) Availability. On many farms, where homegrown feeds are available, one may find it practicable to utilize certain of them. In this way a ration may be compounded which may be less expensive than would be the case if a particular feed were to be sold and something else purchased. For example, oats, buckwheat, kafir corn, and other feeds may be used more freely when they are cheaper in price, and available at home or in the local market.

A mash of homegrown, ground feeds with animal feeds added gives good results.

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 lb. ground corn</td>
<td>150 lb. coarse ground wheat</td>
</tr>
<tr>
<td>100 lb. fine ground oats or barley</td>
<td>75 lb. meat scrap</td>
</tr>
<tr>
<td>25 lb. dried skimmilk</td>
<td></td>
</tr>
</tbody>
</table>

When liquid skimmilk or buttermilk is available, omit the dried skimmilk and reduce the meat scrap to 50 pounds.

A grain mixture:

150 lb. oats, buckwheat, and barley
50 or 100 or 150 lb. wheat
150 or 100 or 50 lb. corn

(8) Cost. The best feed, of course, is the one that gives the most economical return. The cost of feeds, however, differs greatly in different sections of the country and at different
The cost of a feed is not always in proportion to its value for poultry feeding; other market demands may be governing factors in determining its market value. The demand for buckwheat, oats, or wheat for human consumption may make the price of these grains almost, if not quite, prohibitive. One is justified in making changes in the kinds of feed in a ration when it is economical to do so. The feeding value of the ration should not be lowered because of cost.

The laying rations in use by successful poultrymen and recommended by various experiment stations differ. It is not likely that all conditions and factors entering into the make-up of a poultry ration would be similar, except in one locality. In certain fundamental factors all agree; in other, less essential factors they differ. What is entirely practicable for one may be decidedly impracticable for another. Thus we find that there is no one best ration.

(9) Danger in excess or deficiency of any food nutrient. If the ration is deficient the bird may draw upon its body reserves, suffering a loss in body weight and later in production. An excess may prove injurious to the health as the bird must either deposit or eliminate it. Some freedom of choice of feeds is desirable even with the best-balanced rations.

5. The importance of vitamins in feeding poultry

Vitamins are absolutely essential for growth, reproduction, and maintenance of health. Without them no poultry ration is complete. Their discovery has made the poultryman less dependent on outside weather conditions as chicks can be reared indoors quite satisfactorily, and keeping layers confined to their houses, through the entire laying year, is rapidly becoming a universal practice. They are found in foodstuffs in very small quantities. Whenever there is a prolonged deficiency in the food of any of the vitamins, animals usually develop a characteristic deficiency disease.

Up to the present time, many vitamins and factors have
been discovered. Those required by poultry are: A, B\textsubscript{1}, B\textsubscript{6}, D, E, G, K, and the four factors, antidermatosis, antigizzard erosion, and the new Cornell factors R and S. Those not required or not yet known to be required are: C, nicotinic acid, and the grass juice and W factors. (Research is constantly uncovering new vitamin facts.)

A poultry ration is considered adequate in the known vitamins if it contains a liberal amount of yellow corn, wheat, wheat by-products, milk by-products, cod-liver oil, or other satisfactory vitamin D carriers (during confinement), and alfalfa meal of a good grade.

**Vitamin A.** A serious deficiency of vitamin A frequently causes the eyelids of chickens to become granular and sticky. This condition is often accompanied by creamy-white pustules or cankers in the roof of the mouth and down the esophagus. An excess deposit of urates may also be found in the kidneys so that these organs appear nearly white in color.

The extreme form of vitamin-A deficiency is sometimes called nutritional roup. It can be distinguished from ordinary roup by the absence of the customary vile odor.

When there is an excess of vitamin A in the feed over a period of time, it can be stored in the body so that a deficiency will not appear until several months of feeding a low vitamin A ration have passed. If a partial deficiency of this vitamin occurs for a long time, unquestionably the vitality of the birds and their rate of production are lowered. A deficiency should not occur in poultry feeding. Vitamin A will be amply provided for layers and breeders if the entire ration is comprised of at least 35 per cent yellow corn and 2\(\frac{1}{2}\) per cent good alfalfa meal.

Chicks require about 1600 U.S.P. units per pound of feed. Green clover or grass range helps chicks to store a reserve for the start in production.

**U.S.P. units per gram:**

- Yellow corn—7  
- Cod-liver oil—600–3000  
- Alfalfa, sun cured—10–20  
- Alfalfa, dehydrated—165–250
Fig. 65—Effects of Vitamin deficiencies in chick rations.

A. A young White Leghorn Cockerel in the last stage of Vitamin A deficiency.
B. Symptoms of Vitamin B (thiamin) deficiency. C. Nutritional encephalomalacia, or the crazy chick disease.
Vitamin A is obtained by animals from carotene, which is abundant in feeds containing yellow pigments called xanthophyll. The xanthophyll-bearing feeds, however, tend to darken the yolks and should be fed in limited amounts. Sources of carotene in feeds for poultry are the following:

<table>
<thead>
<tr>
<th>Feeds Containing Both Carotene and Xanthophyll</th>
<th>Feeds Containing Neither Carotene nor Xanthophyll</th>
<th>Feed Containing Carotene, but No Xanthophyll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green cabbage leaves</td>
<td>White cabbage leaves</td>
<td>Carrots</td>
</tr>
<tr>
<td>Yellow corn</td>
<td>White corn</td>
<td></td>
</tr>
<tr>
<td>Alfalfa leaf meal</td>
<td>Mangels</td>
<td></td>
</tr>
<tr>
<td>Growing green feeds as:</td>
<td>Wheat</td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>Oats</td>
<td></td>
</tr>
<tr>
<td>Clover</td>
<td>Barley</td>
<td></td>
</tr>
<tr>
<td>Grass</td>
<td>Buckwheat</td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rye</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rape</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Vitamin B₁ or Thiamin.** A deficiency of vitamin B₁ in the ration results in loss of appetite and vigor, and emaciation. The disease is known as polyneuritis. Fowls in the final stage of this disease frequently will pass into violent convulsions when suddenly disturbed. The disease is not found in the field, since large quantities of vitamin B₁ are found in all unprocessed cereals.

Twenty to twenty-five U.S.P. units of vitamin B₁ in 100 grams of ration, or 60 to 80 micrograms of the commercially available crystalline synthetic vitamin B₁, protect against any trouble. The average poultry ration contains at least three times the necessary amount, providing it is made of the usual number and quantity of cereals and their by-products. The addition of yeast to poultry rations for its vitamin-B content or any special vitamin-B preparation is therefore unnecessary.

**Vitamin B₉.**¹ The symptoms of a deficiency of this vitamin

¹ From a quotation by Dr. L. C. Norris.
are reported to be slow growth, depressed appetite and inefficient utilization of food, followed in some cases by spasmodic convulsions and death. An abnormal, jerky gait is occasionally shown. The symptoms resulting from a deficiency of vitamin B₆ are apparently somewhat similar to those caused by a deficiency of vitamin B.

*Vitamin C.* Vitamin C prevents scurvy. But hens are not subject to scurvy. However, the vitamin has been found in certain of the internal organs of hens. Presumably, then, hens are able to synthesize all that they require.

*Vitamin D.* Vitamin D is concerned in the use of calcium and phosphorus. Its absence from the ration causes the bones of young chicks to fail to harden, and a deficiency disease called rickets develops within a few weeks. This is frequently called leg weakness, as the chicks become lame and finally are unable to stand. Rickets results from the inability of the bird to deposit the proper amount of calcium and phosphorus in the bones. Vitamin D is necessary also for egg production and hatchability. Its presence in the ration helps to prevent the occurrence of thin-shelled eggs. The ultra-violet light of sunlight is an effective substitute for the D vitamin as both assist the bird in utilizing the calcium. However, these ultra-violet rays do not pass through ordinary window glass. Special glazing materials can be used which allow a proportion of these rays to pass through. They must be kept clean, as dirt prevents passage of ultra-violet rays. If curtain fronts are used, they should be opened on all favorable days during the winter. Even the small amount of ultra-violet light rays in the sun and atmosphere assists in strengthening egg shells.

For hens, at least 454 A.O.A.C. units of vitamin D per pound of ration should be fed. For chicks, 180 A.O.A.C. units appear sufficient.

Vitamin D is most easily supplied by using cod-liver or sardine oil (page 104). Fish oils, reinforced in vitamin D, are available.
**Vitamin E.** This vitamin is required for successful reproduction. A lack of it in the feed produces sterility. It is difficult to prepare rations from the usual feeds which do not contain adequate amounts of vitamin E. Attempts at Cornell, and other stations, to cure range paralysis or neurolymphomatosis by the use of vitamin E has failed. This claim has been made for it.

Vitamin E deficiency in chicks causes nutritional encephalomalacia. This disease is occasionally found in the field. It results in difficulty in walking, loss of balance, tremor, retraction of the head and jerking of the legs. It is sometimes called craky chick disease. A total of 5 to 8 per cent of alfalfa meal may be added to chick mash to reduce the trouble if serious in any season.

Vitamin E is very stable in feeds except in the presence of rancidity or oxidative reactions in feeds. However, freshly milled products moving fairly rapidly to poultry farms reduce this possibility.

**Vitamin G.** Vitamin G or riboflavin is necessary for chick growth. It must be present in breeder rations to permit proper embryo growth and livability. It is required by growing chicks.

Its absence causes low hatchability, slow growth, high mortality in young stock, and a leg paralysis causing chicks to walk on their hocks with the toes turning inward.

The chief sources of riboflavin for poultry feeding are milk by-products and alfalfa meal, particularly if made from immature plants.

Chicks require about 1300 units of vitamin G per pound of feed or 290 units per 100 grams during the first eight weeks. Breeders require about 1050 units per pound of feed or 230 units per 100 grams. Not over 600 units per pound, or 130 units per 100 grams, are needed for egg production. An increase of 20 per cent above these minimum requirements is desirable as a margin of safety allowing for variation in feeds.
## Importance of Vitamins in Feeding Poultry

### Vitamin Content of Poultry Feeds

<table>
<thead>
<tr>
<th>Vitamins</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cereals:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Corn, white</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Corn, yellow</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Oats</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Soybeans</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Wheat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td><strong>Cereal by-products:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn gluten meal</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hominy feed</td>
<td>0 to ++</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Soybean oil meal</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Wheat germ</td>
<td>0</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>0</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td><strong>Milk products:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butter milk</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Butter milk, dried</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Skimmilk</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Skimmilk, dried</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Whey</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Whole milk</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td><strong>Animal products:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cod liver oil</td>
<td>++ ++</td>
<td>0</td>
<td>0</td>
<td>+ ++ ++</td>
<td>0</td>
</tr>
<tr>
<td>Fish meal</td>
<td>0 to ++</td>
<td>0</td>
<td>0</td>
<td>0 to ++</td>
<td>0</td>
</tr>
<tr>
<td>Meat scrap</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td><strong>Forages:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa, dehydrated</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Alfalfa, green</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Alfalfa, sun cured</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Clover, green</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Grasses, green</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td><strong>Vegetables:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage, green leaves</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cabbage, white portion</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Carrots, yellow</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mangeles</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Potatoes</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rutabagas</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Miscellaneous:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Liver, dried</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Yeast</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Explanation of Table

- 0 Indicates none or no appreciable amount of vitamin.
- ++ Indicates increasing amount of vitamin.
- - Indicates evidence of vitamin content lacking or insufficient.

---

### Relative Vitamin-G Content of Common Feedstuffs Used in Poultry Feeding

<table>
<thead>
<tr>
<th>Feedstuffs</th>
<th>Units of vitamin G per gram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dried pork liver</td>
<td>100</td>
</tr>
<tr>
<td>Dried yeast</td>
<td>35</td>
</tr>
<tr>
<td>Dried whey</td>
<td>30</td>
</tr>
<tr>
<td>Dried skimmilk</td>
<td>20</td>
</tr>
<tr>
<td>Alfalfa meal, dehydrated</td>
<td>16</td>
</tr>
<tr>
<td>Alfalfa meal</td>
<td>11</td>
</tr>
<tr>
<td>White fish meal</td>
<td>10</td>
</tr>
<tr>
<td>Sardine fish meal</td>
<td>7</td>
</tr>
<tr>
<td>Meat scrap</td>
<td>6</td>
</tr>
<tr>
<td>Menhaden fish meal</td>
<td>5</td>
</tr>
<tr>
<td>Wheat germ</td>
<td>4</td>
</tr>
<tr>
<td>Soybean oilmeal</td>
<td>3</td>
</tr>
<tr>
<td>Wheat middlings, standard and flour</td>
<td>2</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>2</td>
</tr>
<tr>
<td>Wheat red-dog flour</td>
<td>1</td>
</tr>
<tr>
<td>Yellow corn</td>
<td>1</td>
</tr>
<tr>
<td>Wheat, hard and soft</td>
<td>0.5</td>
</tr>
<tr>
<td>Barley</td>
<td>0.5</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>0.5</td>
</tr>
<tr>
<td>Oatmeal</td>
<td>0.5</td>
</tr>
<tr>
<td>Oats</td>
<td>Trace</td>
</tr>
<tr>
<td>Corn-gluten meal</td>
<td>0</td>
</tr>
</tbody>
</table>

Table from Cornell Agricultural Experiment Station Bulletin 660.
IMPORTANCE OF VITAMINS IN FEEDING POULTRY

D. A young White Leghorn Cockerel suffering from rickets (Vitamin D deficiency). E. Nutritional leg paralysis resulting from Vitamin G (riboflavin) deficiency. F. Dermatosis, a result of a deficiency of the anti-dermatosis vitamin (pantothenic acid).

Courtesy of Dr. L. O. Norris, Cornell Univ.

Fig. 66—Vitamin deficiencies.
### The Vitamin-G Content of 100 Grams of a Breeder Ration

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Per cent of ingredient</th>
<th>Units of vitamin G per 100 grams</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mash:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow cornmeal</td>
<td>17.5</td>
<td>20</td>
</tr>
<tr>
<td>Wheat-flour middlings</td>
<td>20.0</td>
<td>40</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>20.0</td>
<td>40</td>
</tr>
<tr>
<td>Ground heavy oats</td>
<td>15.0</td>
<td>Trace</td>
</tr>
<tr>
<td>Alfalfa meal</td>
<td>5.0</td>
<td>50</td>
</tr>
<tr>
<td>Dried skim milk</td>
<td>10.0</td>
<td>200</td>
</tr>
<tr>
<td>Meat scrap</td>
<td>5.0</td>
<td>30</td>
</tr>
<tr>
<td>Fish meal</td>
<td>5.0</td>
<td>30</td>
</tr>
<tr>
<td>Pulverized limestone</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>Salt</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Cod-liver oil (when hens are confined)</td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total mash</strong></td>
<td></td>
<td>410</td>
</tr>
<tr>
<td><strong>Scratch grain:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cracked yellow corn</td>
<td>50.0</td>
<td>50</td>
</tr>
<tr>
<td>Wheat</td>
<td>50.0</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total scratch</strong></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td><strong>Ration:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mash</td>
<td>50.0</td>
<td>205</td>
</tr>
<tr>
<td>Scratch</td>
<td>50.0</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total ration</strong></td>
<td></td>
<td>245</td>
</tr>
</tbody>
</table>
Vitamin K is not necessary for growth. Its absence prevents normal clotting of the blood. The vitamin is found in large amounts in alfalfa meal, and in meat scrap and fish meals that are not fat extracted. Hence, it is not a field problem. One per cent of dehydrated alfalfa gives protection.

The antidermatosis factor is found in cane molasses, liver meal, yeast, peanut meal, and milk and its by-products. Its absence causes chick dermatosis or chick pellegra (crusty scabs at the corners of the mouth and thickened and cornified skin on the bottoms of the feet). The eyelids become granular and sometimes stick together.

There should be little, if any, trouble when chick mash es contain a reasonable amount of milk and alfalfa. See table, page 139.

However, all such conditions occurring in the field are not of nutritional origin.
The *antigizzard erosion factor* protects against crater-like lesions on the gizzard lining. The condition is more likely to occur in the forward end of the gizzard. Growth is not affected by the presence of the trouble. Oats contain the prevention factor, while corn is a poor source of it. A mixture of feeds containing wheat bran and middlings, oats and alfalfa meal usually prevents the trouble. Hence, the usual chick rations are well supplied with the *antigizzard erosion factor*. Chicks from hens fed properly are less likely to be troubled with the disease.

*Factors R and S*, water-soluble factors, have recently been discovered at Cornell, but little information is yet available.
# Importance of Vitamins in Feeding Poultry

**Vitamins Needed by Poultry**

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Symptoms of Absence</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Slow growth, incoordination of gait, granular eyelids, urates in kidney tubules, general emaciation.</td>
<td>Yellow corn, alfalfa meal, green feeds, fish liver oils.</td>
</tr>
<tr>
<td>Vitamin B₁ (thiamin)</td>
<td>Loss of appetite, spasms with frequent head retractions, high mortality.</td>
<td>Cereals, cereal by-products, alfalfa meal, green feeds, milk by-products.</td>
</tr>
<tr>
<td>Vitamin B₆ (pyridoxine)</td>
<td>Slow growth, poor appetite, convulsions.</td>
<td>Cereals, wheat by-products, cane molasses.</td>
</tr>
<tr>
<td>Vitamin D (7-dehydrocholesterol)</td>
<td>Stiff-legged, stilted gait, beaded ribs, spinal curvature, soft bones, failures in egg production and hatchability, soft-shelled eggs.</td>
<td>Fish liver oils or synthesized in body by exposure to direct sunlight.</td>
</tr>
<tr>
<td>Vitamin E (tocopherol)</td>
<td>Hatchability failure, sterility of males, encephalomalacia (crazy chick disease).</td>
<td>Cereals, cereal by-products, alfalfa meal, green feeds, wheat germ oil.</td>
</tr>
<tr>
<td>Vitamin K (2-methyl-3-phytyl-1, 4-naphthoquinone)</td>
<td>Subcutaneous and internal hemorrhages.</td>
<td>Alfalfa meal, green feeds, animal by-products.</td>
</tr>
<tr>
<td>Vitamin G (riboflavin)</td>
<td>Poor growth, curly toes and leg paralysis, failure in hatchability.</td>
<td>Milk and milk by-products, alfalfa meal, yeast, liver.</td>
</tr>
<tr>
<td>Antidermatosis vitamin (panthenic acid)</td>
<td>Incrustations at the corners of the mouth, thickening of skin on bottom of feet, poor feathering, poor growth.</td>
<td>Yeast, cane molasses, peanut meal, soybean meal, milk by-products.</td>
</tr>
<tr>
<td>Antigizzard-erosion factor</td>
<td>Crater-like lesions in gizzard lining, frayed and loosened lining.</td>
<td>Alfalfa meal, green feeds, wheat bran, oats.</td>
</tr>
<tr>
<td>Factors R and S of Cornell workers †</td>
<td>Slow growth, lowered egg production, hatchability failures.</td>
<td>Liver, yeast, milk by-products, wheat by-products, alfalfa meal, green feeds.</td>
</tr>
</tbody>
</table>

* Table prepared by J. C. Bauernfeind, revised 1941 by Dr. L. C. Norris.
† Factor U recently discovered by Stokstad and Manning is probably identical with one or both.

Research on other vitamins is yet too incomplete or confusing for practical use. However, in order to avoid difficulties which the future may reveal, it is wise to adhere to the use of such protective feeds as green feed, dried skim milk, and other ingredients least processed in manufacture.
concerning them. They are apparently present in wheat by-products, milk, liver, yeast, and fresh green grass:

REFERENCES


CHAPTER VII

ANATOMY AND PHYSIOLOGY OF THE DOMESTIC FOWL

It is human nature to desire to take things apart and see how they are made. The poultryman is fortunate in being able to satisfy this desire, since a chicken, which is a small individual, and usually one of a large number, may be killed, examined, and later used for food. In this way no loss is occasioned, while some interesting and valuable information may be obtained. Some knowledge of the anatomy of the fowl, and of the functions of the various parts and their relation and importance to many recognized practices of poultry management, is of practical value to the poultryman. Moreover, the division of labor among the various organs and the intricate interlocking and relationship of the many muscles, bones, blood vessels, etc., furnish a most amazing example of the coordination of parts and functions.

Operations:

Studying various parts of the bird’s body, as follows:

1. A feather.
2. The feather tracts.
3. The head.
4. The brain.
5. The muscular system.
6. The respiratory system.
7. The circulatory system.
8. The digestive system.
9. The reproductive system.
10. The excretory system.
11. The skeletal system.
1. A feather (Fig. 68)

All feathers are formed on the same general principle, but they differ in size, shape, and rigidity. A large feather is most easily studied. Secure a primary or secondary feather from the wing, or one of the stiff, main tail feathers, and find the following parts:

A. The stem. This is the main part of the feather and consists of two parts, the quill and the shaft.

B. The quill. This is cylindrical and hollow, and makes up the base of the feather. It is filled with a parchment-like material called pulp. In new feathers the quill is filled with blood. This fact is used to determine whether or not a hen has new feathers.

C. The shaft. The remaining part of the stem is called the shaft. It is grooved on the under side, and therefore has great strength in proportion to its weight.

D. The vane. This comprises the shaft and the barbs attached to it. It provides a wide, tight, flat surface for protection to the body and for use in flight.

E. The barbs. The long, slender parts, projecting at right angles to and from either side of the shaft, are called barbs. The barbs and their barbules are sometimes referred to as the web of the feather. The barbs may be easily seen and appear to be stuck together.

F. The barbules. Along the sides of the barbs, and at right angles to them, are smaller processes called barbules,
which bear hooklets. These hooklets hold the adjacent barbs together and are responsible for the resistance offered when the barbs are separated.

G. The inferior umbilicus. This is a small hole in the lower end of the quill through which the blood enters to nourish the feather.

H. The superior umbilicus. This name is given to a small opening at the junction of the quill and shaft at the point where the quill emerges from the skin. The superior umbilicus connects the interior of the quill with the outside air.

I. The accessory plume. A small growth, which in some cases resembles a feather and in other cases is rudimentary and consists merely of down, is attached to the under side of the feather at the base of the shaft. This growth is called the accessory plume. It partly covers the superior umbilicus. It appears only on old feathers and hence serves a useful purpose in distinguishing old feathers from the new.

2. The feather tracts

In several sections of the body, the feathers are developed in compact formations extending over definite areas. These areas may best be seen by killing a fowl and studying the skin. The feather tracts are indicated by raised portions of the skin on which are the scars, or feather follicles. The feather tracts are located where they provide the greatest protection to the body.

When dry-picking poultry for market, the feathers on the feather tracts should be removed promptly, since tearing is likely to occur if the skin cools (Chapter XV).

Observe the following feather tracts:

A. The ventral tract. This extends the entire length of the body on the under side, passing from the head along the neck to the breast, where it divides and passes on either side of the keel bone to the cloaca. Throughout the greater part of its length, it is separated from the spinal tract by featherless spaces, one on either side of the trunk and neck (Fig. 69).
B. The femoral tract. This is a triangular tract of considerable size, on the thigh (Fig. 69).

C. The humeral tract. On the upper arm of the wing, and close to the back, this narrow strip runs crosswise of the wing. The wing coverts grow in the humeral tract.

The ventral, femoral, and humeral tracts are those most likely to tear in the process of dry-picking. There are other tracts of somewhat minor importance.

3. The head (Fig. 70)

An examination of the external head reveals the following parts:

A. The upper and lower mandibles. These form the beak, and are especially designed for picking or tearing food.

B. Two nostrils. These are oblique slits, one on either side of the upper beak.

C. The eyes. Each eye has three lids.

(1) The upper and (2) the lower lids are easily seen. The upper lid moves slightly; the lower lid moves upward, covering almost the entire eye when closed.
(3) The inner, or third lid, is a white, transparent membrane, which moves with great rapidity and diagonally across the eye, starting from the upper front section of the eye socket.

Hold a live bird quietly and, with the tip of a soft feather, carefully touch the eyeball. The inner lid will quickly pass over the eyeball.

On a dead bird, this lid is seen as a whitish material in the corner of the eye. With a pencil point it may be moved out and across the eye.

D. The ear opening. This opening is covered for protection by a cluster of small, stiff feathers. It lies behind and slightly below the eye.

E. The comb. The fleshy growth at the top of the head is called the comb, and, like the earlobes and wattles, is a secondary sexual character, the function of which appears to be sex attraction.

F. The earlobes. These are the oval, fleshy growths on the face, back of and below the ear openings.

G. The wattles. These are attached to the under side of the throat and the lower beak.

H. The face. All the fleshy, nearly featherless area around the eye is included in the face.

4. The brain (Fig. 71)

In order to study the location of the more important parts of the brain, remove the comb and skin from the top of the head, and, with a heavy, sharp knife and a hammer, cut through the center of the head lengthwise. If the cut is made directly through the middle, the brain should be easily seen.
A. The cerebrum. This is a large, bi-lobed section of the brain, lying in the upper part of the skull. It is somewhat heart-shaped.

B. The cerebellum. This is an oval body lying just below and back of the cerebrum. When the cerebellum is cut lengthwise, the inner cut surface shows several whitish lines radiating out from a whitish center.

C. The medulla oblongata. This is the rather thick, wide body lying just under the cerebellum and at the upper end of the spinal cord. It is the connecting link between the other parts of the brain and the spinal cord, and, through the cord, connects the brain with the rest of the body.

Either the cerebellum or the medulla must be pierced with the knife when the stick for drypicking is made, in order to make the muscles relax their grip on the feathers. Piercing the cerebrum will kill the bird, but will not loosen the feathers.

Place a knife on the half of the head, and observe that the
point must be directed low down at the base of the skull if the proper result is to be secured when sticking for drypicking (Chapter XV, "Sticking and Debraining").

5. The muscular system

With a sharp knife or scalpel, cut through the skin from the corner of the mouth down the side of the neck, and along the keel to the vent. Remove the skin from one side of the bird, from the keel to the middle of the back. Use the fingers as much as possible while doing this, and do not cut the flesh. Several important muscles should now be seen.¹

A. The major pectoralis. This is the large breast muscle used to pull the wing down in flight. It reaches from the rear of the keel, down and over the wishbone. Start at the base of the keel and, with the fingers, loosen this large muscle (Fig. 72). It lies on, but is separated from, a muscle just beneath.

B. The minor pectoralis. This is located below the major, and is used to raise the wing in flight. It lies in the angle formed at the junction of the keel with the body skeleton (Fig. 72).

C. The biceps. The muscle located on the inside of the humerus or upper arm, and used in closing the wing, is called the biceps.

D. The triceps. This is a muscle located on the outside of the humerus or upper arm. It opens and spreads the wing, its action being the reverse of that of the biceps.

E. The gastrocnemius. The large muscle at the rear of the tibia, or drumstick, is the gastrocnemius. It is larger at the upper end. It raises the tibia and extends the shank, or metatarsus.

On the front of the drumstick are several muscles and tendons which move the shank and toes.

By carefully removing the large outer muscle of the thigh

¹ For a more complete discussion of the many muscles comprising the bird's body, the reader is referred to Anatomy of the Domestic Fowl, by Kaupp.
and drumstick, other muscles and tendons will be observed. Their uses can be studied by pulling on them, and noting the action of the leg and toes. Note the way the bending of the leg when the bird is at rest on the roost causes the toes to grip the perch.

![Minor and Major Pectoralis muscles](image)

**Fig. 72—The breast muscles.**

6. The respiratory system

Remove the sternum or breastbone. Fig. 108. Insert the knife under the skin near the breast, and run it up the neck. Lay the skin back on the neck, thus exposing the windpipe and the esophagus, or food pipe. The head has already been split, to facilitate the study of the brain.

The respiratory system may now be seen, and may be traced from the nostril through to the end of the lungs. The respiratory system, starting from the nostril, consists of (A) nostrils, (B) pharynx, (C) upper larynx, (D) trachea, (E) lower larynx, (F) bronchi, (G) bronchial tubes, (H) lungs, and (I) air sacs (Fig. 73).

**A. The nostrils.** Examine the nostrils and the nasal chambers, and observe their proximity to the eye.
B. The pharynx. The pharynx is the part of the roof of the mouth, at the rear, on which is a row of horny projections. It is located where the soft palate is found in other animals.

C. The upper larynx. This is the opening at the upper end of the trachea at the base of the tongue.

Fig. 73—The excretory and respiratory systems.
D. The trachea. The trachea, or windpipe, is made up of cartilaginous and semi-bone-like rings, connected by muscular tissue. It extends from the upper larynx to the lower larynx.

E. The lower larynx. At the lower end of the trachea, the pipe divides; it is at this point that the lower larynx is located. The true organ of voice is contained in the lower larynx.

F. The bronchi. The lower trachea divides into two parts or tubes, one going to the right lung and the other to the left lung. These tubes, or bronchi, are provided with incomplete cartilaginous rings.

G. The bronchial tubes. When the bronchi enter the lungs, they immediately change their form, and divide and subdivide, forming the bronchial tubes.

H. The lungs. The lungs are pinkish or reddish organs, one on either side of the body. They lie imbedded between the ribs, extending downward from a point near the back. By carefully moving the internal organs near the front of the body cavity to one side, with the fingers, one may easily see the lungs.

I. The air sacs. Roll a piece of paper or make a tube from a large quill, insert it into the trachea, and blow into it. If the air sacs have not been destroyed, one or more of the nine air sacs may be inflated.

These sacs communicate with the interior of the bones. Kaupp states that, while not communicating with one another, they are so formed that they may be partly inflated, thus making the body of birds lighter for flight.

7. The circulatory system

Carefully moving the organs near the heart, observe the arteries and veins which extend from the heart to various parts of the body.

The circulatory system of birds is very similar to that of mammals. The heart consists of two auricles and two ventricles. The impure blood passes from the right auricle to the right ventricle, and from there through the pulmonary arteries
to the lungs. Purified blood returns to the left auricle, through
the pulmonary veins, and passes from the left auricle to the
left ventricle, and from there through the aorta to the body.
Impure blood returns to the right auricle, completing the cycle.

8. The digestive system (Fig. 74)

Carefully remove the entire digestive system, starting at
the mouth by loosening the tongue and the food pipe, or esopha­
gus, and then the crop. Then lift out the liver, gizzard, intest­
tines, etc., after loosening them from the body walls. Finally,
cut around the vent.

Lay the entire tract on the table and note the various or­
gans. The following organs should be seen in order. It will be
found interesting to measure the length of each section.

A. The tongue. The tongue is normally attached to the
back part of the floor of the mouth.

B. The esophagus. This is the tube through which food
travels from the mouth to the crop, and from the crop to the
proventriculus.

C. The crop. The crop is an enlargement of the esophagus,
and is used for storing and softening the food. Food is gradu­
ally sent along to the stomach as needed, by contraction of the
walls of the crop.

D. The proventriculus. Two or three inches beyond the
crop, an enlarged, muscular portion of the esophagus will be
seen, about \( \frac{1}{2} \) to \( \frac{3}{4} \) inch in diameter and from \( 1\frac{1}{2} \) to 2 inches
long. This is the proventriculus. On the inner surface are the
openings of various glands, which secrete gastric juice and
some acids. These liquids are mixed with the food and assist
in the further softening of it.

E. The gizzard. The gizzard is heavily muscled, reddish­
green in color, and located just back of the proventriculus.
Probably some gastric digestion takes place in the gizzard,
but this organ functions chiefly in crushing and grinding food.
It is the largest single organ in the body.

The gizzard is a powerful muscle. Lippincott says, “It has
been stated that iron tubes capable of supporting a weight of 535 pounds have been completely flattened out by passing through the gizzard of a turkey.”

**F. The duodenum.** Leaving the gizzard, near the point at which it entered, the digestive canal continues, forming a fold immediately after it leaves the gizzard. This loop, or fold, of the intestine is the duodenum, and supports the pancreas.

Gastric digestion, together with some pancreatic digestion, takes place in the duodenum.
G. The pancreas. The pancreas is the long, flesh-colored organ lying between the folds of the duodenum. It empties the pancreatic juice into the small intestines.

H. The liver. This is a large, several-lobed, dark red organ. It is more or less flat, becoming quite thin at the extremities. It is the largest gland in the body. The liver secretes the bile.

It is supposed that certain foods, such as sugar, are stored here by the blood, and that at least some of the uric acid is formed here and passed on to the urine.

I. The gall bladder. Partly imbedded among the folds of the liver is an elongated, greenish organ, the gall bladder. Some of the bile is stored in the gall bladder. The bile is a fluid which helps in the digestion of the fats contained in the food. A duct leads from the gall bladder to the upper end of the duodenum.

J. The spleen. This round, reddish body is found near the liver. It is usually from ½ to ¾ inch in diameter. Its function is little known. Some authorities believe that the white corpuscles of the blood are accumulated in the spleen, and rebuilt or cast from the body.

K. The small intestine. The small intestine includes both the duodenum and the remaining portion of the digestive tube, from the gizzard to the caeca. It is about 2½ feet long in the average bird. The inner surface is lined with minute villi, which may be seen by washing under water.

Pancreatic digestion, together with the emulsifying of fats by the bile, takes place in the upper end of the small intestine. Absorption, by the blood, of nutrients contained in the food mass takes place throughout the entire length.

L. The caeca. At the junction of the small and large intestines are two branches, 5 to 7 inches in length. These open into the intestine at one end, but have no outlet at the other. Because of this, they are sometimes called "blind guts." Their function is not definitely known. They appear to serve as temporary storage organs for fecal material, and some absorption may take place in them.
M. The large intestine, or rectum. That part of the tract between the caeca and the cloaca corresponds to the large intestine in other animals, and is more widely known as the rectum in poultry.

Kaupp states that digestion and absorption may continue in the large intestine.

N. The cloaca. The rectum terminates in a short, sac-like organ, slightly larger in diameter. This is the cloaca, and it is here that the ureters deposit the urine from the kidneys. The urine and the solid waste material in the large intestine are mixed together in the cloaca. The oviduct also opens into the cloaca.

The alimentary canal ends at the vent.

9. The reproductive system

In the female, the ovaries and oviduct may be seen after the digestive system is removed (Fig. 75). (See Chapter XX for illustrations and description of the system and its function.) The reproductive system of the male includes the following organs:

A. The testes (Fig. 76). In the male, the two light-colored testes will be seen lying on either side of the back, near the center of the body.

B. The vas deferens (Fig. 76). From the testes, the vas deferens extends along the kidneys and to the outside of the ureter, finally ending in the upper wall of the cloaca. Its function is to carry the seminal fluid.

10. The excretory system (Fig. 73)

This system consists of the kidneys and the ureters.

The kidneys are a pair of convoluted, three-lobed, dark red bodies, firmly imbedded among the bones along the spine and extending from the lungs well to the rear.

The ureters are a pair of tubes connecting the kidneys with
the lower part of the cloaca. The urine is passed through the ureters to the cloaca, where it is expelled with the feces. The

white, chalk-like deposit frequently seen in the voidings is due to urates, and is not, as sometimes believed, a deposit of lime.
Fig. 76—Male reproductive system.
11. The skeletal system

The structure of the bones of poultry is quite similar to that found in other animals, except that many of the bird’s bones are hollow.

In the baby chick, many of the future bones consist of cartilage, which becomes hardened into bone as the chick grows older. This fact is sometimes used in determining the age, as the rear end of the keel does not harden, and may be bent, until the bird is nearly one year old.

For names and location of the bones, see Fig. 77.

Kaupp\(^1\) gives the following divisions of the skeleton:

\[\text{The Axial Skeleton}\]

- Skull
  - Cranium
  - Face
  - Cervical Region
- Vertebral Column
  - Dorsal Region
  - Ribs
  - Sternum
  - Lumbar Region
  - Sacral Region
  - Coccygeal Region
- Shoulder Girdle
  - Scapula
  - Coracoid
  - Clavicle
- Fore Limb
  - Arm—Humerus
  - Forearm
    - Radius
    - Ulna
  - Hand
    - Carpus
    - Metacarpus
    - Phalanges

\[\text{The Appendicular Skeleton}\]

- Pelvic Girdle
  - (Hip Bone)
  - Ilium
  - Ischium
  - Pubis
- Hind Limb
  - Thigh—Femur
  - Leg
    - Tibia
    - Fibula
  - Foot
    - Metatarsus
    - Phalanges

\(^1\) Anatomy of the Domestic Fowl.
Secure a skeleton and identify the bones comprising the skeletal system by referring to the illustration.

REFERENCES

CHAPTER VIII

USING ARTIFICIAL ILLUMINATION ON LAYING AND BREEDING STOCK

Operations:
1. Installing illumination in the poultry buildings.
2. Operating the lights.

General information:
1. Artificial illumination vs. the hen's nature.
2. The principle of artificial illumination.
3. Intensity of light.
4. The lighting unit.

1. Installing illumination in the poultry buildings

The lighting unit which best fulfills all the requirements is a standard 40-watt Mazda lamp. (If all night lights are used, a 10- or 15-watt lamp may be used in place of each 40-watt lamp. The total watt-hours are not greatly different.) A cone-shaped reflector (Fig. 78), 16 inches in diameter at the base by
4 inches high, with the reflecting surface of aluminum bronze gives the best results.

A. How to make the reflector. In Extension Bulletin 411, published by Cornell University, we find these instructions for making a reflector:

The local tinner can do a much neater job than the amateur. If the tinner is to make the reflectors, it will only be necessary to furnish him the shade holders and the dimensions of the reflector, 16 inches in diameter by 4 inches high, and to instruct him to rivet or solder the shade holders to the reflectors. When the reflectors come from the tinner, wash them in a weak solution of vinegar and water, allow them to dry thoroughly, and then paint them on the inside with three coats of aluminum paint. One ounce of aluminum bronze and $\frac{1}{2}$ pint of French bronzing liquid will be sufficient for three coats on ten reflectors. The aluminum reflecting surface will not discolor, and will retain its reflecting properties much better than will white enamel paint.

B. Height above the floor. The best distribution of light is obtained when the lighting units with the reflectors are located 6 feet from the floor, 10 feet apart, and along a line midway between the front of the house and the front of the droppings board.

C. Determining the number of lighting units necessary per pen. In the Cornell Extension Bulletin 411 we find also these instructions for determining the necessary number of lighting units:

To find the number of lighting units that will be required for a given size of pen, divide the number of square feet of floor area by 200. The nearest whole number will be the number of units required.

**Examples**

(1) For a $15 \times 50$-foot pen:

\[ 15 \times 50 = 750 \text{ sq. ft.} \]

\[ 750 \div 200 = 3.75 \]

Thus, four lighting units will be required. Place these units 10 feet from either end and 10 feet apart.

(2) For a $20 \times 20$-foot pen:

\[ 20 \times 20 = 400 \text{ sq. ft.} \]

\[ 400 \div 200 = 2. \]
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Thus, two lighting units will be required. Place these units 10 feet apart and 5 feet from either end.

It has been found, by repeated experiments, that a spacing greater than 10 feet causes the birds to form groups under each unit. A 10-foot spacing of the lighting units produces a regular feeding area when floor feeding is practiced. A 12-foot spacing produces an irregular feeding area.

If the poultry house is partitioned into pens, figure each pen separately.

2. Operating the lights

The lights should be operated in accordance with the principles laid down in the following paragraphs.

A. Length of day. A 10-hour night and a 14-hour day provide a desirable lighting plan, duplicating the normal April night and day in the latitude of New York State. However, all-night lights, using a smaller lamp (page 160), are satisfactory.

B. General rules. The following rules for the use of artificial illumination on a flock of layers will be found useful.

Part-time lighting. (1) Turn the lights on, by hand or automatically, at 5 or 6 A.M.

(2) Turn the lights off when there is sufficient daylight to enable the birds to find grain.

(3) Turn the lights on at twilight, when the fowls would have difficulty in finding grain in the litter, because of darkness.

(4) Turn the lights off at approximately 6 or 7 P.M. When the above procedure is used it should be followed regularly throughout the season of illumination.

The exact time of day that the lights should be turned on in the late afternoon (3 above) will vary from day to day according to the season and condition and amount of sunshine.

It is desirable, but not absolutely necessary, to install a dimming device in order to enable the birds to go to roost of their own accord. However, if the birds are fed at 4:30 or 5:30 P.M., thus having 1 ½ hours of feeding time before the
lights are turned off at 6 or 7 P.M., they soon become accustomed to going to the roosts when their crops are filled.

For a few nights, the attendant should see that the birds which have not gone on the roosts of their own accord are placed on the perches and are not allowed to remain on the floor or roost on the window sills, or interior fixtures. This precaution will usually result in fixing the roosting habit. It will help prevent colds among the birds and will also prevent the appliances from becoming soiled.

A board from floor to perches helps the birds in reaching the roosts after the lights are out.

*All-night lighting.* Turn the lights on any time in the evening and off when convenient in the morning. An auto-
matic device will save current in the spring when daylight begins early.

C. Determining the season to start lights. The time of the year to start artificial illumination will depend upon, first, the latitude in which the poultry plant is located; and second, the age, the maturity, the laying and physical condition of the birds. There is no one best time for all flocks.

**THE AMOUNT OF DAYLIGHT AND DARKNESS AND ILLUMINATION**

AT CORNELL UNIVERSITY, ITHACA, NEW YORK

*In Monthly Periods From Sept. 1, Apr. 1 Illumination Twilight 8 P.M.*

![Diagram](image)

**FIG. 80.**

Lights to a certain hour at night only provide an uneven length of day. Note the distance from dawn until the evening hour when the lights are turned off. A different length of day from day to day is not satisfactory.

D. Starting lights. When commencing to use lights in the fall of the year, full lighting may be given immediately. Once started, lights should be continued without interruption; otherwise a slump in production and a molt may occur.

E. Taking the lights off in the spring. Artificial illumination should be continued with commercial laying and breeding flocks until such time as the normal length of day is 13 to 14 hours. This usually occurs in the latter part of March or early
April. At this time the lights may be gradually discontinued until sunshine or daylight then takes the place of artificial light.

All-night lights. Half the lamps in each pen may be discontinued first, and the others a month or six weeks later or just before the longest days of the year.

F. Determining the time of day to use lights. The time of day when lights should be used will depend quite largely upon the source of light, i.e., commercial electric current supplied by power plants, current generated by a private or independent electric lighting unit, or lanterns. Whether the lights are given at twilight, later in the evening with an evening lunch, in the morning, both evening and morning, or all night is of less consequence than the total number of watt-hours of illumination.

The use of lights at any particular time of the day is primarily a question of convenience for the operator. Each method of using lights has its particular advantage.
(1) The *early evening* lights give the birds the opportunity to fill up their crops before going to roost regardless of the method of feeding grain.

They are also easy to apply in many cases, since it enables the operator to include the feeding and lighting among the early evening chores.

(2) The *evening lunch* has the advantage of reducing the time between the last feeding at night and the first feeding in the morning. The evening lunch is the most economical in the use of light, and consists of giving lights and feeding for 1 to 1½ hours between 8 and 9:30 P.M.

Fig. 82—Wiring diagram for morning light.

This system of wiring is controlled by a switch and is the same as any house lighting circuit.

(3) The *morning lights* have the distinct advantage of enabling the birds to make the best possible use of the lighting period, since it comes early in the morning after a long night’s rest. The birds leave the perches quickly, thus soon becoming exposed to the rays of light. Morning lights may be turned on by an automatic device. Dimmers are unnecessary (Fig. 82).

(4) Giving the light *partly at night and partly in the morning* has the great advantage of enabling the operator to overcome the changing period of twilight and dawn, thus giving the birds a uniform day and a uniform night throughout the entire lighting season (Fig. 83). It enables the bird to secure its exercise and its food in the 13- to 14-hour day with perfect regularity.

(5) The *all-night* method comes closest to meeting indi-
vidual needs. Hens go to roost about the normal time whether lights are on or not. A few may busy themselves about the pen the first half of the night. Starting at 1 or 1:30 A.M. larger numbers leave the perches. Thus, no bird is compelled to remain roosting longer than she desires.

G. Using lights on pullets. Separate the pullets into flocks according to their maturity and laying condition, as indicated by their comb development and weight.

**THE AMOUNT OF DAYLIGHT AND DARKNESS AND ILLUMINATION**

<table>
<thead>
<tr>
<th>Time</th>
<th>Summer Daylight</th>
<th>Winter Daylight</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 A.M.</td>
<td>Dawn to 7 P.M.</td>
<td>6 A.M. to Dawn</td>
</tr>
</tbody>
</table>

**Fig. 83.**

Lights in the morning from a certain regular hour until daylight and from twilight until a certain fixed hour provide an even length of day during the winter and prevent a constant changing of hours for eating and sleeping, for the birds. There should be perfect regularity of the time between supper and breakfast and breakfast and supper throughout the winter.

1) High producers. Well-matured pullets will be the best laying birds, assuming that all are approximately of the same age and have been given similar rearing conditions. Such birds will require less light in order to give a satisfactory winter production. The better the laying quality of a bird, the less it needs artificial light to enable it to lay well.

Such pullets should continue to increase in production without lights. When very cold weather arrives and the birds
appear inactive, lights may be started. After once starting the lights, continue them until the following spring.

(2) Slow-maturing birds. The slow-maturing pullets of the same age as (1) should be given somewhat longer hours of illumination if they have well-developed bodies but are slow in reaching sexual maturity.

These two groups or grades of pullets (1 and 2) can be given artificial illumination more successfully when in separate pens, because each grade may then be supplied according to its needs.

(3) Late-hatched pullets. To late-hatched pullets which have not yet reached their proper size and maturity, little if any illumination should be given until their bodies are well-developed, in order to prevent premature production of eggs, and ultimate smaller size of eggs and stock.

(4) Rule for using lights on pullets. As to the exact amount of illumination which should be given there is no fixed rule that will apply in all cases. The principle which should be followed, however, is that pullets must have an ample supply of a complete ration to meet adequately the demands made on the body by the stimulating effect of light, thus constantly maintaining or increasing the body weight.

The three qualities of birds mentioned above (1, 2, 3) could reasonably be expected to produce as follows, if they were good-sized birds for their breed: for grade (1) from 60 to 70 per cent; for (2) from 40 to 60 per cent; for (3) no eggs should be produced until the birds have reached the proper size for the variety.

H. Continuing fall production by the use of lights. The usual flock of hens during late summer and fall is made up of individuals which may differ widely in their physical condition and laying capacity. Artificial illumination cannot be applied with the greatest satisfaction to such a flock. Hence it follows that, if lights are to be used most effectively, the hens must first be separated into grades according to their physical condition and laying capacity. Failure to do this is the principal
cause of the unsatisfactory results which sometimes follow the use of artificial illumination.

The first step, therefore, to be taken in the use of lights is to so separate the prospective layers into flocks during the fall and winter that all the hens in each flock shall be essentially similar in their reproductive condition.

1. The hens that cease production during June, July, and early August presumably are such poor layers that it would not be profitable to feed them during their long vacation period in order to get the few eggs they might lay in the fall and winter. These birds should be culled (Chapter I).

(early-hatched birds that have laid continuously for thirteen or fourteen months by June or July and then have rested may be kept for a second year. As layers, however, they are less desirable than their sisters in 3 and 4.)

2. As the days become shorter in late August and September in the latitude of New York State, lights may be started on the laying flock, keeping a 13- to 14-hour day. This practice holds the birds in production longer in the fall, at a time when egg prices are usually advancing.

3. The birds that cease production, under normally satisfactory conditions of feeding and care, in late August or September, may be culled or, if they are to be held as layers for a second year, they should be given full opportunity to recover their plumage and regain their weight. To do this, place them on range away from the main flock, or by themselves in separate pens but without artificial illumination. Recovery is indicated by the return of a normal amount of color pigment in their beak, shanks, plumage, and skin. Give artificial illumination about the first of November, at which time their new plumage will be nearly full grown. They should respond quickly with a production of approximately 50 per cent or more, and should maintain it with only slight variation, under correct methods of feeding, through the winter. They may drop off slightly for a short time in the spring of the year, and increase production during the late summer.
4. The fall-lighted flocks (2) will continue producing well into the winter. However, if the birds are to be held for production a second year, better results, financially, are likely if they are given ample time to rest, recuperate fully, regain their weight, and renew their plumage and pigmentation.

About November 1 to 15 for future breeders, or November 15 to December 15 for future layers, force the remaining non-molting birds out of production.

I. Forcing birds out of production. Turn off the lights abruptly. Take the mash away. Give no water for one day. As soon as production has stopped and the birds are molting, feed grain and mash in the usual manner. Seven or eight weeks from the time production ceased, give artificial illumination in the usual manner. The new plumage should then be nearly two-thirds or three-fourths grown.

As layers or breeders the flock should respond within two weeks after the lights are started.

The policies outlined in this chapter should make it clear that the proper segregation of birds according to their laying capacities and time of molting, supplemented by artificial illumination, will result in the division of the laying flock into two distinct groups of layers. The first group consists of those birds which cease production late in the summer or early in the fall, take their vacation, and then, through the use of artificial illumination, are induced to resume production several months earlier than they otherwise would. These are the commercial layers. The second group consists of those birds which, being aided by artificial illumination to continue their laying cycle to November or December, postpone their molt and thus increase the length of their laying cycle and the number of eggs laid within the laying year.

It also correspondingly delays the beginning of their next year's production until the middle of the winter or early spring. These birds are, almost without exception, the highest producers.

From the above it will be seen that artificial illumination
provides a powerful controlling factor in starting or in stopping production, as may be desired according to the quality of the birds.

J. Artificial illumination in the second year of production. Artificial illumination, it should be understood, with all of its power in controlling production, cannot create a condition which will enable birds to lay uninterruptedly from one laying cycle into the next without a rest.

Two methods of managing birds through the winter are used. First: The forced rest described on page 170. Second: Continuous lighting. In this method management for production continues through the winter and the following year. Individual birds will cease production for a time, rest, molt, and resume production.

Continuous lighting should not be used. Higher production and better hatchability usually result after rest. Failure to appreciate the need for several weeks of rest is responsible for the general impression on the part of poultrymen that frequently the second year's production of birds that have had artificial illumination the first year is not as satisfactory as the second year's production of birds that have not had artificial illumination the first year.

If, however, the poultryman observes the principle of giving the birds a proper vacation between their annual laying cycles, the use of artificial illumination in the first year should have no detrimental effect.

K. The problem with high producers. The more highly birds are developed by breeding, in their tendencies to lay large numbers of eggs, the more difficult becomes the problem of creating conditions which will enable these high-producing birds to take their vacations before they have reduced their vitality to the point of permanent injury.

The problem is quite as much a question of feeding as of artificial illumination. Both means may be used to enable the high-producing birds, by taking a proper vacation each year, to maintain high production for periods of years.
which is made too often is allowing the high-producing birds to continue in production until but a short time before the hatching season, or even, in some cases, right through without a stop. The desire of the owner for eggs at that season of the year must not take precedence over the natural laws of reproduction which demand that breeders be allowed a rest of several weeks or months, in order that good fertility, hatchability, and vigor of chicks may be secured.

Breeders, therefore, should be thrown out of production approximately 15 to 16 weeks before chicks are desired.

Birds handled as suggested under H to J are more vigorous, more productive, and produce more fertile eggs and stronger chicks than hens not having this advantage.

L. Using lights on males. The same principles of artificial illumination and feeding apply to the males as to the females. Whatever tends to cause the development of eggs in the female results in more active mating and fertilization of eggs on the part of the male.

M. Cost. One extra egg per bird during the fall or early winter is usually sufficient to cover the cost of the electric current. Poultrymen have frequently found that the increased returns due to artificial illumination have been sufficient to cover the entire cost of installation and operation the first year where one thousand birds or more were involved.

The fuel and operating cost of lights for a flock of 1100 birds was 4.4 cents per bird for the season where an individual Farm Lighting Unit was used, according to the N. J. Agricultural Experiment Station. In this case one egg per bird would about pay the bill.

The Oregon State Agricultural College found that "the cost of electricity was always small in comparison with the increased returns for winter eggs. Less than two-fifths of an egg per hen, per month, paid the electricity cost." This station found, on the basis of a flock of 400 pullets not culled during the period, that for eleven months the gain made by the lighted pens over the unlighted would pay 8 per cent interest on an
investment in lighting equipment of $1013. Had the test been made on a properly culled flock, the value of lighting would, no doubt, have been even more pronounced.

GENERAL INFORMATION

1. Artificial illumination vs. the hen's nature

The hen is by nature a native of a tropical country where the nights and the days are of essentially equal length, and where the temperature permits fowls to live in the open air the year round. In domestication in the north, she is kept under unnatural conditions.

In all the centuries during which the hen has been under domestication, she has adapted herself to her environment—to cold climates, unnatural food, and close confinement—by changing her habits, rather than by changing her physical nature. Not being able to migrate to more favorable environments as some of her bird relatives do, when the days shorten and the amount of light lessens, she simply makes the best of it. She produces fewer eggs unless her progressive owner gives her the normal daylight conditions of spring during the dark winter months.

The owner can accomplish essentially the same result either by transferring the hens in the fall of the year to a more congenial southern climate where the hours of daylight are longer and the nights are shorter, as in Florida, or by doing what is less expensive and more practicable—by providing light to duplicate the normal spring day in the north or winter day in the south.

The hens can then see to eat and work as they desire. Food and water, while not the primary motivating influences, are efficient co-workers with artificial illumination. If they are not supplied in quantity, the stimulating effect of light may result disastrously, by causing loss in weight and production.
2. The principle of artificial illumination

Light increases food consumption indirectly. Certain rays of light stimulate, largely through the eye, the hypophysis or pituitary gland near the base of the skull. This gland, under this stimulation, liberates into the blood circulation a material called a hormone (one of several), which in turn stimulates the ovaries of the bird, causing increasing development of the egg yolks.

The rapid growth of egg yolks draws heavily on the reserve food supply and the consumption of food is increased as the larger numbers of eggs are produced.

Birds bred for many years for high production are less affected by light, possibly because the availability and supply of the particular hormone is likewise hereditary.

But the proper use of artificial illumination is a wonderful aid, even under these conditions. Its use to help prevent slumps in production during very cold weather and to start birds into production quickly after the rest period are examples.

However, the most marked results are seen on late-maturing pullets and on hens, which, under normal conditions, would not have laid until spring. Here the difference in production due to the use of artificial illumination is sometimes surprising.

Whetham states that "high producers are less affected by variations in the daily light period, probably because of an hereditary high level of the hormone" involved, and further that light raises "the production of the poorer... toward that of the best," presumably by stimulating an increased secretion of the necessary hormone until the amount more nearly approaches the amount already available to the higher producers.

3. Intensity of light

The use of artificial illumination is closely associated with the method of feeding. Although the effect of light is one of stimulation, an appetite for more food is created. The birds

should go to roost with full crops. Hence, the influence of the
method of lighting on the efficiency with which the birds can
eat grain at night must be considered.

A greater intensity of light is needed when feeding grain in
the litter at night, in order for the birds to see the kernels of
grain, than is required when feeding by the trough or free-
choice methods.

Professors Fairbanks and Heuser, in the Cornell Extension
Bulletin 411, have written on the intensity of light, the lighting
unit, and the means of supplying illumination. Their com-
ments and suggestions are reproduced in the remaining pages
of this chapter.

Since nature determines the rapidity with which birds pick up grain
under normal daylight conditions, it seems reasonable to assume that
there is a certain intensity of light on the floor of the poultry house
below which a decrease in the activity of the birds would be noted and
above which no increase in activity would be obtained.

The general illumination of the pen is quite as important as is the
illumination of the floor. In experiments at Cornell University, it was
found that, even with the proper intensity of light on the feeding floor,
if the perches were dark, a number of the birds would not come down
to feed (Fig. 84); and that when the lighting unit was changed so as
to throw light on the perches and at the same time keep the proper
floor intensity, all the birds came down to feed (Fig. 79).

It has been determined that the intensity of light on the floor
necessary for active feeding is from 0.8 to 1.0 foot-candle.¹

4. The lighting unit

The selection of the lighting unit therefore resolves itself into a
question of the size of the lamp, the size and shape of the reflector,
and the height from the floor which would best combine to give the
required intensity of light for active feeding, over the largest floor area
and also on the perches, with the least expenditure of electric energy.

A. The lamp. Refer to Fig. 78.

B. The reflector. Refer to Fig. 78.

¹ A foot-candle is the amount of illumination given by a standard
candle at a distance of one foot.
The effect on the birds of a lamp without a reflector is shown in Fig. 85. There is not enough light on the floor for the birds to see the grain readily. Owing to the insufficient light, the birds are not active, and are going back on the perches.

Fig. 84—Result of using a wrong type of reflector.

The corners and perches are dark.

The cause of this low intensity on the floor is that the rays of light are going out from the lamp in all directions, some striking the walls and the ceiling, where light is not needed. When the reflector, a very important part of the lighting unit, is placed on this lamp (Fig. 79), it will deflect the rays of light from the walls and ceiling to the floor. When the reflected rays are thus added to the direct rays from the lamp, they bring the light on the floor to the proper intensity for active feeding.
5. Means of supplying illumination

The easiest and most efficient method is by the use of electricity.\(^1\)

These subjects are discussed thoroughly in Cornell Extension Bulletin 204 and a book in the Wiley Farm Series *Electricity in the Home and on the Farm*, by Forrest B. Wright. The various power companies have valuable publications, free upon request. A good contractor or other capable electrician is necessary in order that the work will meet the approval of the National Board of Fire Underwriters.

\(^{1}\) When it becomes necessary to carry electric current from a distance to and into the poultryhouse, special information is needed concerning the size of wiring necessary to carry the maximum amount of current required, the system of wiring best adapted to the particular situation, and proper installation.
(1) The resistance-unit system. The resistance-unit system now used (Fig. 86) makes use of a fixed resistance \((R)\) instead of a variable resistance. The time switch \((S)\) turns the lights on bright by moving the knife arm up to contact the main circuit. To dim the lights, the knife arm is moved down to throw the resistance \((R)\) in series with the lights. To turn the lights off, the knife arm swings up to the central, or off, position as shown in Fig. 86. This system does not lend itself readily to any subsequent rearrangement, because, if the number of lights were increased or decreased, the resistance unit also would have to be changed, in order to give the desired intensity of light. This system is seldom used.

(2) The two-circuit system. The two-circuit system
requires no change of apparatus to maintain the same respective intensities of light for bright and for dim, regardless of changes in the number of units, and may be extended as far as the current-carrying capacity of the wire permits.

The two-circuit system (Fig. 87) consists of two lighting circuits with a common wire or two separate circuits of two wires each. For this system, three wires are run the length of the house. Across  \( N \) and  \( B \) are the standard 40-watt lamps for the bright feeding light, and across  \( N \) and  \( R \) are the small 15-watt lamps for the dim or roosting light, one for every 400 square feet of floor area. To turn the bright lights on, the switch (\( S \)) arm is moved up to contact the  \( BN \) circuit. When the dim or roosting lights are required, the switch arm is moved down to contact the  \( RN \) circuit. To turn all lights off, the switch arm is moved to the central, or off, position (Fig. 87).

This system may be operated by hand or by a time clock, and permits any method of handling birds under artificial light.

B. Control devices. About control devices Professors Fairbanks and Heuser have written:

The simplest circuit is one without a dimming device and requires only a switch for turning the lights on and off. The time switches that are on the market for this purpose cost from $10 to $15; but many ingenious poultrymen have connected an ordinary alarm clock (Figs. 88, 89, and 91), with a simple switch for turning on the lights.
C. Gasoline and kerosene lanterns. On this subject Professor Fairbanks wrote in a previous Cornell Extension Bulletin, No. 90:

Where electric current is not available and the size of the poultry plant does not warrant the purchase of an independent lighting system, several other sources of light may be used successfully.

The use of kerosene lanterns serves the purpose of lighting up a small portion of the feeding area of the floor so that the fowls may secure food from the feed hopper and in the litter near the lantern. Considering the cost of fuel, the time spent in operating the lantern, and the possible danger from fire, the kerosene lantern, when lighted outside of the poultry building and placed properly in it, is perhaps our simplest form of illumination.

Side or top reflectors may be used advantageously to concentrate the light where it is most needed (Fig. 92).

The gasoline lantern furnishes a more brilliant light than does the ordinary kerosene lantern. During the time it operates, it has the dis-
advantage, unless a special reflector is used, of throwing a dark shadow directly beneath the bowl of the lantern. Gasoline, being more volatile and explosive than kerosene, is somewhat more dangerous from the standpoint of fire hazard. The intensity of the light of the gasoline lantern, when proper pressure is maintained in the tank, is its chief advantage over the ordinary kerosene lantern as a source of illumination.

Gasoline or kerosene lanterns or open-flame lights of any kind should be used, if at all, only when the attendant is reasonably near and can use the lights in connection with his regular chore work, thus reducing the danger of fire.
COMMUNITY SURVEY

Visit as many poultrymen as possible and, by means of inquiring and by observation, find:

(a) The method of supplying light, as lanterns, home generating plant, city supply; etc.
(b) What percentage of the poultrykeepers are using lights.
(c) What kinds of reflectors for electric lights are used.
(d) During what hours lights are used.
(e) The number of lights carried.
(f) The watts or candle-power used per hour of illumination.
(g) The total watts or candle-power used per day.
(h) The methods of wiring for electric lights.
(i) How far above the floor the different lights are located.
(j) What, in the minds of the poultrymen of the community, are the chief benefits derived from lights.
(k) What the cost of lights is for the year.
(l) What percentage of the poultrykeepers are using lights on breeders.

REFERENCES

Bissonette, T. H., "Does Increased Light Absorption Cause Increased Egg Production?" Poultry Science, November, 1933.
Wright, F. B., Electricity in the Home and on the Farm, John Wiley and Sons, Inc., 1935.
CHAPTER IX

KEEPING RECORDS OF THE FLOCK

Practices intended to improve the poultry enterprise may be put into effect quickly, because the business lends itself readily to study by means of records and accounts. Rapid advances in the poultry business have been brought about in recent years by the experiment stations and colleges of agriculture and the accurate records and accounts kept by poultrymen. Because of the varying conditions existing on poultry farms, it is necessary for the poultryman to keep such records as will enable him to study his business. Records and accounts, accurately kept and studied, will bring increased profits in greater proportion than almost any other work the poultryman performs.

Operations:

1. Keeping the egg record.
2. Keeping the flock record.
3. Keeping the incubation record.
4. Keeping the brooder record.
5. Keeping the financial records.

1. Keeping the egg record

Regardless of the number of records kept, no poultry enterprise, whatever its size, should be without a record of the daily egg production.

A. Using the sheet. A sheet may be placed in each house, or in the room where each day’s gathering of eggs is counted. Tack a string and pencil, with eraser, to the wall near the sheet.
**EGG RECORD**

**CORNELL POULTRY ACCOUNT BOOK**

**PEN SHEET**

NEW YORK STATE COLLEGE OF AGRICULTURE AT CORNELL UNIVERSITY, ITHACA, N. Y.

Operator No. 63

Total eggs during year 34945

Breed S. C. W. L.

Pen No. 1 and 2

No. Birds 212

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<th>P.M.</th>
<th>December A.M.</th>
<th>P.M.</th>
<th>January* A.M.</th>
<th>P.M.</th>
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<th>P.M.</th>
<th>March A.M.</th>
<th>P.M.</th>
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29 ...

30 ...

31 ...

Total ... 3275 1098 3270 1090 2567 903 2196 1060 1117 516 1302 459

* A respiratory disease broke out in January. Apparently this was a form of wet pox, unaccompanied by external lesions. Production dropped. Many birds molted. Production was resumed after two months.
B. Importance. The egg record shows variation in production, and gives information on which a change in feeding or management may be based. It serves to check the influence of weather conditions, feeding, housing, and general care on production, and is used as a basis for flock improvement. It also creates and stimulates interest in better management.

2. Keeping the flock record

This record does not include males, except that the number on hand at the last of each month may be recorded, if desired.

A. Using the sheet. Record any change that occurs in the number of birds.

B. Importance. This record shows the number of birds in the flock at any time. It shows when mortality occurred, gives a record of culling, and, with the egg record, provides a means of finding the per cent production during any month or any period of time.

3. Keeping the incubation record

A. Using the record. A record should be kept of eggs set, chicks hatched, pen number, percentage infertile or dead or both; and other details of each hatch. A card may be tacked at each machine, or at each section in the case of Mammoth machines. By numbering trays, a record may be kept of any group of eggs on which the data are desired.

Some persons prefer to use one large sheet only, recording on it the data as found. This may save time for the operator and is best under some conditions.

B. Importance. The incubation record not only gives a check on the fertility and hatchability of the flock for different periods during the season and for different seasons, but enables the operator to compare the efficiency of different pens, or perhaps different individuals in the pen, if pedigree breeding work

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1 The method of figuring per cent production is shown in Chapter X.
is being done. (See Chapter XIX for discussion of pedigree breeding.)

Perhaps the greatest immediate service rendered by the incubation record is of an experimental nature, and consists of checking the efficiency of machines or sections in the same machine, or the method of operating machines. This record is made more interesting and profitable when used in connection with a sheet on which the temperature curve is plotted as the hatch progresses and changes in ventilation and moisture conditions are recorded (Fig. 218).

4. Keeping the brooder record

A record should always be kept of the number of chicks placed under a hover, the date hatched, the mortality each day, and birds sold or used. On this sheet or elsewhere the amount and value of feed, litter, and fuel used should be recorded.

A. Using the sheet. If the chicks are brooded in large flocks, a sheet for each flock is desirable. If a hatch is divided among several small hovers, one record for the entire hatch may be sufficient.

B. Importance. The brooder record shows the mortality and the number of chicks on hand at any time, and compares the efficiency of groups of chicks, heaters, and brooder practices.

5. Keeping the financial records

On most farms, poultry is kept for financial gain. The best results can usually be accomplished, and the facts of the business most clearly known, when a system of accounts is kept.

Poultry keeping is a business involving many financial and other details. No business can be efficiently managed without keeping adequate records.

A. Single entry. The single-entry system of bookkeeping is best for the small flock. By its use a record is kept of all income and outgo. From it a person can find the gain or loss, the amount of grain and mash consumed and cost of the same,
**CORNELL POULTRY ACCOUNT BOOK**

**MORTALITY AND CULLING RECORD**

Operator: No. 63  
Period: Sept. 1, 1936 to Aug. 31, 1937

Number to begin period: Hens: .......  
Pullets: 212  
Breed: W. L.  
Pen No.: 1 and 2

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Hens added:  
Date: .......  
Nov. 1  
Dec. 1  
Jan. 1  
Feb. 1  
Mar. 1  
Apr. 1

Hens left:  
211  
208  
203  
198  
195  
194
## BROODER RECORD
### Record Losses Below

#### Name No. 63

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### Chicks Sold or Eaten

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<td>June 11</td>
<td>74</td>
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<td>May 30</td>
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### Pullets Sold

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<tr>
<th>Pen</th>
<th>Date</th>
<th>No.</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

* Oil stoppage in brooder stove, 70° at noon. Temp. back to normal by 2 p.m.
**INVENTORY**

Farm No. 63

<table>
<thead>
<tr>
<th>Include below everything used for or by the poultry flock, either the whole valuation or the proportionate share.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beginning of year:</strong> Date Sept. 1, 1936</td>
</tr>
<tr>
<td><strong>Number or amount</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>I. STOCK †</strong></td>
</tr>
<tr>
<td>Pullets</td>
</tr>
<tr>
<td>Hens</td>
</tr>
<tr>
<td>Males—Capons</td>
</tr>
<tr>
<td>Broilers and fryers</td>
</tr>
<tr>
<td><strong>Total stock</strong></td>
</tr>
<tr>
<td><strong>II. FEED</strong></td>
</tr>
<tr>
<td>Grain</td>
</tr>
<tr>
<td>Mash</td>
</tr>
<tr>
<td>Grit, shells</td>
</tr>
<tr>
<td><strong>Total feed</strong></td>
</tr>
<tr>
<td><strong>III. LITTER</strong></td>
</tr>
<tr>
<td><strong>IV. EGGS ON HAND</strong></td>
</tr>
<tr>
<td><strong>V. EQUIPMENT AND SUPPLIES</strong></td>
</tr>
<tr>
<td>Specks</td>
</tr>
<tr>
<td>Water warmers</td>
</tr>
<tr>
<td>Egg cases, fillers, cartons, etc.</td>
</tr>
<tr>
<td>Shipping coops</td>
</tr>
<tr>
<td>Fencing</td>
</tr>
<tr>
<td>Disinfectant and spray material</td>
</tr>
<tr>
<td>Cleaning equipment</td>
</tr>
<tr>
<td>Feed and egg pails</td>
</tr>
<tr>
<td>Feed hoppers</td>
</tr>
<tr>
<td>Superphosphate</td>
</tr>
<tr>
<td>Hatchet and nails</td>
</tr>
<tr>
<td>Miscellaneous</td>
</tr>
<tr>
<td><strong>Total equipment</strong></td>
</tr>
<tr>
<td><strong>VI. LAND</strong></td>
</tr>
<tr>
<td><strong>VII. BUILDINGS</strong></td>
</tr>
<tr>
<td>Laying houses and barn</td>
</tr>
<tr>
<td>Brooder houses</td>
</tr>
<tr>
<td>Storage space, feed, eggs, incubators, litter</td>
</tr>
<tr>
<td><strong>Total buildings</strong></td>
</tr>
<tr>
<td><strong>Total investment</strong></td>
</tr>
</tbody>
</table>

*This inventory is for a laying flock only. Rearing inventories for 1937 are not included. See pp. 206 and 207 for example of finding rearing costs.

† Inventory stock at the price they normally would have sold for on the farm.
Expenses and income should be recorded each day. If there are no items to be recorded or whether they were forgotten. Include here eggs used for home consumption (not including hatching eggs) worth at the farm at that time.

<table>
<thead>
<tr>
<th>Date</th>
<th>Grain</th>
<th>Mash</th>
<th>Other feed</th>
<th>Litter</th>
<th>Egg cases, fillers, cartons, and the like</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pounds</td>
<td>Dollars</td>
<td>Pounds</td>
<td>Dollars</td>
<td>Pounds</td>
</tr>
<tr>
<td>1</td>
<td>1000</td>
<td>23.33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>2.30</td>
<td>100</td>
<td>2.80</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>100</td>
<td>2.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1800</td>
<td>37.28</td>
<td>300</td>
<td>8.40</td>
<td>1.65</td>
</tr>
</tbody>
</table>

* Include only hatching eggs purchased.
† Indicate kind and number of poultry in last column.
MONTH OF JAN., 1937

expenses, place a check mark (✓) by the date, so that you will know later
Each item of expense and income is to be listed under the proper heading.
and feed or other supplies used from the farm, valued at what they are

<table>
<thead>
<tr>
<th>Disinfectants and spray material</th>
<th>Electricity</th>
<th>Chicks</th>
<th>Hatching eggs*</th>
<th>Poultry †</th>
<th>Other costs ‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dollar</td>
<td>Dollar</td>
<td>Number</td>
<td>Dollar</td>
<td>Down</td>
<td>Dollar</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† Do not include building repairs or long-time investments such as buildings or special equipment (brooders, incubators, and the like) which will last more than two years.
### INCOME FOR MONTH

<table>
<thead>
<tr>
<th>Date</th>
<th>Eggs sold</th>
<th>Eggs consumed at home</th>
<th>Hens</th>
<th>Old males</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doses</td>
<td>Price</td>
<td>Dollars</td>
<td>Doses</td>
</tr>
<tr>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.00</td>
<td>30 L.</td>
<td>.30½</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 L.</td>
<td>.25½</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18 M.</td>
<td>.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>268½</td>
<td></td>
<td>72</td>
<td>32</td>
</tr>
</tbody>
</table>

*Indicate hatching eggs by x.*
## SALES

<table>
<thead>
<tr>
<th>Breeding cockerels</th>
<th>Pullets</th>
<th>Broilers</th>
<th>Chicks</th>
<th>Poultry consumed at home</th>
<th>Other Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>Dollars</td>
<td>Number</td>
<td>Dollars</td>
<td>Number</td>
<td>Dollars</td>
</tr>
</tbody>
</table>

- **200 pullets used**
- **6 bags returned**
- **2.00**
- **5.00 1.38**
the number of eggs sold, consumed at home, or used for incubation, the causes of gain or loss, and other information of interest and value.

(1) The inventory. This is essential in any type of accounts. An inventory may be taken of the entire enterprise of the laying or breeding flock, or the rearing, depending upon the study to be made. The proper expense and income items should accompany any particular inventory. An inventory consists of a list of all the things one owns and of all the debts one owes. A value is assigned to each article.

The best time to take an inventory is when there will be the least figuring involved and at the logical time for closing the year's business. For a poultry enterprise, this is usually September 1 or October 1.

Taking the inventory. Make a list, in a book, of the items suggested on page 189. Leave space between for other items, if found. Take a pencil and the list, and go over the plant systematically. Enter the number of each item found and estimate its value. The basis for estimating values should be the value which would probably be received for the article at the farm, if there were plenty of time in which to make a sale.

At the end of the account year, use the same list and make the rounds of the plant as before, adding to or subtracting from the list as the case may be.

Taking an inventory after the first year requires only a short time.

The depreciation charge. (a) Items may be entered in the last inventory at a certain percentage less than in the beginning inventory; or (b) items may be entered at their value in both inventories, the percentages applied to the average of the inventory items, and the result entered as an expense (debit). Common depreciation percentages are, 3 on buildings, 10 on portable colony houses, range shelters, and fences, and 8 on other equipment.

When repairs are made during the year, increase the value at the last inventory [under (a) above] after the depreciation
has been figured; or [under (b)] the depreciation charge in the expenses may be decreased accordingly.¹

Value of inventory. The inventory shows the amount of money invested in the enterprise. It serves to call attention to the condition of equipment and to repairs that should be made; it is also a reminder of tools which have been loaned or borrowed and not returned.

(2) The charge or debit. A record must be kept of every purchase. The principal item will be feed, but there are a great many other items for which cash will be spent during the year. If a record is not made when these articles are purchased, they are likely to be forgotten. These items include disinfectant, litter used, fees for various purposes, taxes, insurance, egg cases, equipment purchased, and many other things.

(3) The poultry credits. The credits include all transactions in which anything of value is disposed of; they may include eggs or poultry sold, used, or given away, feathers sold, manure sold or used on the farm, equipment sold, etc.

The records may be filed away and worked up as time permits.

(4) The summary. Each month the totals of expenses (debts) may be transferred to a similar sheet with one line for each month. The amount and value of each item, as grain, mash, chicks, etc., can be compared easily any time. A quick summary of income vs. expenses thus far in the record year is then possible. The same procedure should be followed with the income (credits).

In order to have the information available for use in the

¹ The Cornell Poultry Account book suggests the following method of charging to cover interest, taxes, repairs, and depreciation. Average the values in both inventories, find a percentage of this average, and enter the result in the expenses (debts).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
<td>10%</td>
</tr>
<tr>
<td>Land</td>
<td>7%</td>
</tr>
<tr>
<td>Equipment</td>
<td>15-20%</td>
</tr>
<tr>
<td>All other items</td>
<td>6%</td>
</tr>
</tbody>
</table>
next year's work, the yearly summary should be made promptly at the end of the year and the labor income on poultry, or the profit, determined.

B. Keeping a rearing account. For keeping a record with rearing only, the single-entry system may be used. The plan is the same as that just outlined. An inventory of items used during rearing, or a proportionate value of buildings, land, or equipment used, is needed.

A complete record of the debits and credits for the period, together with the inventories, provides the data from which one may figure the cost of producing pullets, amount and cost of feed, and many other items.

Points to have in mind. In a single-entry set of accounts, an entry should not be recorded if a payment is made on a mortgage or bill for anything that has been inventoried. When an item is inventoried it means that the enterprise is charged with that item at the start or credited with it at the end. When a payment on the article is made, the transaction is outside of these accounts and should not be entered.

An increase in inventory during the year should be reckoned as a receipt or credit, and a decrease in inventory should be reckoned as an expense or debit.

Check over the differences between the inventories, and see that the proper entries have been made in the debits and credits.

COMMUNITY SURVEY

1. Canvass the farms in the neighborhood and list the records that each is keeping with the different farm enterprises.
2. How many are keeping complete cost accounts on one or more enterprises?
3. How many are keeping a cash account only?
4. Are any of the poultrymen keeping a single-entry account such as that outlined in this chapter?
5. Secure the following facts from as many farms in the neighborhood as can be visited during the period of the class assignment. When all records have been secured, a class exercise should be planned for combining the information secured for the entire community.
Farm No. ........................ Name of operator ..........................
Date of taking record ...... Year record is taken ..........................
Size of farm ............... Acres owned ...... Acres rented ......
Kind of animal enterprises kept commercially ..........................

(Arrange in order of importance)

What cash crops are grown? ............ (arrange in order of importance)
Number of mature birds ................ Breed ......................
Number of pullets ............. Cocks .......... Cockerels ..............
What per cent of the poultry is marketed alive? ...... Dressed? ......

<table>
<thead>
<tr>
<th>Products sold</th>
<th>Amount</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market eggs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fowls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broilers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breeding stock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day-old chicks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What per cent of the total farm income is derived from poultry?

REFERENCES

Poultry record books from your state college or agricultural school.
CHAPTER X

STUDYING THE RECORDS

In Chapter IX the various operations required to keep records with poultry were described. Merely to keep records and accounts is not sufficient, however. They must be analyzed carefully to see how the business may be improved the following year. At the end of the year it is important for the poultryman to ask and answer four questions:

1. How much is the business making for me?
2. How much have the various departments gained or lost?
3. Why did certain departments fail and others succeed?
4. Where has my money gone?

If a good income was received, it is important to know whence it was derived. A good income from eggs might be due to low cost of production, or to a high average price for a certain period or a particular year, or to all these causes.

Studying records is a good rainy-day job. Keeping and studying records does not take time; it saves time, by affording short cuts in actual practice.

In this chapter a method of summarizing the data from single-entry accounts will be described.

Operations:

1. Finding the per cent production.
2. Finding the labor income on poultry.
3. Finding the profit on poultry.
4. Finding the cost of rearing pullets.
5. Finding the cost of producing eggs.

General information:

1. Explanation of cost items.
2. Factors affecting profits.
1. Finding the per cent production

Both the flock and the egg records are used in finding the per cent production.

A simple method is to take the number in the laying flock in the beginning inventory, add any additions during the month, subtract any death losses and those sold or consumed. The result is the number left on the last of the month. The average of the two figures times the days in the month gives the “hen days.” The number of eggs produced divided by the hen days and multiplied by 100 equals the percentage production.

Production per hen per year. Add the number in the beginning inventory to the twelve average monthly numbers and divide the sum by 13. This equals the average number of hens for the year. Divide the total eggs produced by the average number of hens to equal production per hen per year.

2. Finding the labor income on poultry

Labor income may be defined as what a person receives for his year’s work, above all farm expenses and interest on the capital, in addition to having the use of his house and such farm produce as was used for the family. It is what a person receives for his labor. All labor employed or used, except the operator’s labor, is included in the farm expenses.

In finding the labor income, therefore, it is customary to include as real estate the value of the dwelling. The results in this chapter do not include the dwelling or a proportional share of it, as varying residential values would materially influence the results. In this respect the term “labor income” as here worked out differs from “labor income” in the large sense; hence we speak of it as the “labor income on poultry.” It deals with one department of a farm business, whether this department be a part or the whole of the business of the farm.

To find the labor income on poultry, three groups of figures are necessary: first, two complete inventories, one at the beginning and another at the end of the year; second, total expenses for the year; and third, total receipts.
STUDYING THE RECORDS

SUMMARY OF EXPENSES

1936–

The expenses and receipts for Farm 63 were as follows,

Farm No. 63

<table>
<thead>
<tr>
<th>Month</th>
<th>Grain</th>
<th>Mash</th>
<th>Other feed</th>
<th>Litter</th>
<th>Egg cases, fillers, cartons, and the like</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pounds</td>
<td>Dollars</td>
<td>Pounds</td>
<td>Dollars</td>
<td>Pounds</td>
</tr>
<tr>
<td>1936</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept.</td>
<td>3,400</td>
<td>69.65</td>
<td>400</td>
<td>10.90</td>
<td></td>
</tr>
<tr>
<td>Oct.</td>
<td>400</td>
<td>9.30</td>
<td>700</td>
<td>18.60</td>
<td>100</td>
</tr>
<tr>
<td>Nov.</td>
<td>1,500</td>
<td>30.11</td>
<td>400</td>
<td>10.90</td>
<td>100</td>
</tr>
<tr>
<td>Dec.</td>
<td>600</td>
<td>13.50</td>
<td>500</td>
<td>13.80</td>
<td>100</td>
</tr>
<tr>
<td>1937</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan.</td>
<td>1,600</td>
<td>37.28</td>
<td>300</td>
<td>8.40</td>
<td></td>
</tr>
<tr>
<td>Feb.</td>
<td>1,400</td>
<td>34.40</td>
<td>200</td>
<td>6.15</td>
<td></td>
</tr>
<tr>
<td>Mar.</td>
<td>1,200</td>
<td>29.20</td>
<td>300</td>
<td>7.90</td>
<td></td>
</tr>
<tr>
<td>Apr.</td>
<td>1,300</td>
<td>34.15</td>
<td>500</td>
<td>13.65</td>
<td>100</td>
</tr>
<tr>
<td>May.</td>
<td>1,200</td>
<td>31.65</td>
<td>400</td>
<td>11.00</td>
<td></td>
</tr>
<tr>
<td>June.</td>
<td>1,000</td>
<td>25.30</td>
<td>500</td>
<td>13.75</td>
<td>100</td>
</tr>
<tr>
<td>July.</td>
<td>900</td>
<td>20.20</td>
<td>400</td>
<td>10.00</td>
<td>100</td>
</tr>
<tr>
<td>Aug.</td>
<td>1,000</td>
<td>22.65</td>
<td>500</td>
<td>12.05</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>15,400</td>
<td>357.42</td>
<td>5,100</td>
<td>138.80</td>
<td>625</td>
</tr>
</tbody>
</table>
FINDING THE LABOR INCOME ON POULTRY

FOR THE YEAR

1937

after they were summarized from the single entry record:

<table>
<thead>
<tr>
<th>Disinfectants</th>
<th>Electricity</th>
<th>Chicks</th>
<th>Hatching eggs</th>
<th>Poultry</th>
<th>Other costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>and spray material</td>
<td>Dollars</td>
<td>Dollars</td>
<td>Dozen</td>
<td>Dollars</td>
<td>Dollars</td>
</tr>
<tr>
<td></td>
<td>Dollars</td>
<td>Number</td>
<td>Dollars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 94</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 80</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>6 62</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>12 10</td>
<td></td>
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<td>3 60</td>
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<td>4 40</td>
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<td>4 60</td>
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<td>11 00</td>
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<tr>
<td>10 40</td>
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<td></td>
</tr>
<tr>
<td>77 06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Months</td>
<td>Eggs sold</td>
<td>Eggs consumed at home</td>
<td>1936-</td>
<td>Poultry</td>
<td>1936-</td>
</tr>
<tr>
<td>--------</td>
<td>-----------</td>
<td>-----------------------</td>
<td>------</td>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td>Dozens</td>
<td>Price</td>
<td>Dollars</td>
<td>Dozens</td>
<td>Dollars</td>
</tr>
<tr>
<td>1936</td>
<td>683½</td>
<td>19 09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept....</td>
<td>329½</td>
<td>103 28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct.....</td>
<td>450</td>
<td>160 97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov.....</td>
<td>295½</td>
<td>85 43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec.....</td>
<td>266½</td>
<td>72 52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1937</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan.....</td>
<td>180</td>
<td>42 70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb.....</td>
<td>180</td>
<td>48 73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar.....</td>
<td>270</td>
<td>67 19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr.....</td>
<td>330</td>
<td>79 94</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May.....</td>
<td>270</td>
<td>67 43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun.....</td>
<td>240</td>
<td>68 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>July....</td>
<td>180</td>
<td>58 23</td>
<td>275</td>
<td>68 75</td>
<td>55</td>
</tr>
<tr>
<td>Total</td>
<td>882½</td>
<td>275</td>
<td>68 75</td>
<td>111</td>
<td>72 24</td>
</tr>
</tbody>
</table>
## FINDING THE LABOR INCOME ON POULTRY

### FOR THE YEAR

**1937**

### SALES

<table>
<thead>
<tr>
<th>Number</th>
<th>Dollars</th>
<th>Number</th>
<th>Dollars</th>
<th>Number</th>
<th>Dollars</th>
<th>Number</th>
<th>Dollars</th>
<th>Dollars</th>
<th>Dollars</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeding cockerels</td>
<td>Pullets</td>
<td>Broilers</td>
<td>Chicks</td>
<td>Poultry consumed at home</td>
<td>Other income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>Dollars</td>
<td>Number</td>
<td>Dollars</td>
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<td>Dollars</td>
<td>Number</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>5.50</td>
<td></td>
<td></td>
<td>4 fowls</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.70</td>
<td>1.13</td>
<td></td>
<td>3 broilers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.00</td>
<td></td>
<td></td>
<td>2 capons</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.50</td>
<td></td>
<td></td>
<td>5 capons</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.00</td>
<td>1.26</td>
<td></td>
<td>3 fowls</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.00</td>
<td></td>
<td></td>
<td>2 capons</td>
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<td></td>
<td></td>
<td>3.50</td>
<td>3.00</td>
<td></td>
<td>1 capon</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.00</td>
<td>3.00</td>
<td></td>
<td>3 fowls</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.00</td>
<td>7.50</td>
<td></td>
<td>1 capon</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.50</td>
<td>3.00</td>
<td></td>
<td>3 fowls</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td>4.00</td>
<td>2.00</td>
<td></td>
<td>1 capon</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.70</td>
<td>2.20</td>
<td>0.30</td>
<td>4 fowls</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>measure value</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>bags(22@.03)</td>
</tr>
</tbody>
</table>

**Total**: 65.70 | 41.42
Inventories from Farm No. 63 appear on page 189. Inventories are used to find the increase or decrease in inventory at the end of the year and to find the interest on the capital invested.

Referring to page 189, we find a decrease of inventory of $240.55.

The decrease is due to the loss in stock inventory and depreciation of equipment and buildings. Stock of the same quality should be inventoried at about the same amount each year. Stock which is held over to later inventories is usually valued less than on the previous inventory.

The following shows the method of arriving at the labor income:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average capital (average inventories)</td>
<td>$467.87</td>
</tr>
<tr>
<td>Receipts</td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>$882.01</td>
</tr>
<tr>
<td>Poultry</td>
<td>72.24</td>
</tr>
<tr>
<td>Manure</td>
<td>15.00</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>26.42</td>
</tr>
<tr>
<td></td>
<td>995.67</td>
</tr>
<tr>
<td>Expenses</td>
<td></td>
</tr>
<tr>
<td>Feed</td>
<td>$499.47</td>
</tr>
<tr>
<td>Labor (except operator's)</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>98.26</td>
</tr>
<tr>
<td>Decrease in inventory</td>
<td>240.55</td>
</tr>
<tr>
<td></td>
<td>$838.28</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$157.39</td>
</tr>
<tr>
<td>Interest on average capital at 5½%</td>
<td>25.73</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$131.66</td>
</tr>
</tbody>
</table>

In addition, the following were used in the house:

- Eggs, 275 doz.                      $68.75
- Meat, 41 fowls.                     39.00
- 14 capons.                         21.00
- 6 broilers.                        3.70

Plant income is what the poultry keeper receives for his time and the use of his money. Deducting the interest leaves
the amount received for his time, or the labor income on poultry. In addition to this figure, he must consider that various products from the plant have been used in the house throughout the year. On a large enterprise labor income is usually larger than profit, while on a small business the reverse is likely to be true.

3. Finding the profit on poultry

Profit differs from labor income in that, in calculating profit the enterprise must receive credit for all products of the plant that have been used by the operator. The enterprise must also pay for all the operator's labor in addition to the other expenses. Profits may be defined as "the return from a business or enterprise or transaction above all costs. The return should include both actual receipts and actual or estimated appreciation on capital involved. The costs should include all actual expenditures and the estimated value of all labor, materials, etc., used; all rents, interest, insurance, and any depreciation on the capital involved." ¹

To find the Profit on Farm 63, it is necessary to add to the labor income the value of the products used and deduct the value of the operator's labor.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor income on poultry</td>
<td>$131.66</td>
</tr>
<tr>
<td>Value of product used</td>
<td>132.45</td>
</tr>
<tr>
<td>Total</td>
<td>$264.11</td>
</tr>
<tr>
<td>Value, operator's labor (estimated)</td>
<td>$50.00</td>
</tr>
<tr>
<td>Profit</td>
<td>$214.11</td>
</tr>
</tbody>
</table>

4. Finding the cost of rearing pullets

In finding this cost, record and proceed as follows:

(1) Take two inventories, one at the beginning and one at the end of the year. The inventories should include everything used for rearing, but not the value of the chicks themselves.

¹ From Department of Agricultural Economics, Cornell University.
(2) Record all costs of rearing, including hatching eggs purchased or secured from the breeding flock.

(3) Record all returns of rearing, including cockerels sold, used, or retained. Pullets sold or retained are not considered.

(4) Deduct the returns from the costs. This figure represents the working capital which is required to rear the pullets and none of which is returned to the operator until the pullets are placed in winter quarters.

(5) Charge interest on one-half of the working capital for six months at 6 per cent and add to the working capital. The result is the net cost of rearing.

(6) Divide by the number of pullets reared to find the cost per pullet.

COST OF REARING PULLETS

Financial Record of Chickens Raised

Name of Operator

Farm No. 63

Address

INVENTORY

| Include below everything used for rearing, either the whole valuation or the proportionate share. | \( \begin{array}{c|c|c|c|c|c} \\
\text{Items} & \text{Beginning of period} & \text{\( \text{\$} \)} & \text{\( \text{\$} \)} & \text{\( \text{\$} \)} & \text{\( \text{\$} \)} \\
& \text{Date, April 1, 1936} & \text{No. or amount} & \text{Price} & \text{Value} & \text{No. or amount} & \text{Price} & \text{Value} \\
\hline
\text{I. Real Estate} & & & & & & & & \\
\text{Land} & 1a & 825.00 & 1a & 825.00 \\
\text{Brooder house} & 1 & 15.00 & 1 & 15.00 \\
\text{Range shelter} & 2 & 8.00 & 2 & 8.00 \\
\text{Barn} & & & & & & & & \\
\text{II. Equipment, Supplies} & & & & & & & & \\
\text{Water founts} & 2 & 3.00 & 2 & 3.00 \\
\text{Brooders} & & & & & & & & \\
\text{Pails} & & 1.00 & 1 & 14.00 \\
\text{Feeders} & & 4.00 & 2 & 2.00 \\
\text{Miscellaneous} & & 5.00 & 4 & 6.00 \\
\hline
\text{Total} & & 857.00 & & 74.00 & & & & \\
\hline
\end{array} \) |

* Proportionate share used for storing feed, litter, supplies, equipment, etc.

† A difference in the totals means an "Increase" or "Decrease in Inventory" and will appear in "Returns" or "Costs," respectively.

‡ Any item appearing in the Inventory at the "Beginning of the Period," if still on hand at the "End of the Period," must not be valued higher at the "Second Inventory" than it was at the first, unless special improvement has been made. In this event it must appear as a "cost." Ordinary "repairs" to "equipment" or buildings should not add to the "Inventory value" of any item.
5. Finding the cost of producing eggs

On farms where the rearing expenses, receipts, and inventories are kept separate, the cost is readily found. The necessary steps are:

A. Inventories. At the beginning and end of the year, take inventories of the capital invested in real estate, stock, equipment, and supplies used for the laying and breeding flocks. Rearing inventories are not included.
B. Costs. These include the value of all materials of any nature purchased or received for the use of the adult flock and include feed, labor, taxes, insurance, fees, interest on the average inventory, decrease in inventory (if any), and any miscellaneous costs.

C. Returns. These include all sales from the adult flock except sales of eggs, the increase in inventory (if any), and any mature stock used by the operator's family or given away.

D. Cost of producing eggs. Deduct the returns from the cost and divide by the number of dozens of eggs produced, as shown by the daily egg record. See page 209 for method of finding costs.

GENERAL INFORMATION

1. Explanation of cost items

The following items of cost may require some explanation.

A. Labor. In finding costs, the labor must be included as a cost. If a record of the exact hours and value has not been kept, an estimate of the time and value required should be made. On the average, about two hours per year of man labor is required for each hen kept, and about one hour for each pullet reared. By the use of these figures and a certain rate per hour, the value of labor can be arrived at approximately.

On a large farm where horse labor is largely used about one-tenth the number of hours representing man labor will be required for horse labor, for cleaning, carting, etc. Since the horses are seldom used without equipment of some sort, usually a harness and a wagon, the same number of hours of equipment labor is charged as for horse labor. If an automobile or truck or both are used, estimate the mileage and charge 3 to 6 cents for the automobile and 5 to 10 cents for the truck, depending on size and age.

B. Taxes. No taxes were charged to the poultry on this farm. It is likely that a charge should have been made, but the figure was not given.
GENERAL INFORMATION

COST OF PRODUCING EGGS

<table>
<thead>
<tr>
<th>Cost</th>
<th>Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Include all items and values of items used by all old stock.</td>
<td></td>
</tr>
<tr>
<td>No. or Lb.</td>
<td>Value</td>
</tr>
<tr>
<td>I. Feed (Homegrown or purchased)</td>
<td></td>
</tr>
<tr>
<td>Grain</td>
<td>15,400</td>
</tr>
<tr>
<td>Mash</td>
<td>5,100</td>
</tr>
<tr>
<td>Other feed</td>
<td></td>
</tr>
<tr>
<td>II. Labor</td>
<td></td>
</tr>
<tr>
<td>Man-hours, 450.4 @ .25</td>
<td>112.60</td>
</tr>
<tr>
<td>Horse-hours, 5 @ .10</td>
<td>.50</td>
</tr>
<tr>
<td>Equip. hours, 5 @ .10</td>
<td>.50</td>
</tr>
<tr>
<td>Use of auto</td>
<td>7.80</td>
</tr>
<tr>
<td>III. Taxes</td>
<td></td>
</tr>
<tr>
<td>IV. Insurance</td>
<td></td>
</tr>
<tr>
<td>V. Fees and dues</td>
<td></td>
</tr>
<tr>
<td>VI. Water</td>
<td></td>
</tr>
<tr>
<td>VII. Misc. expenses</td>
<td></td>
</tr>
<tr>
<td>Litter</td>
<td>2.60</td>
</tr>
<tr>
<td>Egg cases</td>
<td>12.60</td>
</tr>
<tr>
<td>Truck shipment charge</td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>41.20</td>
</tr>
<tr>
<td>Poultry</td>
<td>6.75</td>
</tr>
<tr>
<td>Equipment purchased</td>
<td>7.50</td>
</tr>
<tr>
<td>Superphosphate</td>
<td>1.00</td>
</tr>
<tr>
<td>Electricity</td>
<td>6.00</td>
</tr>
<tr>
<td>Repairs</td>
<td>11.81</td>
</tr>
<tr>
<td>VIII. Interest on Av. Investment</td>
<td></td>
</tr>
<tr>
<td>at 5½%</td>
<td>25.73</td>
</tr>
<tr>
<td>IX. Decrease in Inventory (if any)</td>
<td>240.55</td>
</tr>
<tr>
<td>Total cost of eggs</td>
<td>$976.61</td>
</tr>
</tbody>
</table>

Summary

Total cost of eggs: $976.61
Total returns: $177.36
Net cost of eggs: 799.25
Total dozen produced: 3334½
Cost per dozen: 0.24

* Inventory for the laying flock on Farm 63, p. 189.

C. Poultry fees. Fees for associations, entry fees at fairs, etc., should be included.

D. Water. The water on Farm 63 is drawn from a spring. The upkeep is very small, and the operator felt that no charge was necessary.

E. Depreciation. See page 194.
F. Equipment or stock purchased. These items increase the last inventory. As any increase acts as a return and tends to lower the cost just that much, it follows that the items must be included in the costs to offset it.

G. Hatching eggs or chicks. The cost of eggs used for hatching or for chicks is part of the cost of rearing, and must be added as a cost, whether they are purchased or produced on the plant.

2. Factors affecting profits

Various factors may be found after summarizing a set of accounts, many of which may be of great importance in measuring efficiency in management and in showing where the weak or strong points are. Various factors from the records of Farm 63 may serve to illustrate.

A. Labor income and profits

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor income on poultry</td>
<td>$131.66</td>
</tr>
<tr>
<td>Labor income per hen</td>
<td>0.585</td>
</tr>
<tr>
<td>Profit</td>
<td>214.11</td>
</tr>
<tr>
<td>Profit per hen</td>
<td>0.951</td>
</tr>
<tr>
<td>Eggs and poultry used by the family</td>
<td>132.45</td>
</tr>
</tbody>
</table>

The amount received for the operator's labor (labor income) is low. A smaller flock is likely to show a smaller labor income on poultry per bird than a larger flock, if the same value of eggs and poultry are used. In this case the value of products used exceeds the labor income figure. Since this is so, profit is higher.

Higher egg production would have increased both figures. High feed prices and low fall egg prices prevailed.

Under the circumstances the operator provided the family with eggs and poultry and made money in addition. A larger business should have shown increasingly higher returns since all products above family needs could then have been sold.

B. Investment

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average number of hens</td>
<td>225.2</td>
</tr>
<tr>
<td>Average investment</td>
<td>$467.87</td>
</tr>
<tr>
<td>Investment per hen</td>
<td>$ 2.08</td>
</tr>
</tbody>
</table>
The investment is unusually low. The building is many years old but serviceable. A new building of the same capacity would raise the inventory considerably. Hoppers, water stands, nests, and the like were built by the owner. Almost no new equipment has been purchased in recent years, and there is no unnecessary equipment. The birds are inventoried at a reasonable value at the start and at meat value at the end. The plant is efficiently capitalized. An effort has been made to keep the investment low and to get long-time use of equipment.

C. Eggs, production, and sales

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total egg production</td>
<td>3334 1/2 doz.</td>
</tr>
<tr>
<td>Production per hen</td>
<td>177.7</td>
</tr>
<tr>
<td>Market eggs sold</td>
<td>3059 1/2 doz.</td>
</tr>
<tr>
<td>Eggs used</td>
<td>275 doz.</td>
</tr>
<tr>
<td>Cost of producing eggs</td>
<td>$0.24</td>
</tr>
<tr>
<td>Cost of feed per doz. eggs</td>
<td>$0.15</td>
</tr>
<tr>
<td>Average price received per doz. market eggs</td>
<td>$0.288</td>
</tr>
</tbody>
</table>

These results show a narrow margin between the cost of production and the price at which eggs were sold. The price received was one to two cents above the quotation for "exchange specials" on the New York market. The feed is 62.5 per cent of the total cost of producing eggs. Higher egg production per hen would reduce the cost of eggs. On the basis of the 281 hens at the beginning of the year the production was 142.4 eggs or 177.7 eggs for the average number of hens. Without disease more eggs might have been laid.

D. Feed

<table>
<thead>
<tr>
<th>Description</th>
<th>Lb.</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain per hen</td>
<td>68.4</td>
<td>$1.59</td>
</tr>
<tr>
<td>Mash per hen</td>
<td>22.6</td>
<td>.60</td>
</tr>
<tr>
<td>Cost of grain and mash per hen</td>
<td></td>
<td>2.19</td>
</tr>
<tr>
<td>Per cent of mortality, based on the number of hens at the beginning of the year</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td>Per cent culled, based on the number of hens at the beginning of the year</td>
<td>47.7</td>
<td></td>
</tr>
</tbody>
</table>

The ratio of grain to mash indicated that the flock was fed by the "free-choice" method (page 99). Ninety-one pounds
of grain and mash were consumed, in spite of the reduced con-
sumption during part of the winter when the flock suffered from
chicken pox (page 184). The cost of food in 1936 was high
This was a financial handicap on each bird.

The mortality is lower than is usually experienced. A high
food intake resulting, no doubt, in a fine physical condition
together with careful culling may have helped keep mortal-
ity low.

Altogether these results are desirable.

<table>
<thead>
<tr>
<th>Pounds of grain per pullet reared</th>
<th>12.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds of mash per pullet reared</td>
<td>13.7</td>
</tr>
<tr>
<td>Cost of grain and mash per pullet reared</td>
<td>$0.538</td>
</tr>
</tbody>
</table>

Considering that the food consumed by several capons is
included, these figures are low. Mash was kept before the
birds constantly during the brooding and rearing periods and
grain, also, after the first six weeks.

A knowledge of the management conditions often helps
when results are studied. These chicks were moved to a fine
grass range when eight weeks old. They were separated into
two flocks, each in a range shelter. A brook furnished fresh
water. Abundant green food during the growing season appar-
ently helped to reduce the feed cost.

E. Brooding and rearing

**White Leghorns**

- No. chicks at start: 489
- No. dead and missing: 18
- Percentage dead and missing: 3.7
- No. cockerels sold and used: 217
- Percentage cockerels sold and used to chicks started: 44.4
- No. pullets housed: 252
- Percentage pullets housed to chicks started: 51.5
- Pullets used as broilers: 2
- Percentage used as broilers: 4
- No. chicks per pullet housed: 1.94
These results are excellent. Reference to the brooding record (page 188) will show that eight pullets were missing when they were moved from the rearing field to the laying house in the fall. Considering the eight as dead, the mortality is 3.7 per cent. Good brooding and rearing and pullorum-free chicks are responsible, together with properly selected breeders.

The number of pullets exceeded the cockerels. This is chance and cannot be credited to skill in operation. It does contribute, however, to the high number of pullets housed in relation to the chicks started.

The chick mortality is being duplicated on many farms and should be on others. Science has contributed greatly to the success of poultrymen in this field.

COMMUNITY SURVEY

1. Using forms similar to those in this chapter, secure figures from one or more farms in the community and find:
   (a) The labor income on poultry.
   (b) The profit on poultry.
   (c) The cost of producing one dozen eggs.
   (d) The cost of rearing a pullet.

REFERENCES

CHAPTER XI

DIAGNOSING COMMON DISEASES

PARASITES, PESTS, AND VICES IN ADULT STOCK

Operations:
1. Examining a live bird.
2. Examining a dead bird.

Vastly discouraging, and in the aggregate totaling an enormous loss, is the mortality which frequently occurs in both mature and young stock. This loss is a serious drain upon the profits of keeping poultry. Much can be done to reduce it.

To have a well-reared flock of mature birds, in good health and producing well, is a source of keen satisfaction.

To find a dead bird occasionally and not know the cause of death is, to many careless poultrymen, nothing more than the "expected normal mortality" of a flock and often does not create a proper feeling of concern.

To discover many dead birds, together with a diseased appearance of the flock as a whole and a pronounced drop in egg production, and then not to know the cause or the means of correcting it, is a pitiful condition, in fact, a calamity to the poultry keeper.

Considerable time and care are required to bring the flock back into production after the cause of the trouble has been found and removed or corrected. This loss in production emphasizes the need of great vigilance on the part of every poultry keeper.

Every person keeping poultry will do well to attempt to diagnose the cause of every death that occurs. Many dis
eases and troubles can be recognized at once by any one who has given some thought and study to the subject. Other troubles are revealed only by a careful post-mortem examination of the inside of the bird's body, while still others require laboratory facilities for studying bacteriologically and otherwise.

This chapter and the one following have been arranged to aid the poultry keeper in diagnosing the various troubles, and in determining the treatment, if known, that may be necessary for individuals or flocks, in order to keep the loss due to diseases and parasites as low as possible.

The reader should keep the following points in mind:

(1) Many diseases and parasites develop because of wrong conditions of sanitation, feeding, or other care. Where these conditions are correct, the percentage of mortality is likely to be smaller. Epizootic diseases occasionally cause great losses, but usually the responsibility may be traced back to the operator.

(2) Unless a bird is particularly valuable or the disease especially responsive to treatment, it is better to kill the bird and burn it immediately rather than bother with individual treatment. A bird is of comparatively small value, so that if but a few individuals are affected it usually costs too much in time to attempt a cure.

(3) Certain diseases and troubles may be common in one locality but entirely unknown in another, primarily because of differences in climatic conditions.

(4) The following common diseases and parasites should be familiar to every poultry keeper:
DISEASES AND PARASITES WHICH FREQUENTLY CAN BE DETERMINED WITHOUT OPENING THE BIRD

<table>
<thead>
<tr>
<th>Disease</th>
<th>Symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apoplexy</td>
<td>Cropbound</td>
</tr>
<tr>
<td>Body lice</td>
<td>Enlarged crop</td>
</tr>
<tr>
<td>Bumble foot</td>
<td>Fowl tick</td>
</tr>
<tr>
<td>Canker</td>
<td>Inflammation of crop</td>
</tr>
<tr>
<td>Chicken pox</td>
<td>Limberneck</td>
</tr>
<tr>
<td>Colds</td>
<td>Mechanical canker</td>
</tr>
<tr>
<td>Coryza</td>
<td>Paralysis</td>
</tr>
<tr>
<td>Pickout</td>
<td></td>
</tr>
</tbody>
</table>

DISEASES AND PARASITES, SOME OF WHICH CAN BE DETERMINED WITHOUT OPENING THE BIRD, BUT WHICH NEED A POST-MORTEM EXAMINATION

<table>
<thead>
<tr>
<th>Disease</th>
<th>Symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air sac mites</td>
<td>Dropsy</td>
</tr>
<tr>
<td>Aspergilosis</td>
<td>Impaction of the oviduct</td>
</tr>
<tr>
<td>Caecal worms</td>
<td>Infectious laryngotracheitis Ruptured yolk</td>
</tr>
<tr>
<td>Cholera</td>
<td>Infectious bronchitis</td>
</tr>
<tr>
<td>Chronic coccidiosis</td>
<td>Internal hemorrhage</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>Internal layer</td>
</tr>
<tr>
<td>Lymphocytoma (Big liver)</td>
<td>Roundworms</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>Tapeworms</td>
</tr>
<tr>
<td>Tumors</td>
<td></td>
</tr>
</tbody>
</table>

1. Examining a live bird

When a bird appears to be out of condition, one of the first things to do is to examine the perches and see if red mites are present (Fig. 93). (For combating and treating the diseases and parasites mentioned in this chapter, see Chapter XII.)

Next pick up the bird, and, if uncertain as to the nature of the trouble, examine the different parts of the body systematically, referring to the following (see page 6 and Fig. 9):

HEAD

There are several symptoms to look for on the head. These will be discussed in order.

Comb. Symptoms: Purple blade. Frequently found but usually not serious. May indicate slow circulation at that point. If most of the comb is purple, that is usually a danger

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1 See Chapter XXII for discussion of mortality of young stock and other diseases affecting them.
signal. In itself it may not indicate any particular disease. It is more likely the result of faulty circulation or faulty respiration, due to heart or lung trouble. If the bird does not regain her natural comb color in a day or two, she had best be culled and used if in good flesh.

**Comb, wattles, base of beak or face.** Symptoms: Small raised water blisters, when the disease is just starting or new spots are forming (Fig. 94). As these blisters get older they turn hard and dark (Fig. 95). Either type of blisters may occur alone, or both may be found together on the same individual.

*Fig. 94—First evidence of chicken pox.*

Note the blister.

**Disease—Fowl pox, or chicken pox, page 236.**

**Eyes and nostrils.** (1) Symptoms: Watery eyes. Running or clogged nostrils, and stained shoulder feathers caused by rubbing the eyes. The odor is disagreeable. (See Fig. 96.)

*Disease—Colds, page 241.*

(2) Symptoms: Eyes filled with a yellow cheesy material.

*Disease—Mechanical canker, page 235.*

Advanced stage of colds, Fig. 97.

(3) Symptoms: Filled with a whitish cheesy material.

**Vitamin-A deficiency, page 128.**

In the more advanced stages, the eye may be displaced and closed by badly swollen membranes in the face. This condition may be accompanied by cheesy accumulations in the nostrils and bulging face (Fig. 97). In severe cases the bird is unable to close its beak.

**Mouth.** (1) Symptoms: The bird may gasp, and breathe with difficulty and more rapidly than usual. Breathing may be accompanied by a rattling sound or a wheezing in the throat. Coughing may be frequent.
Disease—Aspergillosis, page 233.
Infectious laryngotracheitis, page 244.
Infectious coryza, page 241.
Fowl cholera, page 239.
Infectious bronchitis, page 243.

Fig. 95—An advanced case of chicken pox.

Note the presence of scabs over the face, comb and eyelids.

(2) Symptoms: Same as 1. Open the beak and look inside. Patches of yellowish-white, cheesy growth may be found on the membranes of the sides or roof of the mouth or on the throat. Occasionally, a white growth will be seen around the opening of the windpipe.

Disease—Canker, page 235.

Fowl pox, page 236.

Face near the eyes or comb. Symptoms: Ulcers or patches of small, dark brown insects.

Parasite—Sticktight flea, page 257.
If no symptoms have been discovered in the various sections of the head, pass to the other parts of the body, in order.

**NECK**

1. **Symptoms:** Head hanging with neck limp or twisted.  
   *Disease—Limberneck*, page 246.
2. **Symptoms:** Peculiar swaying of head and neck as if dazed. More noticeable when excited.  
   *Disease—Internal parasites*, pages 256 and 259.

**CROP**

1. **Symptoms:** Enlarged, hanging, bulging, and hard.  
   *Disease—Cropbound*, page 242.
2. **Symptoms:** Enlarged, pendulous, and soft.  
   *Disease—Inflammation of the crop*, page 249.  
   Enlarged crop, page 243.

**LEGS AND WINGS**

1. **Symptoms:** Weakness or entire loss of strength in one or more. Bird may look sick about the head or may be in
excellent condition at first, but loses flesh in a few days and may die.

*Disease—Paralysis*, page 247.

![Fig. 98—A bird suffering from paralysis.]

**BODY**


**ABDOMEN**

1. Symptoms: Hard, sometimes enlarged. This should not be confused with a very fat abdomen. Fig. 100A. A fat abdomen, although hard just beneath the skin, will usually yield to pressure, showing that it does not fill the body cavity.
If a lump is felt which is more or less loose in the abdomen, or if, in pressing with the fingers, a hard body is felt, as if a baseball were inside, the trouble may be either of the following:

*Disease—Tumor*, page 250.

*Internal layer*, page 246.

(2) Symptoms: Enlarged and soft. On working with the fingers, a substance like a sac of water is felt.

*Disease—Dropsy*, page 243.
VENT

(1) Symptoms: Skin around the vent inflamed. In a more advanced stage, there may be bloody sores covered with dark scabs. A disagreeable odor is given off.

_Disease—Vent gleet_, page 250.

(2) Symptoms: A mass of soft, inflamed material protruding from the vent or soiled plumage below vent.

_Prolapse of the oviduct_, page 248.

SKIN BENEATH THE VENT

(1) Symptoms: The presence of straw-colored, elongated insects. Very often patches or clumps of grayish material will be found attached to the bases of feathers at this section. These clumps are eggs of the lice, infesting the bird’s body.

_Parasite—Lice_, page 252. (See Fig. 102.)

Fig. 102—Drawing (enlarged) of lice.

The common hen louse, male. (Left.)
The common large louse of the hen. 1, Female; 2, antenna; 3, end of abdomen of male. _Bulletin 359, Cornell University._
(2) Symptoms: Feathers below the vent wet and soiled with litter or dirt, or having accumulations of greenish, yellowish or watery discharges. Flaky white material around the vent.

Diarrhea, page 242.

**SHANKS**

Symptoms: Rough, raised scales with white, powdery material beneath. This condition is known as scaly leg (Fig. 103). *Parasite—Scaly leg mite*, page 257.

![Fig. 103—A case of scaly leg.](image1)

![Fig. 104—Bumble foot.](image2)

**FEET**

Symptoms: Bottoms of feet swollen. In a more advanced stage, the swelling may be inflamed, pushing out between the toes and causing lameness. (See Figs. 104 and 105.)

*Bumble foot*, page 233.

2. Examining a dead bird

(See Chapter VII for anatomy of the domestic fowl.)

When a bird dies, examine her comb and head first. If they are dark purple in color the trouble is likely to be

*Apoplexy*, page 233.

Symptoms: Birds in good physical condition, showing no
evidence of disease or vermin, found dead on the nest or about the buildings during very warm weather.

**Heat prostration**, page 260.

**Internal hemorrhage**, page 245.

If neither of these troubles appears to be the cause of death, examine the bird externally for disease and troubles mentioned above.

In case the trouble cannot be diagnosed by a superficial examination or the bird has been killed because of a supposed disease, a post-mortem examination of the internal organs should be made to determine the cause.

**A. Materials needed.** A few materials, together with a knowledge of what to do and what to look for, are all that is needed.

The materials needed are:

A wooden surface about 2 feet square, such as a board or the side of a box, about waist high.

4 small nails.
A hammer.
A sharp knife.
A pair of heavy shears for cutting through bones (pruning or tin shears or any shears having a narrow blade on one side, for pushing between the bones and internal organs).

**B. Arranging the bird.**

(Fig. 106.) Place the bird on its back, head away from the operator. Stretch the wings out, and nail to the board by passing a nail through each wing near the tip. Cut the skin between the legs and body, bend the legs back, dislocating the joints at the hips. Stretch the
legs toward the operator and out, and nail through the web of the toes.

C. Opening the carcass. (Figs. 107, 108, and 109.) With the shears lay open the esophagus from the corner of the mouth to the crop. Look for cankerous growths inside the mouth and around the windpipe. Slit the windpipe or trachea and the bronchi.

TRACHEA, LARYNX, OR BRONCHI
(1) Symptoms: Presence of bloody mucus.
   Disease—Infectious laryngotracheitis, page 244.
(2) Symptoms: Moldy patches of a white or greenish yellow color, on the inside of the trachea. They may occasionally be found in the lungs and air sacs.
   Disease—Aspergillosis, page 233.

ESOPHAGUS
(1) Symptoms: Numerous small whitish nodules on the inside lining.
   Disease—Vitamin-A deficiency, page 128.
With the knife, cut through the skin, across the abdomen. Grasping the skin near the vent, tear it loose from the breast by pulling up and toward the head.

Examine the breast, which should now be exposed. If it is found emaciated, tuberculosis or worms may be the cause. If small, hard, yellow bodies are found attached to the under side of the skin over the muscle, they are due to encysted parasites. These parasites have no harmful effect on the fowl and do not affect the edibility of the flesh.

D. Continuing the examination. Using the knife, cut through the flesh of the abdomen. Do not cut deeply.

With the shears, cut through the ribs to the neck near the base of the wing. Fold the breast back and remove.

(1) Symptoms: Clotted or fluid blood among the intestines and particularly in the region of the heart. Likely to be
accompanied by a comb from which the blood appears to have been drawn.

**Internal hemorrhage, page 245.**

2. Symptoms: Fine, yellow, dust-like particles. If found, examine between the ribs and internal organs, without displacing them, for the same particles. They may be found on the lungs or along the side of the body, where they are left after the rupture of the air sacs.

**Parasite—Air-sac mites, page 250.**

**LIVER AND SPLEEN**

(1) Symptoms: Presence of raised, white, hard, cheesy nodules, easily removed from the tissue with a pair of tweezers.

**Disease—Tuberculosis, page 249.**

(2) Symptoms: White areas, usually softer than the tuber-
culosis nodules. Removed with difficulty from the surrounding tissue.

*Disease—Tumors, page 250.*

Fold the liver back or remove in order that the heart may be seen.

**HEART**

(1) Symptoms: Clot of blood near the heart. 
*Internal hemorrhage, page 245.*

![Fig. 109—Intestines removed and reproductive system exposed.](image)

(2) Symptoms: Sac (pericardial) about the heart enlarged and filled with a chocolate-colored pus. Pericardium may be attached to the heart by strings of tissue.

*Disease—Pullorum disease ¹ or bacillary white diarrhea.*

With the fingers, loosen the heart, liver, and intestines and spread out over the board. They may be left attached to the bird at the beak and vent.

¹ Pullorum disease discussed in Chapter XXII, page 470.
INTESTINE

(1) Symptoms: Nodules of various sizes attached to the intestinal wall. Occasionally several nodules and walls seem to be grown together. Cut a nodule. Open cavities are usually found which open into the intestine.

*Disease—Tuberculosis,* page 249.

(2) Symptoms: Clumps in the intestine. Whether found or not, cut the intestine lengthwise at intervals and examine for elongated, white worms. (See Fig. 110.)

*Parasites—Roundworms,* page 256.

(3) Symptoms: Segmented white worms attached at the small end to the intestinal wall. Length: 1 to 3 inches; sometimes 6 to 10 inches.

*Parasite—Tapeworm,* page 259.

(4) Symptoms: Thickened wall in the fore part of the small intestine. May be inflamed. Microscopic examination necessary for accurate diagnosis.

*Parasite—Tapeworm (microscopic),* page 259.

*Chronic coccidiosis,* page 240.

CAECA

Symptoms: Small worms ½ to ¾ inch long.

*Parasites—Caecal worms,* page 251.

*Fig. 110—The roundworm (enlarged).*

*Fig. 111—Pullorum disease or bacillary white diarrhea, Infected ovary.*

*Fig. 112—Normal ovary.*

*From Conn. State Univ.*
OVARIES

Symptoms: Hardened, irregular bodies, mingled with the normal ovules. The color may be mottled, light, dark, or occasionally so dark and of such a color as to appear like gangrene. (See Fig. 111.)

*Disease*—Pullorum disease or bacillary white diarrhea,\(^1\) page 470.

Symptoms: Yolk material loose in and around the ovary.

*Ruptured yolk*, page 249.

OVIDUCT

Symptoms: Enlarged throughout several inches of its length. Upon opening, a mass of coagulated white material (albumen) is found.

*Disease*—Impaction of the oviduct, page 243.

ABDOMEN

(1) Symptoms: Free water in the body cavity.\(^2\)

*Disease*—Dropsy, page 243.

(2) Symptoms: Hardened bodies, which when cut show a solid mass of yellowish material.

*Internal layer*, page 246.

(3) Symptoms: Complete or partly complete eggs outside of the oviduct and free in the body cavity. (Fig. 101.)

*Internal layer*, page 246.

VICES

Symptoms: Evidences of broken eggs found in the nests; the beaks and heads of birds smeared with egg yolk.

*Egg eating*, page 260.

\(^1\) Pullorum disease discussed in Chapter XXII, page 470.

\(^2\) That part of the body which contains the intestines and internal organs.
Symptoms: Birds bloody and partly eaten about the head or back.

During periods of heavy production, birds may be found dead, with vents, intestines, and, sometimes, their internal organs eaten away.

Cannibalism, page 234.

COMMUNITY SURVEY

1. What diseases appear to be most common among local poultry flocks?
2. What is the apparent cause?
3. How was the trouble checked?
4. Arrange with a local poultryman to examine all birds that die during one or more months. Determine the cause of death by a post-mortem examination on as many as possible, keeping account of the number that die from each cause.
5. What is the percentage of mortality in the flock for the period examined?
6. In what way, if any, might this percentage be decreased?
CHAPTER XII

TREATING DISEASES AND COMBATING PARASITES, PESTS, AND VICES

Having determined the trouble, the next step is to know its cause and decide how to combat it. Many diseases are the result of wrong conditions. Individual treatment is expensive, seldom advisable, and of little lasting benefit unless wrong conditions are corrected. It is better to spend time and money in working at the cause, thereby reducing to a minimum the necessity of treating diseases. Any individual treatment to eliminate internal parasites of poultry must be considered as an expensive temporary expedient. The only satisfactory solution to the problem is prevention by methods of rearing and management.

General information:

1. Cause and treatment of various diseases.
2. Controlling disease by the carrier elimination method.

1. Cause and treatment of various diseases

Apoplexy
Aspergillosis
Bumble foot
Cannibalism
Canker
Chicken pox
Cholera
Chronic coccidiosis
Colds
Coryza
Cropbound

Diarrhea
Dropsy
Enlarged crop
Impaction of oviduct
Infectious bronchitis
Infectious laryngotracheitis
Internal hemorrhage
Internal layer
Limberneck
Lymphocytoma (big liver)
Mechanical canker
Paralysis
Pickout
Prolapse of oviduct
Ruptured yolk
Sour crop
Tuberculosis
Tumors
Vent gleet
Air-sac mites
Caecal worm

Fowl tick
Lice
Red mite
Roundworm
Scaly leg mite
Sticktight flea
Tapeworm
Tropical or Northern mite
Heat prostration
Egg eating

Apoplexy

*Cause:* A ruptured bloodvessel, which allows a clot of blood to press on the brain. Any unusual exertion, such as the strain of laying, or sudden fright, may cause apoplexy.

This is not a disease that will spread from bird to bird.

*Treatment:* Practically none for the individual, as the bird is usually dead when first observed.

Aspergillosis

*Cause:* Certain molds and their spores, which occur on moldy, musty, and spoiled litter or feed. These molds work into the air passages and grow, penetrating the tissues and causing inflammation of these passages, later resulting in death.

*Treatment:* Consists mainly in providing only clean, whole-some feed and litter. Musty or moldy litter or feed should be avoided. Litter which has been wet and allowed to mold should not be used. Clean dry houses will do much to prevent these molds from starting.

Remove affected birds, burn any that die, and correct the conditions.

Bumble foot

*Cause:* Bumble foot is probably due to a bruise which develops pus beneath the skin. Small stones in the runs or gravelly floors of a poultry house, high perches, requiring birds to jump on to hard floors, and, more commonly, a lack of litter on the floors may be causes.
Bumble foot is an abscess or corn which forms on the bottom of the foot and may spread between the toes. This trouble does not spread from one individual to another.

_Treatment:_ Somewhere, usually on the bottom of the foot, a round, hardened scab and core, about \( \frac{1}{8} \) inch or larger will be seen. Pull this out with the fingernails or with tweezers (Fig. 113). A long core is usually attached to the scab and comes out of the opening, thus leaving a hole. Disinfect the wound thoroughly with 1-1000 bichloride of mercury solution or any other good disinfectant. Then apply iodine and fill the hole with carbolated vaseline.

If the swelling spreads out between the toes, make an incision at the top and clean out all pus before disinfecting. The bird may be released with the flock in mild cases; or the foot may be bandaged and the bird placed by itself for two or three days in advanced cases.

**Cannibalism**

Classed under this heading are various kinds of picking, as toe, feather, back or sides, and cloaca or vent. Toe and feather picking often occur among chicks which are overcrowded, have too little feeding space, or are kept under too high temperature. Chicks will often pick the new quills and later follow along these quills with their beaks to take off the blood.

Put pine tar or an “anti-pick” on the injured part. One anti-pick is made of 4 ounces of vaseline, \( \frac{1}{8} \) ounce carmine,
and ½ ounce aloe. Another is made up of vaseline, colored with Sudan III and made distasteful with 10 drops of creosote for each pint of vaseline. An ample grass range usually eliminates the trouble.

Picking is most common with adults during the first laying year. Oats in the ration from the time scratch grain is given to the rearing flock and also through the laying year assist in prevention. The oat hull appears to contain an ingredient which reduces the tendency. (See page 109.) Mechanical devices may be placed on the birds. One type hangs over the vent and others fasten on the beak.

"Pickouts" may result from prolapse cases but not necessarily so. It often occurs when, immediately after laying, the oviduct protrudes slightly for a short time. Floor layers are often victims. Semi-darkened nests are desirable.

Canker

There are four recognized forms of canker, according to Beach.

A. Benign canker. Cause unknown. This type consists of small, harmless, yellow patches occurring on the inside of the mouth. It does not spread to the other birds.

B. Malignant canker. Cause unknown. Consists of thick, yellow masses in the mouth, which penetrate deeply. Usually accompanied by loss of appetite, and emaciation. Fatal to the individual. It does not spread to the other birds.

C. Mechanical canker. (See page 247.)

D. Chicken-pox canker. Cause: Same as for chicken pox.

This is usually accompanied by chicken pox, a nasal discharge, and perhaps a swelling of the face in severe cases. This is the most common form of canker in some parts of the country, and is the most serious of the various forms. It spreads by contact or through the drinking water.

1 These prescriptions are given by E. L. Brunett, "Poultry Diseases," Cornell Extension Bulletin 337, 1937.
TREATING DISEASES AND COMBATING PARASITES

Treatment: Remove the patches with a blunt stick. Paint or spray the sore with iodine and repeat in a few days.

When canker is located around the windpipe, remove with a wire hairpin or similar instrument. Spray the throat with iodine, because if a patch is left its growth continues, finally shutting off the air and causing death.

Placing a disinfectant in the drinking water may help prevent the spread of the disease. Potassium permanganate or bichloride of mercury (1 tablet to 1 quart of water is recommended).

When canker is accompanied by chicken pox, treat as for chicken pox.

Chicken pox

Cause: A virus¹ which spreads rapidly through contact or in the drinking water. It may also be carried on the feet of birds or attendants or spread by blood-sucking parasites. Mosquitoes having once fed on a diseased bird may carry the virus to well birds for 27 to 30 days afterward. Beach² states that chicken pox “cannot occur unless the chicken-pox virus is present, although insanitary conditions and poor methods of care and housing make it more likely to occur.”

This is a contagious disease. In the early stages, watery, raised blisters are noticed, sometimes accompanied by a foamy discharge from the eyes. Later these blisters change to dark scabs. Cheesy patches may occur in the mouth or throat and the opening into the windpipe (larynx) may become plugged.

In serious cases there is a drop in production, a decrease in

¹ Anything which causes a disease and which is capable of multiplying.
² Circular 251, University of California.
the amount of feed eaten, the birds appear droopy, and diarrhea is often present. If the scabs locate on the eyelids, the eyes soon close.

The disease is most severe in late fall or early winter, although it may break out at various times during the year. Young chicks are occasionally attacked by chicken pox.

**Fig. 115—Using an atomizer to spray the mouth and throat with iodine.**

The operation requires two persons but is twice as rapid and vastly more thorough than swabbing the throat by the usual methods. Clean the instrument thoroughly when finished with the job to prevent its corroding.

**Treatment:** If the disease breaks out in a laying flock, vaccinate immediately with pigeon pox vaccine. This will check the spread of the disease and with less loss in production than if chicken pox vaccine is used. Individual treatment may be given. Remove the diphtheritic patches from the mouth, and paint or spray with tincture of iodine. Wash the eyes and scabs with a disinfectant such as a strong solution of potassium permanganate or 1-1000 solution of bichloride of mercury. Remove the scabs and paint or spray the sores with iodine (Fig. 115). Repeat in one or two days if necessary. Prevent the spread through the drinking water.

The disease once started may be spread rapidly by contact with feed troughs or drinking vessels. Appliances should be
disinfected during the outbreak and for several days after apparent recovery. If possible, prevent the entry of mosquitoes during an outbreak. Take steps at once to eradicate red mites and bloodsucking flies.

_Vaccination to prevent an outbreak_ of chicken pox is advisable if the disease has appeared in the vicinity; this plan is preferred by most poultrymen. It differs from the original method. Vaccine made from _chicken-pox scabs_ is recommended for preventive vaccination or for use in a flock not in production at the time of the outbreak.¹

Range pullets three to four months old may be vaccinated in one of two ways:

1. _The stab method._ Wind a piece of tape around the blade of a knife \( \frac{1}{2} \) inch from the point. Dip the point in the vaccine, and push the point through the skin on the unfeathered portion of the thigh. This method is slightly faster than method 2, and is used extensively. There may be greater danger of infection.

2. _The feather follicle method._ Remove three or four feathers from the lower thigh. Apply vaccine to the follicles with a camel’s hair brush.

Both methods are rapid. There can be no loss in egg production, as the birds recover completely from the inoculation before they reach maturity and commence to lay. Inoculation does retard growth and reproductive development from three to four weeks, but there is satisfaction in knowing that the disease need not be feared the following fall and winter. Vaccination renders the birds immune.

Birds suffering from coccidiosis, internal parasites, or other ailments are affected more severely by vaccination than healthy and vigorous birds. They have less resistance, and considerable mortality is likely to occur.

Some agricultural colleges furnish tested vaccine at a

¹_A more recent method consists of vaccine production by cultivation of the chicken-pox virus on the chorioallantoic membrane of chick embryos._
nominal charge. Directions for administering it should be secured at the time the vaccine is obtained.

Cholera

The germ of fowl cholera is a rather delicate one that lives only a short time outside the body of affected birds. The germ may be present in the nasal chambers of birds that show no symptoms of disease. These carriers and frankly diseased birds are the sources of outbreaks.

Outbreaks of cholera, in many instances, appear to depend principally upon bad hygienic conditions. That is to say, outbreaks may occur when birds are overcrowded, in dirty quarters, and in poorly ventilated quarters, even though infection has not been introduced from outside. Outbreaks may also occur under good sanitary conditions, but usually a virulent infection has been brought in from outside through the introduction of diseased birds. Chickens, ducks, pigeons, turkeys, and caged birds may be affected.

Nature of disease: Fowl cholera has two forms. In one the birds die suddenly without significant symptoms. In this type the germ enters the blood stream and quickly kills the bird. Post-mortem examination reveals small white areas on the liver, hemorrhages on the heart and other organs, and mucoid and bloody intestinal contents.

The other type is chronic and produces respiratory symptoms. Affected birds do not die suddenly, and many may recover. The mortality may be large, particularly when complications are present, and the disease spreads rapidly through the flock. A post-mortem examination reveals pus in the nasal chambers and sometimes in the air sacs.

Symptoms: The first form of the disease produces a general depression. When the birds die suddenly, symptoms are not often observed.

The second form begins with "colds." This is accompanied by gasping and by a swelling of the head and wattles. Symptoms of infectious bronchitis must be differentiated from those of this type of fowl cholera. The wattles when first swollen are soft and warm; later they become hard and cold. When the outbreak has subsided, a number of thin birds will be found in the flock. The air sacs in these birds contain pus, which prevents the birds from making a complete recovery.

Treatment and control: When the first type of the disease occurs, affected birds should be isolated. If there is time, an autogenous bacterin should be prepared and an injection given to all unaffected birds. Mixed or stock bacterins are not helpful. Any improvement that may be made in the sanitation of the poultry plant should be carried out immediately.
In the early stages of the second type of fowl cholera, affected birds should be isolated in heated houses if the weather is cold. Heat assists the birds to overcome the disease. Where individual treatment can be applied, the nasal chambers should be washed out with warm water, followed by a few drops of a 15-per-cent argyrol solution. Spraying or dusting the birds has not proven to be of any particular value. Birds kept warm in a sanitary uncrowded condition may recover without additional treatment. After the more acute symptoms of the disease have subsided, the swollen wattles should be cut off and the pus removed.¹

Chronic coccidiosis ²

This disease may appear in stock three or four months of age or any time during the first laying year. It may be accompanied by poor or rough feathering, pale condition of head and shanks, emaciation, and possibly heavy mortality. Egg production is decreased. An infestation of worms may produce the same symptoms. A thickened intestinal wall, particularly in the duodenum, may be found.

The disease may be spread to the young stock through adult birds which harbor and give off the organisms (Eimeria necatrix).

Most birds have the ability to withstand small doses of the parasites or coccidia. When great numbers are swallowed, their combined forces overcome the bird’s natural resistance. It appears, then, that the method of control is to limit the numbers that birds are likely to get.

Old birds should be confined uncrowded in their pens. Obviously diseased birds should be culled and young stock reared where contact with old birds or their droppings cannot occur, later being housed with the same precautions.

Proper rearing and later management go far in building a natural resistance against the parasites.

Any birds brought in from another plant, laying tests, or elsewhere may well be quarantined and their feces examined

¹ From Cornell Extension Bulletin 337.
² Acute coccidiosis is discussed on pages 475 to 477.
microscopically by a qualified person before the birds are turned loose with the flocks. (See page 477.)

Colds

There are five definite diseases to which the name "cold" has been given. Each of them may show, as part of their symptoms, watery nostrils or eyes. These are cholera, infectious bronchitis, chicken pox, infectious coryza, and infectious laryngotracheitis. When so-called "colds" develop, an accurate diagnosis should be attempted at once and steps taken to reduce the spread of the particular disease.

Infectious coryza

This disease may occur in a mild form with a nasal discharge as the only symptom (simple coryza), or it may include swelling of the face, wattles, or infection in the respiratory tract. In the latter case, coughing, gasping, and sneezing may result.

The disease may last for different lengths of time. Often it spreads slowly from bird to bird in a flock with the result that production although greatly reduced is never zero in the flock as a whole. This loss in egg production in a laying flock may be severe and makes the disease very important economically. Mortality may be considerable.

Coryza is caused by an organism (Hemophilus gallinarum) and may be distinguished by isolating this organism. A laboratory examination is, therefore, necessary for positive identification.

Birds which have recovered from the disease act as carriers. Direct contact must be prevented between old birds and the young stock. If the old flock can be disposed of a few days before young stock is to occupy their quarters and the place cleaned, there is little likelihood of transmitting the disease. The organism is apparently short lived outside the body of the carrier.¹

¹ J. R. Beach and O. W. Schalm in Poultry Science, Vol. 15, No. 6, 1936, report a series of experiments, in one of which an artificially
Cropbound

Cause: Some coarse material, such as straw, dried grass, etc., becomes impacted in the crop and blocks the passage.

Treatment: If individual treatment seems desirable, the mass should be removed from the crop. To do this, tie the bird, back down, to a board, and moisten the skin over the crop with a 5 per cent solution of carbolic acid in water. With a sharp knife, make a slit in the skin about 1 inch long, over the center and upper part of the crop. Move the slit skin to one side and make a cut in the crop, so that when the skin is released the two cuts will not be directly in line. With the fingers, tweezers, or a blunt stick, gently remove the material through the cuts. Clean out the crop with warm water. With a needle and thread, take three or four stitches in the crop, and also the same number in the outside skin. Disinfect the part. Give a little water, and after a few hours some moist mash. In a day or two the bird may be placed with the flock.

Diarrhea

Diarrhea may accompany any one of several conditions. It is a result and not a cause. The whitish discharge often seen on laying birds may be a nutritional disturbance. It may occur generally in a flock or in a few individuals. If the condition is allowed to continue, sores which resemble vent gleet may develop, or, after a time, the birds may recover. Diarrhea often occurs with tapeworm infestation or in the later stages of tuberculosis. Greenish diarrhea may be a symptom in Fowl Typhoid, while greenish or yellowish diarrhea may indicate Fowl Cholera.

infected bird was caged for three weeks, killed, the exudates removed from the head, suspended in a salt solution, and poured over the litter and mixed with the feed and water. Ten birds were placed immediately in the cages thus treated, 9 others after a lapse of 24 hours, and 4 after a lapse of 4 days. They were left in for periods of 5 to 7 weeks. Only 4 of the 10 placed in the cages immediately contracted the disease. All the remaining birds were proved later to be susceptible.
Dropsy

Fluid collects in the body cavity and may enlarge the abdomen. *Cause:* A slight disorder of the lining of the body cavity. "No one specific causative agent is responsible. The accumulation of fluid results from a filtration of blood serum through the serous membranes of the intestine, or the peritoneal covering of the abdominal cavity. . . . It may be present in . . . debilitating diseases affecting the abdominal organs."¹

*Treatment:* It is best to dispose of the bird.

Enlarged or pendulous crop

*Cause:* A condition due to general weakening of the crop muscles. It is thought to be inherited in turkeys. It may be associated with either cropbound or sour crop troubles, in chickens.

*Treatment:* Generally, the bird will remain productive unless the crop is so large as to be in the way while eating. If detected early, the bird may be dressed and used, unless she has lost flesh. Should one desire to save the bird, a portion of the crop may be cut out and the crop sewed up. Generally, the best plan is to kill and burn the bird, when she ceases to lay.

Impaction of the oviduct

*Cause:* An accumulation of material resulting from inflammation and stimulation of the oviduct glands which hardens in the oviduct and which may later decompose.

*Treatment:* There is no satisfactory treatment.

Infectious bronchitis

This disease has the same symptoms as infectious laryngotracheitis except that there is no expulsion of blood mucus. Recovery results in immunity. Treatment is not successful. The sources of the disease are not known. Incubators should

¹Ward and Gallagher, *Diseases of Domestic Birds.*
be cleaned and fumigated between hatches as a precaution against the spread of the disease.

**Adults.** The disease occurs in a mild form, spreads rapidly, mortality is low, and egg production is decreased. In a week or two the disease will have run its course, but egg production may be delayed for several weeks.

**Chicks.** Mortality may be considerable. The chicks are often stunted. Little can be done other than dispose of the flock, or run the risk of *carriers* after they recover. If retained, the stunted chicks should be culled, and the survivors kept away from other uninfected stock.

**Infectious laryngotracheitis**

*Cause:* A filterable virus which finds its way into the eyes, nostrils, or the windpipe. The disease is not in the blood, hence is not spread by blood-sucking insects. It may spread very rapidly, reach the peak in seven to eight days, then subside and disappear in fourteen to twenty-one days. The mucus and clotted blood obstruct the air passages, and, if not coughed up, the bird may strangle. Death is due entirely to suffocation. The coughing and gasping may be accompanied by a rattling of the mucus in the windpipe.

Birds recovering may be immune but become carriers of the disease and may transmit it to others. Once introduced it is carried over from year to year by the bird “carriers” in the flock.

The virus must first come to a farm from some outside source, through purchased stock or birds from laying tests or shows, visitors, crates, bags, or other transferable equipment. The virus does not spread on the shell of eggs except under unusual laboratory conditions.

*Treatment:* Prevention is best. Use caution when introducing adult stock to the plant.

If the disease is discovered its spread may be prevented by vaccinating all unaffected birds. An *accurate diagnosis* is
INTERNAL HEMORRHAGE

necessary before vaccinating because the vaccine will not protect against other diseases that look like laryngotracheitis.

Disposing of all birds and thoroughly cleaning and disinfecting the house and equipment before restocking are likely to be successful. However, the disease may be brought in again by the same means as at first. Hence, extreme caution should be exercised.

When pullets are to be kept on a farm where there are carriers present, the chicks should be vaccinated when about six weeks old. This produces an immunity but not death, so long as the virus does not get into the respiratory tract.

**Vaccination:** E. L. Brunett has discussed vaccination thus: ¹

The vaccine is applied to the bursa of Fabricii, which is on the upper side of the vent. The bird is held by an assistant, and the upper part of the vent is rolled open with the thumb and the forefinger. A stiff brush moistened with the vaccine is inserted into the bursa and is brushed back and forth several times. Some prefer to place the vaccine in the bursa with a syringe. Some practice is necessary before one can become proficient with either method. Five days after vaccination, a swelling of the upper part of the vent should be evident. This indicates a "take." Birds not showing this "take" should be revaccinated. It is rather difficult to get 100-per-cent "takes" in one vaccination.

**Caution:** Birds contracting the disease in the natural manner may continue as carriers for months or perhaps for life.

The virus does not persist in the cloaca longer than ten days after vaccinating. Hence, such vaccinated birds will not spread the disease to other birds on the same or other farms after that time.

**Internal hemorrhage**

**Cause:** The cause may be the same as that of apoplexy. Rough handling of the bird or tumorous growths may cause a rupture of the liver.

Internal layer

Cause: This may be due to a ruptured oviduct or to the incomplete functioning of the oviduct at the time when the ovule breaks loose from the ovary (page 418). In this case the funnel-shaped opening of the oviduct does not pick up the ovule, and it rests in the body cavity.

Occasionally, reverse peristaltic action of the oviduct takes place, and forces the complete egg from the uterus at the end of the oviduct back and out of the funnel-shaped opening, into the body cavity. Hens have been opened and found to have several completed eggs floating free within the body.

Treatment: None. It is better to dress and use the bird.

Limberneck

Cause: A paralytic condition resulting from the eating of toxins present in decaying meat and spoiled food. Flies or larvae feeding on such material take these toxins into their bodies. Fowls eating such flies or larvae may show symptoms of the disease.

Treatment: It is usually best to burn the carcass. Eliminate the cause.

Lymphocytoma (big liver)

This disease goes under various names, such as infectious leukemia, or leukemia. At the present time, poultry pathologists believe there is a close relation between this disease and fowl paralysis. Various tumors are thought to be associated with paralysis. At times, tumor tissue is diffused through the liver tissue, leaving it greatly enlarged, and with a puffed-up, grayish, spongy, roughened surface. The borders are round. The organ may grow to several times its normal size. It ruptures easily and birds often bleed internally, with death resulting.

The disease takes weeks or months to develop to a point where it shows externally. During this time the bird's comb and color appear normal. Toward the end, the bird may become weak and pale about the head.
The disease can apparently be transmitted from affected birds by contact or by contact with contaminated litter or soil or it may be spread by mites or other blood-sucking insects. 

_Treatment:_ Proper rearing (page 445) is best for prevention. Careful culling should be practiced.

**Mechanical canker**

_Cause:_ A foreign body in the eye or other part. Irritation is started, and a white, cheesy material forms about the object. There is no running at the nose.

_Treatment:_ With a toothpick, remove the mass. The foreign material will be found in it. The bird may be released without further treatment.

**Fowl paralysis**

This term, once thought to refer to a single disease, is now regarded as covering a series of troubles, all related somewhat to nerve disorders. It is spoken of as neuritis, neuro-lymphomatosis, fowl leukosis, lymphomatosis, range paralysis, and is thought to be associated with iritis (an eye abnormality), big liver disease, and probably tumors.

The disease expresses itself in various ways. It may work in the nerve tissue slowly, requiring weeks or even months before becoming apparent to the observer. If the final form is a paralyzed condition, the bird may still be laying and a picture of health after she starts losing the normal use of her legs or wings. This form is the one most easily seen. One or both legs appear to be handled awkwardly, later useless, extending full length in front or in back of the body as the bird rests on the litter, or one or both wings may hang down, the bird being unable to control them.

_Iritis_ occurs when the iris becomes diseased. The normal color of the iris of Leghorns is bay. Variations from this take place. The bay color gradually or completely fades, starting at the inner edge next to the pupil, until it is gray or of a very light color. The pupil itself may appear irregular or may be nearly or completely covered by the iris, causing blindness.
These changes usually develop slowly over several months, during which time body weight and production may be unaffected.

In the later stages of the disease, egg production drops and finally death results.

The cause of fowl paralysis is not known.

Fowl paralysis is apparently not affected by the usual rations or methods of feeding. Chicks are usually susceptible during the first five months. The disease runs itself out on a particular farm after a period of years. This, however, is too long and costly a method to be depended upon.

 Preventive measures. There is no known cure for the disease.

Certain families are resistant to the disease and, if the progeny test is being used in the breeding plan, these birds may be found and used as breeders.

Pullets should not be used as breeders on farms where the disease is present. Chicks from such pullets are much more likely to get the disease than are chicks from hens on the same farm.

Rear by the carrier elimination theory. (See page 260.)

Pickout

See cannibalism.

Prolapse of the oviduct

In the process of laying, a larger part of the oviduct than usual is left protruding from the vent. Occasionally the oviduct containing the egg will hang from the vent. Possible causes are eggs too large for the oviduct opening or restriction of it through swelling. This prevents the easy passage of the egg, causes the fowl to strain in an effort to expel the egg, frequently results in breaking the membranes with consequent eversion, and often starts the vice of cannibalism or "pickouts." It frequently occurs with pullets in the fall or early spring and may occur with hens.

 Treatment: In most cases, kill and use the bird. When individual care is justified, wash the dirt off with warm water.
apply carbolated vaseline, break and remove the egg, if there, and gently push the mass back into place. Keep the bird by herself for a few days.

Ruptured yolk

Pullets with the ovary full of yolks may, when suddenly frightened, subject their bodies to a sudden jar, causing the yolk sac to tear or break.

There is no treatment except to prevent the cause by making the birds as tame as circumstances permit.

Inflammation of the crop (sour crop) or thrush

A disease caused by fungi, which may cause small, slightly raised, whitish nodules on the inside crop lining. It may occur in young or old birds, but is likely to be more serious in chicks.

The crop contents become very sour. If detected early, give one level teaspoonful of powdered blue stone (copper sulfate) to each 2 gal. of water, every other day for a week.¹

In advanced cases kill the bird.

Tuberculosis

Cause: Fowls become infected by eating food, soil, etc., on which germs from the droppings of tuberculous fowls are deposited.

Treatment: The disease is incurable. Eliminate all birds suspected of being tuberculous. Where flocks are badly infected, the best authorities recommend disposing of all birds. The disease, it is believed, is not transmitted through the egg, and therefore pullets reared on new ground and in clean buildings should be disease-free. Disinfect the houses and equipment. Work the soil. Sunshine kills disease germs. Vacate both houses and ranges for several months, then start again with new healthy pullets. Keep only pullets for several years. Manage the flock to insure strong, high-vitality birds which are able to throw off the disease.

The diagnosis of tuberculosis in the living fowl is possible

by means of the tuberculin test, which is made by injecting \( \frac{1}{8} \) to \( \frac{1}{4} \) cubic centimeter of a substance known as tuberculin into the skin of the wattle. If an injected bird has tuberculosis, the wattle will swell within 48 to 72 hours.

**Tumors**

Cause and treatment not definitely known.

**Vent gleet**

*Cause:* The cause has not been fully determined. It is evidently a venereal disease spread in the flock, principally by the male. The cankers in the vent have a putrid odor.

*Treatment:* Remove all affected birds. Examine the vent of the male carefully for the symptoms. Vent gleet usually starts with the female and is then spread to other hens by the male. It is seldom worth while to attempt a cure, although softening with carbolated vaseline and painting with iodine may help.

**Air-sac mite**

*Cause:* Small, yellow mites in the air passages and air sacs. The mites enter through the nostrils or mouth and work their way to the windpipe and air sacs. The lining of the air passages is irritated by their sucking mouth parts (Fig. 116). The trouble is serious and it is difficult to rid a flock of it.

When not badly infested, birds show no signs of this trouble. After the mites become numerous enough to cause discomfort, the comb turns purple and the bird may cough and wheeze. In the movement of the body the bird appears awkward, and has a peculiar appearance of the back and shoulders, which gives it a more or less "hunched up" attitude.
Treatment: Remove suspected birds, kill, and examine the carcasses. If air-sac mites are found, cull rigidly. It is doubtful if a flock can be entirely rid of them, but they can be kept down. The only sure way of ridding the flock is to kill off and start new as outlined under tuberculosis. Keep young fowls.

Caecal worms

Beach makes the following statement regarding this parasite:

These tiny parasites, measuring ½ to ⅜ of an inch in length, are found in the caeca or "blind guts" of the intestines. On account of their small size they are often overlooked by poultrymen or taken for the young of intestinal roundworms and their harmful effects are minimized or ignored. Their presence on the wall of these organs interrupts their normal functioning and in the case of baby chicks may result in death as early as the tenth day. On account of their sheltered position, they are hard to remove. Infestation occurs in the same manner as outlined for roundworms and preventive measures should be taken with the chicks and pullets along the same lines.

They injure the intestinal walls and permit the entrance of disease germs such as "black head." Otherwise, their presence in small numbers seems to have no ill effects.

Fowl ticks

Found in the Southern States. The tick lays its eggs in cracks about the house or runs. Larvae find their way to the birds, and feast on the blood of the host for four to ten days. Later, as nymphs, they feed again for a part of a day.

The adult tick is flat, egg-shaped, dark brown, from ½ to ⅜ inch long, and half as wide as it is long.

Treatment: It is difficult to treat the birds with any effective substance, as the power of resistance of the tick requires a material so strong as to harm the bird. It is best to make the

1 Circular 251, University of California.
2 Palton, Poultry Science, Vol. 1, No. 4; Beach, Circular 251, University of California.
attack by treating the houses. Saturate the cracks and crevices with a strong spray, such as crude carbolic and kerosene (1:3). Paint the roosts and cracks with carbolineum. Watch for the ticks. Treat the houses every month or two if necessary.

Lice

Several species of lice use the domestic fowl as a host. They possess biting mouth parts, and irritate the bird by crawling as well as by biting the old scales, which serve as food. Lice spend their entire life on the fowl. The eggs are laid around the bases of the feathers, usually just below the vent and under the wings. Lice vary in size, some being very small and some \( \frac{1}{2} \) inch long or longer.

Treatment: Fortunately, lice are easily controlled, and anyone using ordinary precautions may keep the flock "louse free." The proper use of any of the following should prove effective.

(a) Blue ointment may be purchased at any drug store. It is easily applied and very effective. The flock should be treated twice each year, spring and fall. The effect of the oint-
ment continues for the time between. With the finger, apply a piece about the size of a pea on the skin beneath the vent. Give two or three rubs to make sure that no large pieces remain on the feathers. Place the same amount under each wing, on the bare spot at the base of the wing (Figs. 117, 118). This is a poison and should be handled cautiously.

(b) Sodium fluoride, a white powder, may be secured at the drug store. Hold the bird head down and scatter a few pinches through the feathers of the breast, thigh, below the vent, on each side of the back, neck, and on the head.

Repeat when necessary, perhaps twice a year.

(c) Blackleaf 40 is expensive but quite efficient. Place in an oil can, and, about one hour before the birds go to roost, make two lines of the liquid on each perch. The saving of labor in applying is considerable when compared with other methods.

1 First advocated by the Bureau of Entomology, U.S.D.A.
Red mites

These are very small and difficult to see during the afternoon or toward evening. At this time they are gray. After feeding, they are gorged with blood and are red.

The mites do not stay on the birds constantly. They spend the day on the under side of the perches or in cracks and crevices near by. At night they crawl on to the birds and fill themselves with blood, piercing the skin with their sucking mouth parts. Before morning, they leave to spend the day near by, digesting the blood.

Mites breed rapidly, increasing in numbers at an astonishing rate during warm weather. Filthy conditions aid their breeding.

After a few days of warm weather, if they are allowed to go unchecked, great clumps and masses of the mites may be found. Examine the under side of the perches and the places where they rest on the perch supports. In all probability a wriggling mass will be seen. If left unchecked, mites will be found in cracks in all parts of the house, more especially where birds roost in several places about the house or shelter. The mites are surprisingly tenacious of life. They survive several years after the building has been unused by fowls.

Mites sometimes infest the nests and feed on birds which go on the nest to lay. They cause a decrease in egg production, and very frequently death results from their attacks. It is impossible for birds to function normally where the red mite is present.

Small grayish specks, the cast-off skins, indicate the presence of mites.
Control: When the mites are about the roosts and nests only, the control is comparatively simple. Clean out and spray or paint the interior of the nests and roosts and roosting closet with crude carbolic and kerosene (1:3) or some of the coal-tar preparations. Follow by painting the roosts, roost supports, and nests with carbolineum.

Carbolineum holds its strength for several months. During this time it retains its power to repel mites and at the same time proves effective in combating body lice and disease germs.

Carbolineum is not a coal-tar solution, nor is it soluble in water or petroleum oils. Its efficiency is not due to its content of tar acids, as it contains less than 2 per cent of such. The germicidal or vermicidal effect of carbolineum is due to the fact that it passes through a process of chlorination and for this reason also it does not mix with petroleum oils, and the genuine goods if mixed with such will invariably show a sticky precipitation which will clog the sprayer as well as the brush. For use in poultry houses, carbolineum is always recommended to be used full strength.¹

When the entire house is infested, a thorough cleaning and spraying are necessary to rid the house of the pests.

Brooder houses should be examined before chicks are placed in them during the brooding season. If mites are allowed to prey upon young chicks, the results are disastrous.

The buildings should be thoroughly aired after treatment.

¹From descriptive material published by the company, and quoted because the statements seem to be borne out in practice, in cases where there has been opportunity to use carbolineum in various ways.
Roundworms

Roundworm-infested flocks are very numerous, and such flocks as a rule are unprofitable. Young stock are more seriously affected than mature stock. The failure of pullets and cockerels to develop properly is very often caused by these worms.

There are several kinds of roundworms that infest poultry. The spread of these parasites and the methods of treatment are the same for all.

Fertilized eggs are given off in the droppings, and after a period of a few days at favorable temperature and moisture are ready to hatch when taken into the body by a bird. The minute eggs cling to grain or other food eaten by poultry or may enter the body through drinking water. The infestation is direct, that is, the worm eggs pass from one bird to another without the need of an intermediate host.

The most certain way to detect roundworms is to kill some of the birds and examine the intestines their entire length. The large roundworms of poultry are white, pointed at both ends, and from 1 inch to 3½ inches in length (Fig. 110). They are unattached in the intestine.

Tobacco dust for flock treatment or nicotine sulphate capsules for individual treatment are effective for expelling roundworms.

It is not advisable to use any treatment if the birds are laying heavily.

Method of treatment with tobacco dust. To each 50 pounds of dry mash add 1 pound of tobacco dust, containing 1½ to 2 per cent nicotine, and mix thoroughly. Not over one week's supply should be mixed at one time. Feed this mixture to the birds in place of the regular mash. No other change of feeding is necessary, provided the method used has proved satisfactory. Feed the tobacco dust daily for three or four weeks. Clean the droppings and litter frequently.

It is often advisable to feed tobacco dust daily to young chicks for periods of three or four weeks, with three or four
weeks in between during which time no tobacco dust is fed. The chicks may be fed in this manner from two or three months of age until they reach maturity.

Since there is no practicable method of destroying worm eggs in the soil, young stock should be reared on new range. The contaminated runs or range should be plowed, and poultry and poultry manure kept away from it for at least two years.

Scaly leg mite

Scaly leg is caused by a microscopic mite which burrows beneath the scales of the shank, causing the scales to stand out. In very severe cases, the shanks have great knobs, parts of which may be cracked and bleeding. The trouble is likely to spread.

Treatment: Dip the shanks in a mixture of crude oil and raw linseed oil, equal parts. Do not let the mixture come in contact with the skin above the shank.

Pearl, Surface; and Curtis \(^1\) recommend the application of an ointment (1 part oil of caraway and 5 parts white vaseline, mixed) rubbed in every few days until the trouble disappears. The first method is somewhat easier.

Dipping the shanks in kerosene is also effective.

Sticktight flea

The adult fleas attach themselves to the head, about the eyes and comb. Eggs are laid and fall to the ground, as a rule. There they hatch and, when grown, return to the bird. The flea is more common in the warmer sections of the country.

Control: Thoroughly spray the houses with crude carbolic and kerosene (1 : 3), clean the place thoroughly, and treat the roosting quarters as for mites. It is probable that treating the birds as for lice, page 252, will help.

The prevalence of different poultry diseases as shown by the diagnostic work of the New York State Veterinary College at Cornell University for the upstate laying tests in New York State for the years 1931 to 1937 inclusive.

### Number of Birds That Died and Cause of Loss

<table>
<thead>
<tr>
<th>Cause of loss</th>
<th>Central test</th>
<th>Western test</th>
<th>Cause of loss</th>
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<th>Western test</th>
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<tr>
<td>Abnormal oviduct</td>
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<td>Internal layer</td>
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<td>1</td>
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<td>Laryngitis</td>
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<td>3</td>
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<td>Liver necrosis</td>
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<tr>
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<td>Aspergillosis</td>
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<td>Lymphoecytoma — big liver</td>
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<td>Necrosis — proventricular</td>
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<td>0</td>
<td>Peritonitis</td>
<td>8</td>
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<tr>
<td>Fowl paralysis</td>
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<td>13</td>
<td>Pickled — other than prolapse</td>
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<td>Pneumonia</td>
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<td>2</td>
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<td>Pulmonary disease</td>
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<td>Heart muscle—degeneration</td>
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<td>Rickets</td>
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<td>Roundworms (Ascaris)</td>
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<td></td>
<td>Ruptured yolk</td>
<td>61</td>
<td>54</td>
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<td></td>
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<td>Tapeworms</td>
<td>9</td>
<td>8</td>
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<td></td>
<td>Tumors</td>
<td>218</td>
<td>221</td>
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<td></td>
<td>Visceral gout</td>
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<td>Decomposed</td>
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<td>Findings not conclusive</td>
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<td></td>
<td>Total findings</td>
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<td>Closca</td>
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<td>2</td>
<td>Counted twice</td>
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<tr>
<td>Gizzard</td>
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<td>Crop</td>
<td>26</td>
<td>16</td>
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<tr>
<td>Intestine</td>
<td>8</td>
<td>9</td>
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<td></td>
<td></td>
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<tr>
<td>Oviduct</td>
<td>135</td>
<td>119</td>
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<td></td>
<td></td>
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<tr>
<td>Proventriculus</td>
<td>2</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Total mortality</td>
<td></td>
<td></td>
<td></td>
<td>1193</td>
<td>1089</td>
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### Number of Birds That Died from Seven Most Serious Causes

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<th>Causes</th>
<th>Western test</th>
<th>Central test</th>
<th>Total both tests</th>
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</thead>
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<td>27</td>
<td>60</td>
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<tr>
<td>Impacted oviduct</td>
<td>119</td>
<td>135</td>
<td>254</td>
</tr>
<tr>
<td>Internal layer</td>
<td>47</td>
<td>70</td>
<td>117</td>
</tr>
<tr>
<td>Lymphoecytoma (big liver)</td>
<td>112</td>
<td>127</td>
<td>239</td>
</tr>
<tr>
<td>Pickout (prolapseus)</td>
<td>89</td>
<td>126</td>
<td>215</td>
</tr>
<tr>
<td>Ruptured yolk</td>
<td>54</td>
<td>61</td>
<td>115</td>
</tr>
<tr>
<td>Tumors</td>
<td>221</td>
<td>218</td>
<td>439</td>
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<tr>
<td>Total deaths</td>
<td>675</td>
<td>764</td>
<td>1439</td>
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</table>

Number of birds examined, all conditions: 1089, 1193, 2282

Deaths from seven causes above, per cent of total deaths: 61.9, 64.0, 63.0
Tapeworms

These worms fasten themselves to the walls of the intestines, by means of hooks in the head end. The body of the parasite is segmented, the segments growing larger the farther they are from the head. The older segments develop sexually and become filled with eggs. These segments drop off, pass out with the droppings, disintegrate, and the eggs are eaten by an intermediate host, such as a slug or certain types of beetles. Later these may be eaten by a fowl, and the cycle is completed.

Treatment: No treatment is known that is 100 per cent efficient. As an intermediate host is necessary for subsequent infestation, control consists in breaking the cycle. Remove droppings and litter frequently and carry them far enough away so these hosts will not be likely to find their way from them into the poultry houses. Spread the manure, or store it in tight or screened containers. In tight containers heat will destroy the eggs but also the fertilizing value. In screened pits intermediate hosts may not enter.

Several remedies have been tried but have not been found effective in removing the tapeworm heads although certain of them remove the bodies. The bodies grow out again in one to two weeks. The best treatment is prevention.

Rear on clean ground where no manure has been spread and no chickens have ranged for at least two years. An open range is preferred. Avoid naturally damp, shaded areas. Rotate ranges. Consider the possibility of infestation from neighboring poultry plants.

1 Under date of October 18, 1932, the Food and Drug Administration of the U.S.D.A. issued a trade notice as follows: “Government tests showed definitely that these types of preparations [combinations of nicotine sulphate and kamala and also iodine products], although labeled as being effective for roundworms and tapeworms in chickens and turkeys, are not effective in expelling any species of tapeworms which commonly infest chickens and turkeys nor any species of roundworms other than the large roundworm. No drug or mixture of drugs known at the present time can be truthfully offered to the public as an expeller or vermifuge for all types of worms which infest poultry and other animals.” Poultry Science, January, 1933.
260 TREATING DISEASES AND COMBATING PARASITES

Heat prostration

Heat prostration frequently causes the death of the very best birds, which are overcome by heat during the process of egg laying, in nests or in buildings that are not properly ventilated.

On extremely warm days sprinkling the floor and walls has a cooling effect. The outside of the house is sometimes sprayed with water during the period of most intense heat. The evaporation of moisture inside or out is a cooling process.

Egg eating

This vice seldom develops among birds that are kept occupied, have proper feed and range, and whose nesting material is sufficient. Gather the eggs frequently. Deepen the litter and darken the nests. See that ample oyster shell and fish oil are supplied. Provide for direct sunlight.

Feeding milk for a few days may help.

In an attempt to get the birds' attention on other matters, throw any feed or material, such as waste paper, in the pen for the hens to tear up.

Tropical or Northern mite

The entire life cycle of each mite is spent on the host. Heavy infestation may cause emaciation, lowered egg production, and general debility.

Treatment: Dust with flowers of sulphur or paint the perches with Blackleaf 40. Individual treatment with carbolized vaseline applied about the tail and under the wings appears most effective.

Controlling disease by the carrier elimination method

Through a series of tests, while attempting to reduce the mortality which was steadily increasing in the station flock, poultrymen at the Ohio Agriculture Experiment Station have made important discoveries.¹

¹ Summarized from Ohio Agricultural Experiment Station Bulletin 180.
First. Although a few diseases and parasites live over from year to year in the soil, other very important ones can remain virulent but a short time (2 to 4 weeks) outside the bird’s body.  

Second. The following appear to belong to the second group: paralysis, leukemia (big liver disease), fowl typhoid, cholera-like diseases, infectious coryza, and infectious laryngotracheitis.  

Third. Chicks and growing pullets were highly susceptible to the diseases, and, despite all measures (of sanitation management such as open wire sun porches, fly screening, batteries, and fresh range), became infected from the older birds which served as carriers of the diseases, when kept on the same farm. This occurred even when the old birds were housed or yarded separately or when the chicks and pullets were raised on fresh range ½ mile away and entirely segregated from all other chickens.  

Fourth. These diseases are apparently not transmitted through the egg. Chicks may, therefore, be hatched from either an affected or a non-affected flock.  

Fifth. Chicks should be brooded and pullets reared to at least 5 months on other farms where these diseases do not exist, or completely segregated from older birds.  

Sixth. Four weeks before housing the pullets, dispose of all the old birds (carriers), and thoroughly clean the houses and equipment.

COMMUNITY SURVEY

1. Secure several birds suffering from various troubles, and keep them in well-ventilated quarters, under good management. Treat each one for its particular trouble. Keep account of the time consumed in preparing and giving the treatment and the cost of time and materials. At the end of a week or more, study the data and the quality of the birds, and determine the advisability of attempting a cure. (This should prove more valuable if data are secured on several lots of birds.)  

2. How much emphasis do local poultrymen place on attempting to cure sick birds?
3. What methods are used in your locality in keeping poultry free from lice and mites?

REFERENCES


KENNARD, D. C., and CHAMBERLAIN, V. D., "Eight Years Experience with Losses of Pullet Layers," Ohio Agricultural Experiment Station Bimonthly Bulletin 180, 1936.
CHAPTER XIII

MAINTAINING SANITARY CONDITIONS

Among the more important factors having to do with the success or failure of the poultry enterprise are poultry hygiene and sanitation. One can easily realize that a flock possessing high vitality and vigor, free from parasites, and with proper feed, water, housing, and range, is happy and stands a better chance of remaining free from disease and troubles.

These essential conditions may be secured by anyone at a slight expense. Failure to keep the place clean is the weak spot in the management of many poultry plants; and yet the task of maintaining cleanliness is not difficult or unpleasant when followed systematically with modern poultry plant conveniences.

Since poultry is naturally hardy and can withstand considerable ill treatment, many poultrymen permit the flock to live under filthy, unsanitary conditions. As a result of disease and other factors, losses of birds, reduced egg production, and general lowering of flock vitality may occur. These more than offset any expense that might have been incurred in providing sanitary conditions.

Cleanliness is of paramount importance in providing sanitary conditions. There are several operations which should be thoroughly and regularly performed in the general care of the poultry house. These are the first requisites in maintaining a clean house.

Operations:

1. Removing droppings.
2. Renewing litter.
3. Supplying clean water.
4. Spraying roosting quarters and nests.
5. Cleaning and disinfecting in the fall.
6. Preventing unsanitary conditions.

General information:

Spray material for disinfection and disease prevention.

1. Removing droppings

Remove the droppings frequently. Do not let them remain on the droppings board longer than one week in summer. During winter, clean often if the droppings are not frozen. Where no platforms are provided, straw or other absorbents should be used freely.

Use a hoe, a square shovel, or a regular droppings board scraper (Fig. 121). Clean all corners and do a thorough job.

After the manure is removed, scatter an absorbent, such as superphosphate or litter, over the droppings boards. An excellent practice is to scatter 3 or 4 pounds of superphosphate on the droppings boards to each 10 or 12 pounds of manure secured at a cleaning. (Ordinarily 100 birds will void 10 to 12 pounds of droppings during a roosting period of approximately 11 hours in the winter.) This takes up the moisture and will be mixed with the droppings at the next cleaning. It acts as a preservative and makes a desirable fertilizer for garden and general crop purposes. Never use lime or wood ashes on the droppings as it liberates the ammonia and lowers the quality of the manure. Coal ashes may be used. Where the manure is saved as a fertilizer, it is best to store or spread it with the other farm manures. However, if it is desired to use poultry manure separately, the best place to store
it is in a covered pit or room arranged so that water cannot run in on the floor. This room or pit should be well ventilated near the roof. All openings and doors should be screened to keep flies from entering and breeding in the manure.

2. Renewing litter

When the proper amount and kind of litter has been placed in the pens, it often is not necessary to clean and renew it for several months. Long straws or large pieces of litter material become damp and filthy sooner than a well-pulverized litter, because smaller pieces provide more surfaces for the evaporation of moisture.

Straw put in in the early fall becomes broken up into small pieces before cold weather arrives. A good ventilation system, dry litter near the water vessels, and the proper floor space per bird aid in keeping the litter dry. So long as the litter is dry it may be left on the floor, at least during the winter.

Keep the litter stirred; otherwise it may be lumpy and wet. Feeding some grain in the litter each day causes the birds to scratch and keep it well mixed. The moisture from droppings is quickly evaporated. A good rule is to clean out all litter and nest material in early spring and again in the fall before the new pullets are put in.

Cleaning during the winter may increase the trouble from dampness for a while, as the moisture from the droppings and breath evaporates from the coarse litter slowly.

A small amount of litter may be added from time to time during the winter. It quickly becomes mixed with the other.

There is likely to be but little tendency for disease to spread
when birds pick grain from dry, pulverized litter containing a minimum amount of fresh droppings.

3. Supplying clean water

Disease may be spread rapidly in a flock through the drinking dishes and in the wet places caused by the drip in the litter about the drinking dishes. The danger from both sources should be reduced. Give fresh water daily in vessels so placed that hens cannot scratch litter into them. Empty and rinse the water dishes each morning before filling.

To prevent wet places in the litter about the water dishes construct a four-sided frame with solid or slatted sides 12 to 18 inches high and 8 to 10 inches wider than the water receptacle. Cover the top with 1- to 1\(\frac{1}{2}\)-inch mesh wire supported beneath with two or three narrow cross pieces. Place on a tight board or metal base that will catch or hold the drip. Clean the bottom board frequently.

In the case of an outbreak of disease, wash and disinfect the water vessels at least once each week with a 5 per cent solution of carbolic acid in water, or any other good disinfectant.

4. Spraying roosting quarters and nests

These should be kept clean, as this is where red mites gain a foothold and do their greatest damage. (See page 35, under “Preparation of the House,” and page 254.)

Renew the nesting materials at least every time that new litter is added. A house cannot be sanitary unless it provides roosting quarters that are clean, roomy, well ventilated, and free from mites. Direct sunshine is a cheap and most effective disinfectant.

5. Cleaning and disinfecting in the fall

A thorough cleaning and disinfecting should be given to all poultry buildings at least once each year in the cooler sections of the United States, and at least twice in the warmer sections. This should be done with the least possible disturbance
to the fowls, in occupied pens, since they are easily thrown out of production at this season. Fowls may occupy adjacent pens or houses while the interior of their own quarters is being disinfected; also, substitute fixtures can be installed while the regular fixtures are removed. This is easily accomplished where there is a proper standardization of interior equipment and all fixtures are portable.

See page 34 for directions for cleaning a poultry house.

6. Preventing unsanitary conditions.

While cleanliness is extremely important, other general precautions should be observed.

A. The range. The use of range for laying birds is being reduced or is being abandoned by many poultry keepers. The influence of green feed on yolk color (page 130), the dangers of contaminated ranges, and greater ease of caring for the birds are responsible.

\footnote{This should not result in serious overcrowding at this season of the year, when fewer hens are laying heavily.}
MAINTAINING SANITARY CONDITIONS

Pullets or hens for market egg production appear to function efficiently under continuous confinement when the full use is made of direct sunlight. However, they may be yarded or allowed free range.

Breeders should be allowed range, a sun porch, or open fronts. A complete substitute for direct sunlight in its effects on hatchability and livability of chicks has not yet been found. A sand or gravel loam is best and is most easily handled from a sanitary standpoint. The range should be plowed or spaded and cropped yearly. Cropping the ground loosens the contaminated top soil and allows the air and sunshine to permeate the soil more effectively (Fig. 125).

Seed the range with a quick-growing crop which tends to utilize the manure and aids materially in purifying the soil. An application of lime should be applied if the soil is acid. Ground limestone is usually cheaper than other forms of lime, and when used should be very finely ground. It may be applied at the rate of approximately 1 ton per acre on soils of medium acidity or 1½ to 2 tons on soils high in acidity. An application every three or four years should be sufficient. It may be applied after plowing or spading, and worked into the soil while harrowing. The principal value of lime is in growing crops rather than in destroying disease germs or parasites.

A double- or triple-range system affords the most ideal conditions.

See pages 444 to 445 for range in connection with the growing of young stock.

Drainage. On soils heavier than sandy loam, it may be desirable to drain artificially, especially if water has a tendency to stand on the surface. In a poultry yard, the surface soil around the building becomes packed by the birds constantly walking over it and thus interfering with both natural and artificial drainage. This condition may be overcome by laying tile drains 20 or 30 feet apart and filling in at intervals with cinders or gravel. Care should be taken to place cinders in such a way that when the trench is filled up to the top they will
have the form of a large pyramid, the base of which covers several tile and the top of which is 2 or 3 feet in diameter. The remainder of the trench may then be filled in with the natural soil. Such an arrangement provides drainage for the surface water and will keep the soil in much better condition.

Fig. 125—Letting the air and sunshine into the soil.

Cultivating poultry yards to grow green feed and provide range. The one-horse plow or the gasoline motor cultivator are important tools on sanitary poultry farms.

B. The stock. Breeding stock should be selected for vigor and freedom from parasites and disease. This should be the first requirement. (See Chapter XVI.)

When birds are brought to the plant from some other source, it is well to keep them in an isolated building for approximately two weeks in order to observe the presence of any disease that may develop. Carefully examine and treat each bird for lice before placing it in the main flock.

C. The houses. Well-constructed and ventilated houses are essential, since frequently the lowered resistance of a flock may be directly traced to faulty house construction and operation. (See Chapters III and IV for a review of these factors.)
Removing and disposing of sick and dead birds. The successful poultry keeper will observe his birds daily for any evidence of disease or lowered vitality. The latter is sometimes more easily seen than the former, and may reveal something wrong with the general management.

Whenever one or more individuals are observed to be in poor condition, immediately remove them from the flock and kill them or keep them in a separate building until the trouble can be diagnosed. Prompt removal may prevent the spread of a disease which otherwise might have proved disastrous. Whenever a bird is found dead, it should be immediately removed and posted or burned. Since burying the birds does not necessarily destroy the disease germs, it is a safer practice to burn all birds that die, because of the possibility of spreading the disease to the other individuals in the flock. If birds are buried, the place selected should be far away from the poultry house and range, and the birds should be buried so deep that they cannot be brought to the surface by poultry or other animals. Never allow dead birds to lie about the plant, and never throw them upon the manure pile or bury them in it. Each of these alternatives is a dangerous practice.

D. The crematory. One of the best means of burning dead birds is a crematory. Such a structure may be used the year round, and should be considered a necessary part of the equipment for a plant of several hundred birds.

A satisfactory crematory is one consisting of a firebox of concrete, the inside measurement of which is approximately
2 by 1\(\frac{1}{2}\) by 1\(\frac{3}{4}\) feet. Leave a hole in front for building a fire, and lay iron bars across the top of the firebox for a grate on which the dead birds may be placed.

An incinerating chamber of concrete or galvanized iron, about 1\(\frac{1}{2}\) feet high, should be built to rest on the firebox. The edges should be tight. At the upper rear of the chamber, leave a pipe hole. Place the dead bird on the iron grate and close the incinerating chamber. Start a fire and maintain it until the carcass is reduced to ashes. This eliminates the danger of a further spread of disease from this source. The fire gun can be used to excellent advantage to accelerate the burning of both wood and carcass.

![Fig. 127.](image)

An oil barrel incinerator makes burning all dead birds a cheap, quick operation.

**GENERAL INFORMATION**

Spray materials for disinfection and disease prevention

The "phenol coefficient," which is usually given on the container, is an index of the efficiency of coal-tar products.

1 Spraying or painting for vermin eradication and prevention is discussed in Chapter XII.

2 J. R. Beach and S. B. Freeborn, Cir. 251, University of California.
The coefficient of any disinfectant indicates its germ-killing strength as compared with a 2½ to 3 per cent carbolic acid solution.¹ The higher the coefficient of a disinfectant, the more water can be added to make a solution of definite germ-killing strength and, therefore, the farther it will go. A disinfectant having a coefficient of 3 has three times the strength of a disinfectant having a coefficient of 1. It will, therefore, when mixed with water, make three times the amount of disinfectant of equal strength.

Cresol is one of the best general disinfectants for farm use.² The commercial cresol is derived from coal-tar and depends upon the amount of cresylic acid for its efficiency. Most of the cresol disinfectants sold are used in 3 or 5 per cent solutions. The manufacturer specifies the strength, and this specification should be followed in its use.

To make:

1 per cent disinfectant solution, add ½ part disinfectant to 5 gallons water
2 per cent disinfectant solution, add 1 part disinfectant to 5 gallons water
3 per cent disinfectant solution, add 1½ parts disinfectant to 5 gallons water
4 per cent disinfectant solution, add 1¾ parts disinfectant to 5 gallons water
5 per cent disinfectant solution, add 2 parts disinfectant to 5 gallons water

COMMUNITY SURVEY

1. How often is the litter renewed in summer? In winter?
2. How often are the droppings removed in summer? In winter?
3. What do the poultrymen use on the droppings boards as absorbent?
4. Make a list of the disinfectants and sprays that are used by local poultrymen.
   (a) For what purpose is each used?
   (b) How is each used? (As a spray, spread by brush, etc.)
   (c) How often is each applied?
   (d) What is the cost of each?

Arrange the disinfectants and sprays in tabular form, under different headings as: cost, ease of application, efficiency, etc., and in order—best to poorest. Study the table and write your conclusions.

¹ A 2½ to 3 per cent solution of carbolic acid is strong enough to kill the average disease germ.
² E. L. Brunett, N. Y. S. Veterinary College, from "Disinfection of Poultry Houses," Cornell University.
5. What percentage of the laying flocks in your community is given range? Breeding flocks? Rearing flocks?

6. What are the poultrymen's reasons for and against range?

7. What types of soils are common in your neighborhood?

8. What means of cropping, draining, alternating ranges, etc., are employed to keep the poultry range sanitary and to avoid the spread of disease?

9. How many poultrymen burn or bury their dead birds?

10. Do any of the poultrymen have a crematory for burning dead birds? If so, does it work satisfactorily?

11. In your judgment which kind of crematory or incinerator works best?

12. Ask for an estimate of its cost.
CHAPTER XIV

PREPARING EGGS FOR MARKET

The poultryman has a peculiar advantage, as compared with the producer of milk, for example, in that the hen delivers her product in such convenient form. She gives him the semi-fluid, edible portion of the egg, in a convenient size for table use, in a special sealed package, wrapped with two shell membranes and sealed within the egg shell.

All the skill, expense, hazard, and thought given to the enterprise culminate in the production of the egg. The aim, therefore, should be to preserve the quality of the finished product and thereby secure a proper price.

Operations:
1. Producing clean eggs.
2. Gathering the eggs.
3. Holding market eggs.
4. Cleaning market eggs.
5. Candling market eggs.
7. Packing eggs for shipment.
8. Studying a fresh egg.

General information:
1. Why eggs lose quality.
2. Factors affecting the interior quality of eggs.
3. The standard 30-dozen case.
4. Home preservation of eggs.

For a discussion of distributors, methods of marketing, and the operation of cooperatives, auctions, and other receivers, the reader is referred to *Marketing Poultry Products* by Benjamin and Pierce, published by John Wiley & Sons, Inc.

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1. Producing clean eggs

Dirty eggs are an expense to some one. Washing them takes time. If they are shipped dirty to market, they will bring a smaller price than clean eggs of the same size.

Reduce the numbers of dirty eggs by observing these rules:

(1) Construct the nests 6 to 7 inches deep inside and allow another 7 inches from the top of the front board to the ceiling (Fig. 40).

(2) Provide 4 to 5 inches of fine, clean, fluffy, and absorbent nesting material, such as shavings, oat, buckwheat, or peanut hulls.

(3) Keep the nest material clean and remove any that is dirtied by broken eggs or manure.

(4) Do not let the birds roost on the nests at night.

(5) Allow 1 foot of nesting space for each five or six hens to avoid undue crowding and egg breakage.

(6) Keep the litter clean and dry. See that the house is well ventilated. It may be necessary to stir the litter occasionally with a fork. Fine, pulverized, dry material on the floor remains dry and often gives better results than coarse, unbroken straw or hay.

(7) Do not let storms drive into the house.

(8) Avoid overcrowding. Three square feet of floor space, or more, to each bird helps the litter condition.

(9) Clean up and prevent wet places near the water dishes.

Fig. 128.

A nesting room in the corner of a room housing 120 birds. Nests are 7" deep and contain 5" of shavings for nest material. Each tier is about 5 feet long and contains no nest partitions.

1 Consult your state agricultural college if assistance is needed.
2. Gathering the eggs

Use pails of woven or welded wire or with sides perforated with $\frac{1}{2}$- or $\frac{3}{4}$-inch holes, (Fig. 129). Eggs may be left in the pail to cool, or spread on raised wire trays. Pails are not easily overturned, and they do not crack the eggs by having flexible sides.

Baskets, if strong, are satisfactory, but they should be openly constructed. They permit cooling.

Collect eggs at least twice daily; collection three or four times is preferable. During very warm or very cold weather, and when the birds are laying heavily, collect at 9 and 11:30 A.M., 2 P.M., and at night, to prevent the eggs from becoming heated, frozen, broken, or dirty.

3. Holding market eggs

Take the eggs at once to a clean cellar or room, which is free from any musty odor. Do not leave pails in the kitchen, pantry, or other room until the dirties are sorted out. A uniform temperature between 45 and 60 degrees F., good ventilation, and 75 to 80 per cent relative humidity are desirable. Eggs, like milk, lose quality rapidly under poor holding conditions. Cooling and high humidity retard deterioration; warmth or jarring hastens it. Eggs should cool for 12 hours in the basket before being packed in the cases. Today's eggs should be packed tomorrow. The cases
should have been in the cellar and, therefore, cool. Quickly cooled eggs, packed in a cool case and held in a cool, moist cellar until they are shipped, should reach the market in excellent condition. The fillers and flats hold the cold in but keep circulating air out, which is desirable.

**Egg rooms**

*Still-air cooling* occurs best in a room built under ground and which has a room or building above. An earth floor allows the soil moisture to enter the room. Water may be added to the floor, if needed. Such a room should have outside walls of stone or concrete with insulated walls separating it from the main cellar. It should be placed on the north or northeast side of the cellar and have at least one window near the ceiling which may be used for ventilation. A slatted rack on the floor will keep the baskets and cases off of the ground.

Shrubbery or trees which protect the building will assist the egg room in its functioning.

*Circulating-air cooling* is more rapid and can be satisfactorily used when electricity is available. (See Figs. 131 and 132.)

Excessive use of the fan should be avoided due to possible evaporation of the eggs. One and one-half to three hours is usually sufficient to cool a given lot of eggs as in 132, while \( \frac{1}{2} \) to 1 hour should suffice in an arrangement such as that shown in 131.
Fig. 131—Circulating air is used to cool eggs quickly in this egg room.

An electric fan at A drives air into the wooden chute, through holes in the top, and into and through the wire-bottomed pails. A fine mist of water is sprayed constantly into the room, maintaining a relative humidity of 85 to 90 per cent. Excellent quality eggs reach the market from this farm.

Fig. 132—This 10' × 20' egg cellar is built into a bank of earth.

The ceiling is insulated with several inches of shavings. An electric fan in a movable box blows air against the pipes which contain cold, running water. Water drips over the burlap at the left.
For cooling large numbers of eggs or a large room area, much good has resulted by hanging sheets of burlap on four sides and keeping it wet by water dripping from small holes in pipes placed just above the burlap. A large fan causes faster evaporation from the burlap and reduces the temperature inside of the room.

4. Cleaning market eggs

Dirty eggs may be cleaned with a sandpaper cleaner or with mineral wool, and they may also be wiped with a damp cloth or washed. Do not place the dirty eggs in a pail or pan of water as they absorb both water and bacteria.

Recent work by Funk indicates that “soiled eggs cleaned with NaOH solution kept equally as well in cold storage as clean eggs which were not washed.”

One per cent of concentrated lye (NaOH) added to clear water appeared to destroy surface bacteria and any just inside the shell. Rubber gloves should be used when washing eggs in this solution. “The water containing sodium hydroxide used in washing eggs should be changed often so that the eggs washed are thoroughly cleaned of all contamination.”

How dirt and washing may affect interior quality. When

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the egg comes in contact with wet manure or other moist dirt, damaging bacteria or mold spores, if present, may pass through the shell pores to the inside of the egg. Washing will remove the dirt from the surface, but not the bacteria from inside the shell. Furthermore, the washing may smear more bacteria over the shell and through the shell into the egg. That seems to be the danger in washing eggs.

Investigators have found that, after storage, a larger number of dirty eggs contain bacteria than normally clean eggs; and that a larger number of washed dirty eggs contain bacteria than dirty, unwashed eggs.

Effort should therefore be made to produce clean-shelled eggs, and to establish a reputation in the market to that effect. Such efforts are likely to be amply repaid.

5. Candling market eggs

To candle an egg is to look through it while it is held in front of a bright light in a darkened room (Fig. 134).

Many satisfactory candling devices are available on the market, but a tinsmith can make one (Fig. 135). Desirable results are obtained by using a 40-watt light in a dark room. Do not hold the egg at the opening long enough to heat it. A convenient bench

Fig. 134—Candling eggs.

Note the position of the egg, the pail in which eggs are gathered, and the case for the candled eggs.

Fig. 135.

A candling device that can be slipped onto the center partition of an egg case or piece of similar size. Two persons can work on opposite sides.

1 The use of chloride and potassium tests to determine whether or not eggs have been washed, described by P. F. Sharp in U. S. Egg and Poultry Magazine, Vol. 41, No. 5, May, 1935.
under the candling apparatus facilitates the rapid handling of the eggs (Fig. 134).

In candling, the egg should be held with the large end up, so that the air space will normally be at the upper end. Just before the egg is placed at the lighted opening, the contents should be set whirling by a quick turn of the wrist, in order

![Fig. 136.](image)

Note difference in weight. The same pail and scales and an equal number of eggs.

*Left:* These eggs averaged 1.96 ounces each, 23.5 ounces per dozen, or 44.25 pounds net per case.

*Right:* These eggs averaged 2.2 ounces each, 26.4 ounces per dozen, or 49.75 pounds net per case. A difference of 5.5 pounds of eggs per case. This amounts to the equivalent of 3 3/4 dozen more eggs.

that the condition of the interior of the egg may be easily observed. The egg must be held below the level of the eye if the candler is to see the air space as well as the yolk. Such a position also prevents the light from shining directly into his eyes.

6. Grading market eggs

If the eggs are to be shipped direct to distant consumers or to a dealer who pays on a quality basis, they must be well
packed, and it may be necessary to sort them for size, shape, color, and shell condition, and to candle them for interior quality. The operation of sorting and candling the number of eggs produced on a small plant or farm may be done at one handling.

Place the egg pails on a table or shelf near the candler, and have one or two containers near by to hold eggs that are cracked, too large, too small, ridged, off color, thin-shelled, too long, or too round to be shipped safely.

In cool weather, eggs may be packed into the crates or cartons without candling, but, if the weather is warm, it is best to candle all eggs for a high-class trade and remove any that show a poor interior quality.

The amount of grading that should be done depends upon the person to whom the eggs are sold. If the same price can be secured without grading, it may not pay to grade closely, or perhaps even to grade at all. Each producer must decide what is most profitable under his circumstances. If there is any question as to the best policy, it is generally better to grade carefully and sell only on a good, dependable high-quality basis.

A case should be filled with eggs of as near the same grade as possible; or, if of different grades, they should be separated and the fact indicated on the outside of the crate.

The large markets sort eggs closely and into a number of grades. A poultryman may receive a price which seems too low; but it must be remembered that the quality of eggs is
easily lowered by a number of causes. It is often difficult to know where the trouble lies.

The best possible care should be given the eggs before and during shipment in order that they may be as near the original quality as possible upon arrival at the market. Unless the producer and his method of grading are well known to the receiver in the large market, most eggs are candled and graded by the dealer before being retailed to the consumer.

A. Egg grades. Recognizing that uniform national standards and grades for eggs are essential to efficient egg marketing, the U. S. Department of Agriculture has established U. S. Standards of Quality for eggs and tentative U. S.

Fig. 138—From the pail at the left in Fig. 136.

Note the tray space not used.

A fourth inner thin layer of albumen is enclosed within the middle (jelly-like) layer (page 420).

Grades for eggs as follows: (1) U. S. Buying Grades for Eggs. (2) U. S. Wholesale Grades for Eggs. (3) U. S. Retail Grades for Eggs.
A description of these grades may be obtained by writing to the Division of Dairy and Poultry Products of the Department of Agricultural Economics, U. S. D. A., Washington, D. C.

B. Size. (Figs. 136, 137, 138.) The size of market eggs is usually determined by weight per individual egg, per dozen, or per 30-dozen crate. The size is often estimated by the eye as the eggs are handled, and then checked by weighing a dozen or a case to determine the actual weight.

Market eggs vary in size from about 1½ ounces to 2½ ounces each. Smaller or larger eggs than these are usually not marketed.

Eggs are sorted into large, medium, pullets, and peewees. Approximately the following weights are used in several markets.

<table>
<thead>
<tr>
<th>Weight per dozen in ounces</th>
<th>Minimum net weight per case in pounds</th>
<th>Minimum gross weight per case* in pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 to 27 or above</td>
<td>45</td>
<td>57</td>
</tr>
<tr>
<td>20½ to 24</td>
<td>38.5</td>
<td>50.5</td>
</tr>
<tr>
<td>18 to 20½</td>
<td>33.8</td>
<td>45.8</td>
</tr>
<tr>
<td>16 to 18</td>
<td>30</td>
<td>42</td>
</tr>
</tbody>
</table>

* Estimated weight of case, flats, and fillers, 12 pounds.

An effort should be made to have the eggs uniform in size in each case, carton, or other package (not over ½ ounce variation between individual eggs or 3 ounces per dozen). If eggs of several sizes must be shipped in one case, pack those of each size in separate fillers and indicate the number of dozens of each on the tag.

C. Shape. Long or wide eggs should be eliminated from a shipment or packed in the center of the top filler. It may be necessary to build up the ends of the case with ¼- to ⅔-inch strips before nailing on the top to prevent breakage. Slight bulges, creases, or moderate roughness in the shell are not sufficient to exclude eggs from a grade (Fig. 140).
1. Before the candle the dimly visible yolk shadow and small air cell indicate fine quality. Note large amount of thick white (2). Note (3) full container and even, uncrowded location of the 12 yolks held in place by the thick albumen surrounding each yolk.

4. The visible yolk shadow suggests a smaller amount of thick white and more thin white, as in (5). Note (6) the full container and slight crowding of the yolks in the upper half, due to less thick white.

Plate I—Candled and opened appearance of representative eggs of U. S. Special and Extra or N. Y. State Fancy and Grade A qualities.

The four graduates are the same size and each contains twelve normal-sized eggs. Cuts 3, 6, 9, and 12 furnished by Frank A. Jones, Department of Agriculture and Markets, Albany, N. Y. Cuts 1, 4, 7, 10 furnished by E. W. Benjamin, Pacific Egg Producers, N. Y. City. Cuts 2, 5, 8, 11, are colored photographs taken by the junior author.
7. In the third grade the white has thinned and evaporation has occurred so that a plainly visible yolk shadow is seen when the egg is candled. Note (8) the weakened white and (9) definite crowding of the yolks upward in a container not quite full.

10. The lowest quality in edible eggs is shown by a plainly visible yolk shadow, often dark in color. The white may be very watery and chalazae nearly or completely gone (11). Note (12) less material from eggs with large air cells and yolks which float high in the watery white.

Plate II—Candled and opened appearance of representative eggs of U. S. Standard and Trade or N. Y. State Grades B and C. See page 285 for full description of N. Y. State Grade C.
D. Color. Certain markets prefer white-shelled eggs; others prefer brown. It is well to cater to these preferences, although shell color does not necessarily affect the food value of eggs.

**Standards of Quality for N. Y. State Retail Grades of Eggs**

<table>
<thead>
<tr>
<th>Grade factors</th>
<th>Fancy Grade</th>
<th>Grade A</th>
<th>Grade B</th>
<th>Grade C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell</td>
<td>Clean, sound</td>
<td>Clean, sound</td>
<td>Clean, sound</td>
<td>Clean or dirty; cracked but not leaking</td>
</tr>
<tr>
<td>Air cell</td>
<td>( \frac{1}{4} ) in. or less, localized; regular</td>
<td>( \frac{3}{4} ) in. or less, localized; regular</td>
<td>( \frac{5}{8} ) in. or less, localized; may be slightly tremulous</td>
<td>May be over ( \frac{1}{2} ) in. May be tremulous, bubbly or freely mobile</td>
</tr>
<tr>
<td>Yolk</td>
<td>May be dimly visible</td>
<td>May be visible</td>
<td>May be plainly visible; mobile</td>
<td>May be plainly visible; dark in color; freely mobile</td>
</tr>
<tr>
<td>White</td>
<td>Firm, clear</td>
<td>Firm, clear</td>
<td>Reasonably firm</td>
<td>May be weak and watery</td>
</tr>
<tr>
<td>Germ</td>
<td>No visible development</td>
<td>No visible development</td>
<td>Development may be slightly visible</td>
<td>Development may be clearly visible but no blood showing</td>
</tr>
</tbody>
</table>

**Explanations and Definitions of Terms**

Terms Descriptive of the Air-Cell.

Localized. A localized air-cell is one which retains a fixed position when the egg is twirled before the candle.

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Regular. A regular air-cell is one which shows a practically even smooth outline when the egg is twirled, without any movement from its normal shape and position in the egg.

Slightly tremulous. A slightly tremulous air-cell is one which retains a practically fixed position in the egg, but shows a slight movement, not to exceed one-fourth inch, at one or more points where its lower edge touches the shell.

Tremulous. A tremulous air-cell is one which shows a movement in excess of one-fourth inch at one or more points where its lower edge touches the shell.

Freely mobile. A freely mobile air-cell is one which moves freely about in the egg when it is turned.

A freely mobile air-cell which readily moves to the uppermost point of the egg as it is turned, indicates that the inner shell membrane is ruptured or broken.

Bubbly. A bubbly air-cell is one which has several rather small air bubbles within it which give it a bubbly appearance.

Terms Descriptive of the Condition of the Shell

Clean. A clean shell is one which is free from foreign matter and from stains or discolorations. Processed eggs which show traces of the processing oil on the shell are considered clean unless the shell is otherwise soiled.

Stained. A stained shell is one which has been discolored by contact with foreign substances, such as wet straw, damp earth, etc.

Dirty. A dirty shell is one which has adhering to it particles of soil, foreign matter, masses of egg yolk, etc.

Practically clean or slightly dirty. A practically clean or slightly dirty shell is one which is stained or soiled to such a slight extent that it is not particularly noticeable.

Checked or cracked. A checked or cracked shell is one which is fractured but has an intact shell membrane which prevents the contents from leaking out.

Leaker. A leaker is an egg with a cracked shell and a broken shell membrane which permits the contents to exude or leak out.

Blind check. A blind check is a cracked egg in which the crack in the shell is so fine that it is not readily discernible to the naked eye except before the candle.

Body check. A body check is a healed-over crack in the shell that occurred prior to the time the egg was laid by the hen.

Sound. A sound shell is one that is free from actual checks and cracks.
Terms Descriptive of the Condition of the Yolk

Dimly visible. A dimly visible yolk is one which can be distinguished before the candle as a shadowy object without clear distinction of outline, and which does not move far from its normal position in the center when the egg is twirled.

Visible. A visible yolk is one which has a fairly definitely discernible outline before the candle and which moves somewhat from the center of the egg when it is twirled.

Plainly visible. A plainly visible yolk is one which has a plainly discernible outline before the candle but not dark in color, and which moves freely from the center of the egg when twirled.

Mobile. A mobile yolk is one which shows considerable movement away from the center of the egg when it is twirled before the candle.

Freely mobile. A freely mobile yolk is one which shows a wide movement or swing away from the center of the egg when it is twirled before the candle, and comes sufficiently close to the shell to appear decidedly dark in color.

Dark color. A dark-color yolk is one which, because of its freely mobile condition, closely approaches the shell when twirled before the candle, and is distinctly discernible as dark in color.

Terms Descriptive of the Condition of the White

Firm white. A firm white is one which is sufficiently thick or viscous to permit but little movement of the yolk from the center of the egg. A firm white is one of the principal causes of a dimly visible yolk.

Reasonably firm white. A reasonably firm white is one which has a weakened viscous condition and thereby allows the yolk to move more freely from its normal position in the center of the egg and to approach more closely the shell when the egg is twirled. When the white is reasonably firm, the outline of the yolk becomes fairly distinct, but the yolk does not approach the shell closely enough to appear dark in color.

Weak and watery. A weak and watery white is one which is thin and generally lacking in viscosity, and which therefore permits the yolk to move freely from its normal position in the center of the egg, and closely approach the shell when the egg is twirled. A weak and watery white is indicated by the free movement of the yolk and by the decidedly dark color of it as the egg is twirled before the candle. Eggs with weak and watery whites often develop a tremulous, bubbly or freely mobile air-cell.

Clear white. A clear white is one that is free from any foreign bodies floating in it, which in candling would appear as dark irregular spots,
often called “meat spots.” A thick fibrous chalaza may appear rather prominently in the white and be mistaken for “meat spots.” Such condition of the white, however, would be considered as clear.

Terms Descriptive of the Germ

No visible development. No visible development of the germ indicates that there has been no development of the germ spot; or, if slight development has occurred, that it has not proceeded to the point where it can be distinguished by candling.

Slightly visible development. Slightly visible development of the germ indicates that there has been some development of the germ and that it has proceeded to the point where it is indistinctly visible as a deeper-colored area on the yolk.

Clearly visible development. Clearly visible development of the germ without blood showing, is a condition that indicates that the development of the germ has progressed to a point where it is plainly visible as a deeper-colored area on the yolk.

Inedible Eggs or Loss

Inedible egg. An inedible egg is one which is unwholesome or otherwise unfit for food.

Loss. The term loss as generally used includes all inedible eggs, and those that have been smashed and therefore are of no commercial value.

Inedible Eggs that May be Detected by Candling

Black rot. A black rot is a decomposed egg the contents of which are gray or black in color when seen before the candle.

Mixed rot. A mixed rot is an egg in which the yolk is broken and is partially mixed with the white.

Blood ring. A blood ring is an egg in which germ development has taken place to the point that blood veins have formed around it, giving a reddish glow and visible presence of blood veins.

Seeping yolk. An egg with seeping yolk is one in which the yolk sac is broken and part of the yolk is seeping through into the white.

Large embryo. An egg with a large embryo is one in which there is a network of blood vessels on the yolk in the center of which is a dark body, the embryo, of varying size depending on the degree of development of the germ.

Bloody white. An egg with a bloody white is one which has a general reddish appearance due to blood mixed through it and which may show spots of blood floating in the white.
Moldy egg. A moldy egg is one which has developed moldy spots within the egg shell or along cracks in the shell which appear as grayish or black areas. Advanced stages of mold development may cause the entire egg to appear black before the candle.

Crusted yolk. A crusted yolk is one that is covered with a light-color crust which has a tendency to flake off and in which the white is watery and frequently yellowish in color and possessing a putrid odor. Before the candle it also may show dark spots on its surface.

Stuck-yolk. A stuck-yolk is one which has adhered to the shell and maintains a fixed position at that point. Eggs with stuck-yolks are considered inedible.

Inedible Eggs Which Cannot be Detected by Candling

Green white. An egg with a green white can be detected with certainty only on breaking the shell, when the white shows a distinct greenish-white color.

Musty egg. A musty egg is one which has a stale, musty odor.

Sour egg. A sour egg is one which has a sharp sour odor.

Foreign Material in Eggs Which May be Detected by Candling

Blood clots and “meat spots.” Small clots of blood on the surface of the yolk or floating in the white are usually detectable by candling, and if not mixed with the white do not render the egg inedible. Small particles of foreign material, such as pieces of tissue, known as “meat spots,” are also detectable by candling, but do not render the egg inedible.

Unusual Edible Eggs

Grass egg. A “grass” egg is an egg with an olive-colored yolk, giving a greenish cast to the whole egg, which deepens in the region of the yolk. It may be caused by the hens eating shepherd’s purse and other weeds of the same family.

E. Shell condition. Thin- or very rough-shelled eggs may break easily in shipment. It is better to sell them locally or use.

F. Checks or leakers.¹ Bakeries will often use these eggs, but it is better to use small supplies of them at home or dispose of them to local consumers rather than attempt to ship them.

A leaker is an egg cracked so that the contents leak out.

¹The best preventive is deep, clean nest material and careful handling
290 PREPARING EGGS FOR MARKET

The perfect-shaped egg should fill without crowding either at the top or the side of the carton when packed, little end down.

The 30 eggs shown here illustrate the extent of injury which might take place from crushing when placed in the container. The opening in which each egg is placed is the same size as that in a standard 3-dozen egg case filler, namely, 2\(\frac{1}{2}\) by 12\(\frac{1}{2}\)\(\text{"} by \text{"}\). The black portion surrounding the egg shows the space in the filler unused by the egg.

A. Fills the space completely with slight pressure from the cushion or flat above. Too large for safe shipment without adding to the height of the crate.

B. Slightly smaller and provides a little latitude for movement which allows the egg to tilt slightly in the carton. This permits a longer egg to be placed in

**Fig. 140—A contrast in sizes and shapes of eggs.**
the carton than would be the case if the egg stood perpendicular. This is a desirable size and shape for the fanciest egg trade.

O. Slightly wide, which makes it more difficult to tip the egg diagonally in the container. It exactly fills the carton without danger of side crushing. (A safe type to ship.)

D. Excessively long, making it impossible to ship in any position in the container without crushing from above.

E. Too large for the container and is subject to crushing both from the side and the top. Such eggs could only be shipped in crates higher than the standard, which would permit the liberal use of cushions above and below to absorb the shock.

F. Correct in width but too long to be used in the standard-sized carton. Such eggs may be packed in the corner containers of 5-doz. egg fillers.

G. Abnormal in shape, being somewhat cylindrical and too narrow in proportion to its length. Could be shipped by placing diagonally in the container.

H. An elliptical type of egg of large size, difficult to pack safely without special cushions above.

I. A fairly large egg, filling the container, with slight latitude for motion. A desirable type, but not equal, however, to A, B, or O.

J. A very large egg, filling the carton completely at the sides and requiring a cushion and flat to prevent top crushing.

K. About equal to J as to desirability in shipping.

L. An exceedingly symmetrical type of egg, but must be packed as in the case of F, G, H, J, and K.

1. A very blunt elliptical type, desirable from a display or shipping standpoint. Such eggs weigh heavier than they look when viewed from the side and show to the greatest advantage when viewed from above as in A, B, O, E, which is the position of eggs when placed on sale in the cartons.

M. Not only too long but abnormal in shape. Should not be used for hatching purposes and ordinarily should not be placed in a top grade.

N. Has the same faults as D.

O. An abnormally long, narrow egg. Could not be shipped successfully and must be used for home consumption. Such eggs should never be incubated.

P and Q. Two of a great variety of abnormal types. The birds which laid these eggs might or might not again lay eggs of similar shape.

2. Similar in shape to Nos. 1 and 5 but weighing 2 oz. more per doz. All three are desirable types.

A very large egg, of splendid shape, which requires special care in packing in oversized containers but which would command the highest price on exterior appearance.

5. Quite similar to No. 2 as to size and weight.

6. Similar to No. 3 and exactly meeting the minimum requirements as to weight and fully meeting the requirements as to shape for a fancy pack.

7. Similar to Nos. 2 and 3 in shape, but weighing 1 oz. less than the former and 1 oz. more than the latter.

8, 9, and 11. Three other desirable types, weighing from 24 to 26 oz., a desirable weight for securing the top price.

10. A 30-oz. egg having no fault except oversize and like J, K, and L requires oversize fillers or cushions and crates.

12. Exceedingly desirable type, slightly oversize, requiring special care in packing.

13. A 25-oz. egg, exceedingly deceptive in its weight. It looks when viewed from the side to be larger than No. 7, just above, the difference being due to the fact that No. 7 is wider both near the large and the small end.
7. Packing eggs for shipment

If eggs are to be sold locally at retail, they may be delivered in pails, baskets, or cartons holding one dozen each. The carton is usually best, as it holds the eggs securely and adds to the attractiveness and convenience of the package. The cost of the carton and the extra labor are important items, but eggs so packed usually find customers who are willing to pay the extra cost for having them delivered in a convenient container (Fig. 144).

For shipping to outside points, the standard 30-dozen case is best.

When packing eggs, one should see that the top layer is typical of the whole package. Eggs should be packed with the large end up because yolks are less likely to stick to the shell and the eggs present a better appearance.
In packing the 30-dozen case, the following method gives a minimum amount of breakage. Breakage is usually greatest near the top.\(^1\)

\(^1\)Examination of a filler will show each individual strip to be slit half-way across. Each egg space, therefore, is bounded on opposite sides by a strip of filler which has been slit on either side, thus making this section weak in half of its width. The other two sides have the
Packing with cup flats. Place two flats on the bottom, the lower one bottom side up. Then alternate filler and flat to the top of the case. Place two flats on top of the pack, the upper one bottom side up. The top is laid on and nailed with four nails in both ends. Never nail the top in the center. The cup flat is gaining constantly in favor. It reduces breakage to a minimum and prevents the contents of a broken egg from soil­ing other eggs in the same filler.¹

8. Studying a fresh egg

As a fresh, white-shelled egg is held before the candle, the egg as a whole appears pinkish yellow. Looking closely at the upper end, one can see the air space, about the diameter of a ten-cent piece, or smaller. The yolk also appears as a diffused shadow at about the center of the egg. A dark spot usually follows or precedes the yolk as it turns around after the egg is strong uncut half at the top and are therefore better able to hold the eggs firmly. Fillers should be placed in the crate with the uncut half at the top and crosswise of the case, as most strain and greatest breakage occur through the end movement.

¹ Many market men like to remove a layer or two of eggs to examine the pack below. In so doing, the hand is pushed down at opposite corners of the filler, between the filler and the case, grasping the filler and flat. The filler, held firmly and bent slightly, is removed, together with the three dozen eggs it contains. After a little practice, a person may become quite skillful and may transfer an entire case in a short time.
twisted. This spot is one of the chalazae. It is sometimes confused with a meat spot. The shell membranes are firm around the air space.

A brown-shelled egg looks similar, but the shell gives the contents a darker color.

Variations from these qualities occur when the egg is kept under unfavorable conditions or for a considerable time. The air cell may be larger or perhaps loosened, the yolk darker and heavier. Under ordinary conditions of retailing, eggs will pass to a lower grade in one week or less.

9. Detecting abnormal eggs

As the egg is twirled before the candle, abnormalities will occasionally be detected.

A. Blood clot. A blood clot appears as a red spot attached to the yolk. It differs from an embryo as there are no radiating blood vessels. Blood clots are usually caused by the rupture of a blood vessel of the yolk sac, or a follicle which is broken when the sac splits and lets the yolk drop into the oviduct. The clot is deposited on the yolk before the albumen is laid on. (See Chapter XX for the formation of an egg.) Blood-clot eggs seldom should be marketed but may be used at home after the clot has been removed. A small clot does not injure the egg for food.

B. Bloody eggs. Blood in the albumen gives the egg a red tint throughout. Bloody eggs may be caused by the spreading of a blood clot in the albumen, or may be due to a diseased or injured condition of the oviduct, causing blood to be exuded with the egg white when the egg is being formed. The yolk may be used. The white is usually discarded. Such eggs are less common than blood clots.

C. Meat spots. Meat spots appear floating in the egg white, either entirely free or attached to the chalazae. The floating particles vary in size and color. They may be portions of the walls of the oviduct or abnormal growths of tissue which develop in the oviduct and are later dislodged when an egg
passes through. The meat spot is darker than the chalazae; it is also duller and more opaque than the blood clot. After the meat spot has been removed, the egg is suitable for food. Such eggs seldom should be marketed.

D. Double-yolk eggs. Eggs with two yolks are very common and can be detected easily by the two distinct shadows seen while candling, even if the increased size of the egg is not sufficient indication. These eggs are as good as any, but in order to keep the salable product uniform they are generally used at home.

E. Body checks. See page 286.

Many other abnormalities occur, but those mentioned are the most common. It is well to break open eggs which appear unusual in any particular, and become familiar with the cause. This practice aids the candler in detecting a similar case at another time.

GENERAL INFORMATION

1. Why eggs lose quality

The subject of egg quality is one of great interest and is open to considerable controversy. It is generally assumed that the eggs are best when first laid. Certain it is that the individual egg will never be any better or fresher, if we may use that term, than immediately after it is laid.

It is well to keep in mind that eggs when first laid are not always of high quality. In fact, it is not impossible (though of rare occurrence) that hens lay eggs which are inedible. Eggs of all degrees of quality, from the very finest to the inedible, are found immediately after they have been dropped by the hen. The causes of this are several.

Different hens, as well as the same hens, often lay eggs of varying quality. That is, one bird may consistently lay Grade A quality or Grade B quality. Certain hens may be of low vitality either naturally or as a result of feeding or management, and are not physically able to produce an egg of the highest quality.
Hens through fear or undue excitement sometimes hold their eggs within their bodies for a considerable length of time. Because of bacterial infection from the body of the hen, or because the germ in a fertile egg dies, or for other reasons, decomposition may set in. The natural high temperature of a hen's body, 105 to 107 degrees F., hastens the breaking down of the egg if held for long within the body.

An egg may mature and reach a point where it is ready to be laid just after a bird has gone to roost in the evening and be held until the following morning in the body of the bird. Twelve or fourteen hours at that high temperature after the egg is ready to be laid might throw the quality down a grade or even more before the hen lays the egg the following day.

Hence it can be said that eggs are not of exceptionally high quality in every instance because they were just laid or because they reached the market a very short time after being produced, because an egg may be well along on its quality journey by the time it is laid. In general, it is correctly assumed that under normal conditions the majority of eggs just laid are of fine quality.

Eggs are perishable. Regardless of the quality when laid, an egg moves rapidly from its original quality toward a still lower quality unless something is done to check it. The rapidity of this movement toward lower quality depends on the environment surrounding the egg.

Because there is no known method for making an egg better in quality once it is laid, and because eggs always move toward lower quality, it follows that our only chance of getting to market eggs as good in quality as when they were produced is to provide conditions which will hold the original quality that the hen put into the egg.

2. Factors affecting the interior quality of eggs

The quality of an egg is influenced by a number of factors, some of which are discussed below.
A. Temperature. The older or more inferior an egg is the more rapidly will it be affected by extremes of temperature. The eggs should be cooled immediately after they are laid. Temperatures above 60 degrees are responsible for some deterioration in the quality of the egg whether fertile or infertile, but they are especially disastrous to a fertile egg. Warm, dry air causes rapid evaporation, especially if it blows over the eggs. Weak, watery eggs of a stale flavor soon result.

Sharp and Powell, of Cornell, found the temperature and the number of days required to lower the quality of eggs to the same point (about Grade B) as follows:

<table>
<thead>
<tr>
<th>No. days</th>
<th>Temperature, degrees F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>98.6</td>
</tr>
<tr>
<td>8</td>
<td>77.0</td>
</tr>
<tr>
<td>23</td>
<td>60.8</td>
</tr>
<tr>
<td>65</td>
<td>44.6</td>
</tr>
<tr>
<td>100</td>
<td>37.6</td>
</tr>
</tbody>
</table>

The importance of low temperature is evident. Temperature is of greater importance than age.

High temperatures permit the mucin fibers in the albumen to break down and liquefy and water to pass from the albumen to the yolk, thus increasing its weight and causing the yolk to flatten. A beneficial gas, CO\(_2\), is lost from the egg.

Quick cooling drives the heat out quickly and retards the loss of CO\(_2\).

(1) The dark-yolk problem. The dark yolk, as it is called on the eastern market, when eggs are candled, is largely a fallacy brought about by a combination of conditions which have tended to outweigh the facts. Consumers, in general, prefer the yolk color uniform when breaking out several eggs. Whether the color is light, medium, or dark is secondary. The extreme light or extreme dark yolks are less popular with the consumer.

Weak whites may be inherited or broken down by high temperature. Green feed causes dark yolks as also does heavy
yellow corn feeding. Both conditions are found in many eggs produced on general farms. Eggs of low quality or with weak whites have a more visible yolk shadow and mobile yolk. Therefore, when a low-quality egg which shows considerable yolk shadow is broken, a dark yolk is often found.

A strong-bodied egg has a dimly visible yolk shadow and is considered to have a light yolk, although, upon breaking, it may be found dark. What the dealer sees is the yolk shadow and not the color of the yolk.

A dealer rather than a consumer prejudice against the dark yolk has thus been built up.

Actual yolk color may influence candling judgment only slightly, unless the color is very dark.

(2) Fertile eggs. Before the egg is laid, the embryo in the fertile egg has been developing for several hours, and if the animal heat is not removed at once this development soon continues to such an extent that the embryo can be seen by candling. The temperature in the nest on a hot day may be nearly 100 degrees F. or perhaps more.

When hens are laying heavily, or if broody hens are not confined regularly, the eggs may be at incubation temperature for several hours after being laid. The embryo, if well advanced, may die when the egg is cooled, causing the formation of a blood ring. This ring may be very small and is sometimes difficult to see before the candle.

A fertile egg, kept at a temperature of 68 degrees F. for several days, will develop slightly.

When the embryo dies, decomposition sets in, and in time the egg rots.

Males have no influence on the number of eggs a hen may lay. They are necessary only when fertilized eggs for incubation purposes are desired. Males should not be present in a flock which produces eggs for market after the breeding season is over. It is particularly important that the males be removed from the laying flock during the warm weather months of late spring and summer.
(3) **Infertile eggs.** An infertile egg will not rot if the shell is kept dry, but the quality will quickly deteriorate at temperatures above 60 degrees F.

(4) **Freezing.** Freezing must be guarded against, as it breaks down the white and may crack the shell, either event preventing the egg from being of first quality. Eggs freeze at about 28 degrees F.

**B. Moisture.** High relative humidity surrounding eggs is desirable. Low humidity in the egg-holding room causes moisture to be drawn from the egg. Some moisture is drawn completely through the shell, resulting in an enlarged air cell, while some is stopped in the shell where it spreads between the layers of shell. A pronounced mottled appearance of the shell is often traceable to low humidity in the egg-holding room.

**C. Absorption of odors and flavors.** The egg readily absorbs odors, which may or may not be lost in cooking. Care should be taken to keep the eggs away from filth, disinfectants, decaying vegetables, or any other substances possessing a disagreeable odor.

3. **The standard 30-dozen case**

The 30-dozen egg case has become the standard shipping package on this continent (Fig. 145).

Wood for egg cases should be tough, non-warping, light-colored, non-staining, odorless, light in weight, and low in price. Cottonwood, tupelo, spruce, and gum are commonly used and are mentioned in the order of their desirability. Cases constructed of composition board instead of wood are in use but have not yet proved superior in practice.

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2 *Dimensions of the 30-dozen case.* The outside dimensions of the standard 30-dozen case are: 13 inches high, 12 inches wide, and 25 inches long. These cases are constructed of thin material. The sides, top, and bottom are \( \frac{3}{8} \) inch thick, the partition and the ends \( \frac{3}{8} \) inch thick, with a cleat \( \frac{1}{2} \) inch by about \( 1\frac{1}{2} \) inches nailed to the ends on the outside.
A. Weight of fillers. The quality of fillers should always be considered, since they are responsible for much of the breakage in transit. The heavier fillers are sufficiently superior in strength to justify the slightly higher price.

B. Color of fillers. The strawboard filler is the one most commonly used. The white fillers are most attractive and, for a high-class trade, justify the extra price.

C. Second-hand cases. Second-hand cases can be used to advantage if in good condition. New fillers and flats should be kept on hand to replace broken ones.

4. Home preservation of eggs

In many homes, regardless of whether poultry is kept or not, it is desirable to preserve eggs during the spring of the year when eggs are plentiful and prices are low. Eggs properly preserved may be held for several months in a cool cellar and used during the following fall and winter.

Of the many ways of preserving eggs at home, the waterglass solution is the most popular.

1 Weight of fillers. Fillers for 30-dozen cases are machine made (M. M.) of the following grades: No. 1, weighing 3½ pounds per set; Special, 3¼ pounds; Medium, weighing 3 pounds per set; and No. 2, weighing 2½ pounds per set. The Medium and Special 3¼-pound grades are the most popular for domestic use; No. 1 is sometimes required if the eggs are to be placed in cold storage or exported. The fillers and the flats separating them are made of hard calendered strawboard, except in certain patented designs such as the Mapes cup flats made of news pulp, and others made of spruce pulp.
Preparing eggs for market:

Preparing water glass:

Materials needed for 30 dozen eggs:

- 18 quarts water
- 1 1/2 quarts water glass (commercial)
- 2 eight-gallon earthen jars or crocks.

Boil the water and allow it to cool. Clean the crocks with soap and warm water, and rinse. When the water is cool, pour it into the crocks and add the water glass. Mix the water and water glass thoroughly with a clean stick or long-handled spoon.

Candle or tap the eggs together gently in order to detect any cracked eggs. Only fresh, sound, uncracked eggs should be placed in water glass. Lower the eggs into the solution, several at a time, with a long-handled dipper or spoon.

The crocks may be filled at once or the eggs added daily as gathered.

Five quarts of additional water to each 1 1/2 quarts of water glass may be added if needed to cover the eggs, which should always be kept submerged. Place a cover on the crock.

Eggs may be removed as needed. Water-glass eggs are less desirable for boiling, as the shell may burst, but they may be satisfactorily used in other ways. It is essential that they be kept in a cool place.

COMMUNITY SURVEY

1. What percentage of the poultrymen whom you know have special rooms for holding market eggs until shipped?
2. Inquire of one or two of them what features they have found desirable in their egg rooms.
3. How are their eggs graded?
4. What benefit does grading bring to the poultryman?
5. Name the grades common among the poultrymen.
6. What determines the grades?
7. Do these men candle their eggs?
8. At what season of the year are eggs candled?
9. How many poultrymen visit the markets occasionally to confer with the market men?
REFERENCES

10. Check one day's collection of eggs with a poultryman, and find the
number of eggs and the percentage of the day's collection that will
go into the highest grade that the poultryman is shipping.
11. How many eggs weighed 2 ounces or over? How many were chalk-
white? Checked? Dirty? Poorly shaped?
U. S. Trade? Lower grades?
13. Describe how eggs are packed for shipment.
14. Do the poultrymen in your community use new or second-hand
cases and fillers?
15. Where do they buy cases, and in what quantity?
16. What is the difference in price between new and second-hand cases?
17. What is the express rate on a crate of eggs from your station to the
market?
18. What price is being received by several of the poultrymen in the
community?
19. What reasons can you give for the differences received?
20. What are the cost and time required for preparing eggs for market?

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CHAPTER XV

PREPARING POULTRY FOR MARKET

While it is necessary to give detailed attention and thought to all matters pertaining to the production of eggs and poultry, the ultimate success of the enterprise will depend to a great degree on the manner in which the products are marketed. The appearance of the birds sent to market has a great bearing on the price received.

Where meat varieties are kept, or a special trade is developed, careful attention to the proper preparation of the birds will be amply repaid. Not only does a discriminating trade enjoy the appearance of poultry which is well fattened and well dressed, often paying a premium for appearance as well as for quality, but there should be a genuine feeling of satisfaction on the part of the person who knows how to do this end of the work well, and who can and does put up a product which is decidedly pleasing in every respect. Such a person is proud of his products and takes pleasure in showing his wares to a prospective customer.

LIVE VS. DRESSED POULTRY

A large amount of the poultry sold for consumption is marketed alive. Commercial egg producers and persons keeping Mediterranean varieties usually cater to the live-poultry market. Marketing live poultry takes less time and requires

1 For a more complete discussion of this subject, the reader is referred to Marketing Poultry Products, by Benjamin and Pierce. Published by John Wiley & Sons.
less equipment, both of which items are of great importance where commercial egg production is followed.

For poultrymen located near the large markets, especially New York, the live-poultry market is particularly desirable if shipment can be made just before the Jewish holidays.¹

The price is usually one or two cents higher immediately preceding these dates. The Jewish market takes most of the live poultry. As payment is usually made more on the basis of weight, and less on that of quality, than in the sale of dressed poultry, the care in preparing live poultry is reduced to a min-

Fig. 146—A live-poultry car.

imum. Through the Middle West, poultry is collected from farms and shipped in special cars holding 4000 to 5000 birds (Fig. 146). Sometimes these birds are held for a short period in feeding stations and fattened before shipment.

Small lots of poultry usually cannot be shipped long distances as satisfactorily alive as dressed. The shrinkage in weight of live poultry runs from 8 to 12 per cent. Dressed poultry usually brings a higher price per pound, and the express

¹ Ask your market man for a list of these days.
charges are the same. Killing and picking, however, require considerable experience, as well as time. For this reason, and in view of the fact that bleeding and removing the feathers cause a loss of 10 to 12 per cent of the live weight, each poultry keeper must decide for himself, after learning the marketing conditions, which is the wiser thing to do in his particular locality.

**Operations:**

1. Deciding when to sell.
2. Preparing the fattening quarters.
3. Selecting the birds for fattening.
4. Feeding the rations.
5. Crating live poultry for shipping.
6. Preparing for killing.
7. Sticking and debraining.
8. Dry picking.
9. Cutting off the head.
10. Dislocating the neck.
11. Wringing the neck.
12. Scalding.
13. Wax picking.
14. Cleaning the carcass.
15. Cooling.
17. Drawing fowls or roasters.
18. Drawing broilers or fryers.
19. Trussing.
20. Deboning.

**1. Deciding when to sell**

Fowls are sold or used for meat during the year when they cease to be profitable as producers or breeders or when the

\[\text{The rate per pound is the same as that for the live poultry, when the live-poultry shipment is intended for market and the value does not exceed 50 cents per pound. Shipment of breeding stock, or stock having a value exceeding 50 cents per pound, is usually charged a higher express rate.}\]
DECIDING WHEN TO SELL

INFLUENCE OF COST OF FEED AND PRICE PER POUND (LIVE AND DRESSED) ON RETURNS ABOVE FEED COST AT GIVEN WEIGHTS

**LEghORN COCKERELS**

<table>
<thead>
<tr>
<th>Pounds live weight</th>
<th>Pounds feed</th>
<th>Feed cost per pound live weight*</th>
<th>Return above feed cost</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alive</td>
<td>Dressed †</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>@ $0.20</td>
<td>@ $0.20</td>
</tr>
<tr>
<td>1</td>
<td>2.8</td>
<td>$0.07</td>
<td>$0.13</td>
<td>$0.108</td>
</tr>
<tr>
<td>2</td>
<td>7.4</td>
<td>.92</td>
<td>.215</td>
<td>.171</td>
</tr>
<tr>
<td>3</td>
<td>13.6</td>
<td>.113</td>
<td>.26</td>
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</tr>
<tr>
<td>4</td>
<td>22.3</td>
<td>.14</td>
<td>.243</td>
<td>.155</td>
</tr>
<tr>
<td>4.5</td>
<td>29.2</td>
<td>.162</td>
<td>.17</td>
<td>.07</td>
</tr>
</tbody>
</table>

Using feed at 2½ cents per pound and live and dressed prices as shown, the 3-pound Leghorn cockerel gives the largest return above feed cost. Using columns 1 and 2 for reasonably well-grown birds, local prices may be applied to the other columns to determine the best weight to sell. Other factors, as labor and space available, may need to be considered.

**DUAL-PURPOSE COCKERELS**

<table>
<thead>
<tr>
<th>Pounds live weight</th>
<th>Pounds feed</th>
<th>Feed cost per pound live weight*</th>
<th>Return above feed cost</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alive</td>
<td>Dressed †</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>@ $0.20</td>
<td>@ $0.20</td>
</tr>
<tr>
<td>1</td>
<td>3.13</td>
<td>$0.078</td>
<td>$0.122</td>
<td>$0.10</td>
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<tr>
<td>2</td>
<td>6.5</td>
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<td>15.7</td>
<td>.098</td>
<td>.408</td>
<td>.32</td>
</tr>
<tr>
<td>5</td>
<td>22.8</td>
<td>.114</td>
<td>.43</td>
<td>.32</td>
</tr>
<tr>
<td>6</td>
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<td>.288</td>
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</tr>
<tr>
<td>6½</td>
<td>45.8</td>
<td>.17</td>
<td>.20</td>
<td>.056</td>
</tr>
</tbody>
</table>

* Estimated at 2½¢ per lb.
† Estimated @ 89% of live weight, bled and feathers off.
price for them is in excess of their value as egg producers or breeders.

The time to sell broilers or roasters depends upon: (1) price of feed; (2) weight of the bird; (3) price of the bird per pound.

2. Preparing the fattening quarters

Thoroughly clean and disinfect the coops or pens and allow the sun to shine on them, if possible, before the birds are placed in them. If mites are present, treat as recommended for the laying house (see Chapter 3). For good results, birds must have quarters that are clean and disease-free.

There are three methods of fattening: pen, crate, and cramming.

A. Pen fattening. This is the method usually followed by poultrymen. It consists of placing 20 to 30 birds in a pen, allowing about 2 square feet per bird. This restricts exercise and takes a minimum amount of labor for feeding.

No extra equipment is needed. Troughs are used for feeding and are so constructed as to keep the birds from getting into them. The objection to pen fattening is that there is a tendency to crowding, and the weaker birds are thus forced aside, resulting in more uneven growth. Access to direct sunlight may be given by an outside yard, preferably of concrete, for ease and efficiency in cleaning, or by opening much of the house to let in the sunlight. Attention to this may prove a desirable
help when pen fattening. This method requires less labor in feeding than the crate method. Cleaning must be done regularly and often. The gains in weight may be slightly less than in crate fattening, but the saving in labor is greater.

B. Crate fattening. This method is universally used by the large fattening establishments. Coops or crates hold the birds. A good crate for home use, easily constructed, is 4 to 6 feet long, 24 to 36 inches wide, and 18 to 20 inches high (Fig. 148). Partitions are placed 2 to 3 feet apart. The sides, top, and partitions are slatted. The bottom may be made of 1-inch mesh hardware cloth. A galvanized pan or wooden floor for the droppings is placed beneath the slatted floor. Each compartment holds 6 to 8 fowls or 10 to 12 broilers, the number varying with the size. Metal fattening crates may be purchased.

Crate fattening produces an excellent quality of flesh and gives all birds an equal chance to eat. The crate should be placed in a well-lighted, well-ventilated room, which may be darkened, or in the shade outside. In the latter case a cover of burlap should be hung over it to keep the birds quiet.

C. Cramming. Cramming consists of forcing food by pressure through a tube into the crop. This method produces the finest flesh, but is little used in this country by the farmer or commercial poultry keeper, because of the large amount of hand labor required. It is used in Europe in sections where extra choice fleshing is desired and labor is cheap.
3. Selecting the birds for fattening

The heavy feeding, combined with limited exercise, continues for nearly two weeks and requires strong birds to stand up under it. Therefore, only birds of strong constitution should be selected for the fattening pens.

4. Feeding the rations

Cornmeal and milk are the main feeds used. Yellow corn appears to put fat on in layers beneath the skin, giving the carcass a yellow color. The Jewish trade prefers birds fattened in this manner and, as corn also forms a hard flesh, which shrinks comparatively little during shipment, confining the birds in pens and crates and feeding largely on corn and wheat middlings gives satisfactory results.

Milk appears to put deposits of fat between the muscle fibers, gives a mild flavor and a tender, juicy meat of much better quality than corn alone. Milk-fattened birds will not stand shipment alive as well as corn-fattened ones. For this reason the use of milk is restricted, unless the birds are to be sold locally.

Create a good appetite by giving no food during the first twenty-four hours. The second day, give a small amount. After that, feed all the birds will eat, twice daily at regular intervals, about twelve hours apart.

The following are two rations used at Cornell for fattening poultry. Many other rations are used throughout the country.

**RATION WITH LIQUID MILK**

- 50 lb. yellow cornmeal
- 20 lb. flour wheat middlings
- 10 lb. ground heavy oats
- Mixed to a batter fresh at each feeding with buttermilk or skim-milk.
- Will require approximately 1 qt. (2 lb.) milk to 1 qt. (1 lb.) mash.

**RATION WITHOUT LIQUID MILK**

- 50 lb. yellow cornmeal
- 20 lb. flour wheat middlings
- 10 lb. ground heavy oats
- 10 lb. dried skimmilk or dried buttermilk
- 10 lb. meat scrap
- Mixed to a batter fresh at each feeding, with water. Will require approximately 1½ qt. (3 lb.) water to 2 qt. (2 lb.) mash.
These rations are mixed with the liquid to the consistency of porridge, and are fed by pouring into the feed troughs.

The skillful feeder aims to give just enough feed to satisfy the birds’ appetites without having any food left. If too much is given it should be removed when the birds are through eating.

Watch the birds carefully, and remove any that seem to be losing their appetites, or that are not gaining.

5. Crating live poultry for shipping
Do not overcrowd the birds, as this is likely to cause greater shrinkage. The many crates on the market differ widely in type, cost, and quality (Fig. 149). The requirements are that the crate be strong, handy, roomy, well ventilated, light, and reasonable in price. Crates of the following dimensions should prove satisfactory: 4 feet by 2½ feet, and 12 to 15 inches high. The top and sides should be slatted, 1 to 1½ inches apart. Such a crate will hold 20 to 25 birds, depending on their size.

The birds should be well fed before shipment. If the birds are on the road for several hours, nail a can inside the shipping crate and put in soaked whole grain. No other water is given. The birds’ crops should be empty or nearly so upon reaching the market.

6. Preparing for killing
The birds should be kept without food for twenty-four hours, in order to empty the crop completely, and, to a large
extent, the intestines also. Dressed poultry will keep much better when this precaution is followed.

A. The killing quarters. Where many birds are to be slaughtered, it is well to provide a place where the work can be done quickly and easily. A special room is available on many plants. This room should be large enough for coops, a heater, if scalding is done, boxes or barrels for the feathers, and places to hang the birds. A room having 200 to 250 square feet of floor space will usually meet requirements on a 1000- to 1500-bird plant.

B. The killing equipment. A simple method of holding the bird for killing is to hang on a small nail or rod a string having a block \( \frac{1}{2} \) by 2 inches attached to the end (Fig. 152). The string is wound around the feet, and the block prevents it from unwinding. To catch the blood, a can with a weight on the bottom is hung on a wire, and the upper end of the wire sharpened and bent to hook into the beak.
A better arrangement can be made with a barrel or box, a nail, a can, a small pulley, a strong cord, a weight, and 2½ to 3 feet of fairly heavy wire. No. 6 wire will answer the purpose. Arrange the wire as shown in the cut (Fig. 153). Fasten the cord to it and run up through the pulley, which is fastened a foot or two above the operator's head and about 2 feet toward the rear of the box or barrel. Hang the weight to the other end of the string.

Drive the nail through to the inside of the barrel or box, sharp end sloping down and inward and just below the upper edge. Fasten the can below to catch the blood (Fig. 153).

The wire holds the shanks apart, making the picking easier. The beak is thrust on to the nail, which holds the head, and the weight pulls the feet up, thus stretching the bird out and leaving both hands free for picking. The can catches the blood, and the feathers are placed in the barrel.
7. Sticking and debraining

Sticking in the mouth, when correctly done, gives the best bleeding. Where dry picking is practiced, the brain is pierced immediately afterward, thus loosening the feathers.

Hang the bird up. Grasp the head with the left hand, comb in the palm and palm up. Hold the head with the fleshy part of the thumb and forefinger against the bones near the earlobes. Do not press against the soft part of the neck, as this stops the flow of blood. With the middle finger of the left hand, open the beak (Fig. 154). Insert the knife, being careful not to cut the throat, until the point shown in the illustration is reached (Fig. 155). Hold the knife crosswise in order to cut both blood vessels. Make a quick single cut, pressing against the neck. Making more than one cut is unnecessary and not desirable because it gives more places for decomposition to set in.

When the bleeding is well started, debrain the bird. Hold the head as before, and place the point of the knife in the groove at the roof of the mouth and exactly between the eyes. Push the knife back on a line almost directly between the ear openings, until the base of the skull is reached. (See Fig. 71, for location of medulla, cerebrum, and cerebellum.)
point of the knife will strike the base of the brain and render the bird unconscious. Give a half turn of the knife to destroy the tissue.

When the proper point is hit, the bird usually gives a characteristic squawk. The feathers are loosened, if the stick is correctly made. Successful sticking and debraining require considerable practice.

8. Dry-picking

Hook the beak on the nail and start immediately to pick. Dip the fingers in water to make the plucking easier. Some prefer to lock the wings and pick with both hands, others to hold the wings near the body with one hand and pick with the other until the bird ceases to flop.

Grasp a handful of feathers and pull the hand over and down in a rotary motion. If the
feathers stick, let them slip through, being careful not to tear the skin. Pick the feather tracts on the breast first as these are most likely to tear. Follow with the feathers on the thigh and back at base of wing. Next grasp the wing with one hand and all the quills in it with the other, and pull all out at once with a quick downward pull. Repeat on the other wing. Pull out the tail feathers next. Follow with the neck feathers. Any remaining large body feathers are next removed, after which the bird should be pinfeathered. A blunt-bladed knife helps in removing the pinfeathers, which are grasped between the blade and the thumb (Fig. 156).

9. Cutting off the head

This is perhaps the most common method of killing. The legs and wings are grasped with one hand and the head laid on a block. The neck is severed with a hatchet. The body and neck are held with the flat part of the hatchet until all bleeding and struggling ceases. The beginner may make a better cut if two nails are driven into the block, and the neck laid between the nails and drawn back until the head is held firmly, thus stretching the neck out. The bleeding caused by cutting off the head is satisfactory, provided a sharp instrument is used.

10. Dislocating the neck

This is a popular method where birds are dressed for home consumption. It is not desirable for market purposes. It is
done by holding the legs in the left hand, and near the left hip of the operator (Fig. 157). With the breast of the bird out, grasp the head, having the thumb at the back near the base of the skull, the palm against the face, and the middle finger across the under side of the beak. Bend the head back at nearly a right angle (Fig. 158). Holding the legs firmly, pull down sharply with the right hand.

The neck will separate at the base of the skull and sever the blood vessels there. Stretch the neck to provide space for the blood to accumulate. Bleeding is quite complete, all the blood being held in the neck, as the outside skin is unbroken. If the bird lies awhile before dressing, the blood coagulates and the usual method of dressing may be followed.

11. Wringing the neck.

This is not recommended.

12. Scalding

Some markets object to scald-picked poultry, as it will not keep as well as dry-picked and very frequently is less attractive because of cooking and tearing of the skin. When scalding is properly done, the appearance is not materially different from that of dry-picked poultry.

It is harder to scald-pick poultry properly than to dry-pick it, if it is for market. Unless the picker is an expert, however, dry picking requires considerably more time.

Scalding is desirable in the case of birds intended for home consumption, and many markets do not object to it—some even prefer it.

The temperature of the water should be just below boiling
(about 190 degrees F.). It is important to avoid cooking the skin if birds are to be sold. Hold by the head and feet and keep these parts out of the water. Draw slowly through the water, with the feathers and not against them. Keep the bird moving to prevent the water from flowing between the feathers to the skin. This will steam the base of the feathers. It may be necessary to dip more than once. Try the thigh feathers first; if they are loose, the bird will pluck easily.

The *slack-scald* method consists of holding birds for 25 to 30 seconds in water, heated to 128 degrees F. for broilers and 130 degrees F. for fowls and roasters. This does away with some of the skin injury in scalding but is more difficult to use on the farm as the temperature of the water must be held nearly constant.

**13. Wax-picking**

When lots of twenty-five birds or more are to be picked, the wax method may be used. A special wax can be purchased. Automatic electric wax heaters are best. The wax is heated to 127 to 128 degrees F. Water in another container should be warmed to about 85-90 degrees F.

The birds are bled and debrained and either slack-scalded or dry-picked. All quills and about three-fourths of the body feathers are plucked. Hang before a fan to dry and cool, from 4 to 2 hours if slack-scalded and 1 hour if dry-picked.

Holding the bird by the head and feet, dip 1 to 3 times in the wax. After draining for 1/2 to 1 minute, immerse in the warm water until the wax feels rubbery.

Hang the bird up and remove the wax soon afterward.

Collect the wax in containers, heat, skim off the feathers, and use the wax again.

The wax removes pinfeathers, hair, and other material, leaving a clean carcass.

**14. Cleaning the carcass**

Before putting the birds away to cool, wash the feet. Clean the blood from the mouth, if sticking has been done.
Give the head a quick downward thrust to dislodge any clotted blood.

### Losses Due to Dressing and Drawing

Based on live weight

<table>
<thead>
<tr>
<th>Average weight, birds alive</th>
<th>Loss due to dressing, per cent</th>
<th>Loss due to drawing, per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 3 lb.</td>
<td>13</td>
<td>27</td>
</tr>
<tr>
<td>3 to 4 lb.</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>4 to 5 lb.</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>Over 5 lb.</td>
<td>9</td>
<td>18</td>
</tr>
</tbody>
</table>

15. Cooling

The animal heat should be quickly removed after plucking. If the birds have been dry-picked, the market may prefer them dry-chilled, in which case the carcasses may be hung on racks or placed on the shaping board and cooled in a temperature of 32 to 40 degrees F. A clean, cool cellar is very satisfactory.

Where the market is not too discriminating, the birds may be placed in clean, cold water, iced if necessary, and left there from five to ten hours. Water cooling lessens the keeping quality if the birds are to be stored; but for immediate use it improves the appearance by smoothing out the wrinkles in the skin due to a slight absorption of water.

16. Packing for shipment

It is good practice to wrap the heads. Wrappers of parchment paper may be bought. A common size for roasters is 7 inches wide, 14 inches long on one edge, and 7 inches on the other (Fig. 159).

For irregular or small shipments, the packages may be ordinary clean boxes or barrels. They should be lined with parchment paper and, in warm weather, should be packed in
ice, unless short shipments are made or refrigerator cars are available. Place a layer of ice on the bottom, with the birds on that, breast down and legs toward the center. Alternate the ice and birds until the container is filled. Cover the top with ice and place burlap over that.

Fig. 159—Wrapping the head.

A. The start.
B. The finish.

Large shipments of carefully graded poultry are packed in boxes of sizes to accommodate a certain grade (Fig. 160). There are usually a dozen to the box. This method is to be preferred for the best quality of poultry and the most discriminating high-priced trade.
17. Drawing fowls or roasters

Until recently poultry to be shipped was never drawn. At present there is a tendency to draw poultry for shipment when it can be immediately frozen and held in that manner. Otherwise it should not be drawn. If for home use, the following description, with accompanying illustrations of drawing, may be followed.

Singe the bird over a low alcohol flame, burning off the hair but not scorching the flesh. Denatured alcohol does not produce smoke to discolor the skin.

Place the bird on its breast with head toward you (Fig. 161A). Grasp the neck loosely with the left hand, allowing the neck bone to slip upward, by tightening upon the skin just below. Cut down the back of the neck, through the skin, on the midline from a point between the shoulders to the head. Pull the neck bone loose from the neck skin, and cut the neck bone off close to the shoulders and the head (Fig. 161B).

Loosen the windpipe and gullet from the neck, and the crop from the breast; then pull the crop out (Fig. 161C). Cut off the head, leaving a long fold of skin.

Remove the tendons. To do this, hold the shank with the rear toward you and cut through the skin lengthwise of the shank (Fig. 162A). With old birds, insert the point of the
knife beneath the tendons and loosen them, as the shank skin is tough. Place the shank on the table with the foot and one inch of the shank projecting over the edge, and break the bone by striking down with the hand. Then twist the broken shank

Fig. 161—Drawing a fowl.
1st, 2d, and 3d steps.
DRAWING FOWLS OR ROASTERS

Fig. 162—Drawing a fowl.
4th, 5th, 6th, and 7th steps.
until the skin is broken and the foot hangs by the tendons only (Fig. 162B). If necessary, cut the skin, leaving only the tendons connecting the foot with the leg. Pull on the foot as illustrated, or pull on each tendon separately, and the tendons will be pulled away from the drumstick (Fig. 162C). Repeat for the other shank. The remainder of the shank should be cut off at the joint (Fig. 162D).

Lay the bird on its back, side toward you, tail to your right. Reach over the carcass with the left hand, grasp the vent, and make a cut about \( \frac{3}{4} \) inch long between the vent and
tail. Turn the tail toward you, insert index finger of left hand into the opening, loop up and over the intestine, bring the loop out through the opening, and cut around the vent (Fig. 163A), loosening it from the body but leaving it attached to the intestine. Carefully remove the intestine through this opening until the gizzard is reached (Fig. 163B). Hold the carcass in the left hand, breast up, insert one finger of the right hand, and loosen and remove the gizzard. Loosen the liver and remove it. Remove the heart and lungs from the same opening.

Next remove the wishbone. Place the bird on its rump, turn the skin back from the wishbone, scrape the flesh from the bone (Fig. 163C), and cut through the joint near the breast bone and the cartilage near the neck (Fig. 163D).

Remove the oil sac. Wash the inside of the bird.

Fold the neck skin back over the cut and the shoulders, and fasten down by folding the wings (Fig. 164A).

Trim the heart, and remove the gall bladder from the liver. Cut through the muscle of the gizzard, halfway around, being careful not to cut the inner coat. Fold back the sides and remove the contents of the sac. Wash the heart, liver, gizzard, neck, and wishbone, and place them within the body.

Wipe off any blood or soiled spots on the carcass.

18. Drawing broilers or fryers

When a flat carcass is desired for broiling or frying, the result may be obtained at the time the bird is drawn, as follows: Remove the shanks as before. Hold the carcass in the left hand, breast down. With a sharp knife, cut through the bones along the back, to the right of the center line and from neck to tail. Pull the sides apart. With the fingers, remove all internal organs. Cut around the vent. Work the crop loose, and pull the windpipe and esophagus out. Cut off the head near the base of the skull. Cut off the neck bone near the body. Cut through the cartilage from the inside, at the
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Fig. 164.

A. Drawing a fowl.

B. Trussing a fowl.
The finished carcass from the side.

C. Trussing a fowl.
The finished carcass from the front. Cutting along the back of the neck presents a clean, uncut, attractive carcass when trussed.

D. Trussing a fowl.
The finished carcass from the rear.
Note the absence of long cuts on the abdomen, the result of drawing as in Fig. 163, A and B.
forward end of the breast, to make the carcass lie flat. Clean the gizzard, liver, and heart. Wash and place together.

19. Trussing

The purpose of trussing roasting birds is to make the carcass compact and attractive. There are several methods, the following being a simple one.

Lay the fold of neck skin over the shoulders, and bend the wing tips under and upon the shoulders (Fig. 164A). Place the bird on its back with the rump toward you. Place the loop of a strong string over the front of the body, and pull it into the angle made by bending the wings. Cross the string on the back, and bring the ends up and cross them over the drumsticks near the outer joint. Pull down tightly. Carry the ends down the sides. Turn the bird over and tie the string across the rump. Trim off the ends.

20. Deboning

For private or family use, a carcass may be deboned. This is done by turning back the flesh, starting from the front, and gradually cutting the flesh loose from the bones, until only a mass of flesh is left. After stuffing and roasting, slices of both light and dark meat and dressing may be cut.

21. Home canning of poultry

Cockerels and cull hens may be preserved for home use by canning, in order to avoid the expense of holding surplus stock alive until needed for the table. The canned meat retains its flavor.

Cut a chicken into pieces that will easily go into the jars. The flesh may be removed from the bones or not, as desired. Seasoning, such as celery leaves, onion, pepper, etc., may be added. Fill the jars to within \( \frac{1}{2} \) inch from the top. Add one teaspoonful of salt for each pint. No water is necessary. Use new rubbers. Put the cover in place and partly seal.

For details see Marketing Poultry Products, by Benjamin & Pierce.
Pressure cooker. Use a pressure cooker for most satisfactory results, following directions that come with the cooker. Generally, processing at 15 pounds pressure for 80 minutes is recommended for quart containers.

Hot water. Put the jars in the canner, in cold water. The water in the canner should not rise above the rubbers. Cook the jars of chicken four to five hours, counting from the time the water commences to boil. At the end of this time, remove the jars and seal.

COMMUNITY SURVEY

Talk with the poultrymen of the neighborhood about the marketing of surplus poultry and obtain answers to the following questions:
1. What percentage do they market alive?
2. What percentage do they market dressed?
3. Why do they prefer to market as they do?
4. What influence does the price received have on the method of marketing poultry?
5. What influence does labor have on the method?
6. At what age are the broilers marketed?
7. When is the broiler market best?
8. When is the market for cull hens best?
9. What size shipping crate is used?
10. How many birds are shipped in a crate? What is the shrinkage?
11. How many of the poultrymen fatten the birds before shipping?
12. What rations and method of fattening are used?
13. What influences the time of marketing dressed poultry?
15. Ask the older people of the community how chickens were killed years ago.
16. Has there been any change in the method of killing?
17. What is the express rate for live poultry from your station to market?
18. What is the express rate for dressed poultry?
19. Ask the express agent for regulations governing the shipment of poultry.
20. Are the empty crates returned satisfactorily? If not, why? What are the return charges?
REFERENCES


"Preparing Poultry for Market," Dominion of Canada Department of Agriculture Pamphlet 125, 1930.
CHAPTER XVI

SELECTING BREEDERS

It is clearly recognized that one of the most important means of reducing the cost of production is to have stock of high productive ability and give it proper care.

Selecting females and males is a fascinating job in many poultry flocks. Practice makes one more proficient in reading and interpreting the history of the bird’s performance written as it is in various sections of the body. By physical examination much can be told about the laying ability of a bird, in so far as precocity and persistency are concerned (page 10). The breeder today, in selecting birds, often desires to base his judgment of a bird not alone on his or her performance but upon that of the ancestors and even the progeny.

The steps involved in selection are like those of a ladder. In determining the worth of a breeding bird, selection starts with culling and ends with the performance of the progeny. Selection may cease with any step or it may include them all.

The manner of culling or eliminating the poor producers from the flock has been discussed (Chapter I).

Operations:

1. Selecting for longevity.
2. Selecting for vigor.
3. Selecting for freedom from physical and breed defects.
4. Selecting for production.
5. Selecting for performance of ancestors, brothers, and sisters.
7. Selecting breeding males.
To select breeders properly, handle the birds in the fall, winter, and spring. The fall handling should be made sometime after October 1, and all desirable birds banded. The spring selection should be made just prior to the breeding season and preferably when the breeding pens are being mated.

1. Selecting for longevity

Give preference, other things being equal, to the older birds. It is not desirable, as a general rule, to breed from pullets. Either vigorous cocks or cockerels may be used.

Mature birds have proved their ability to live through many laying years and to survive the molt, whereas a pullet may die before her first year is completed. Any chickens which are hatched in the spring from a pullet which dies from a natural cause before the next breeding season may have a tendency toward a short life.

Mature birds have proved their producing ability; comparatively little is known about the pullet.

A greater percentage of chicks is likely to be reared from stock which is most physically fit at the time of mating, regardless of the age, provided each individual has reached proper sexual maturity.

Birds should not be discarded as breeders on the basis of age alone. If a hen lays eggs that hatch well, or if a male is strong and vigorous and properly fertilizes the eggs, the older they are the better. The fact that a fowl has reached a comparatively advanced age and retains its vitality and power to reproduce is evidence that it possesses, and therefore should transmit to its offspring, the tendency to live long and produce well.

Either cocks or cockerels may be mated with hens. However, in the event that pullets are used for breeding, cocks are better than cockerels to mate with them. The greater maturity of the cock will thus tend to counterbalance the lesser maturity of the pullet. In rare instances, where quick results from cer-
tain matings are especially desired, pullets may be used as breeders, but only when hens of the right type are not available. In case pullets are used, they should be large and mature.

The selection of female breeders, therefore, should be confined for the most part to pens containing mature birds.

2. Selecting for vigor

The use of strong, vigorous birds is essential, as it means better fertility and hatchability, and less mortality in chicks.

Examine carefully, in the flock, each bird that is a candidate for the breeding pen. Then handle the bird, as outlined in Chapter I:

The head is the most important character to indicate constitutional vigor.

### HIGH VITALITY

- Head short and thick for the variety, full of color and life.
- Beak short, heavy, curved.
- Eye bright, full, prominent.
- Comb full, bright.¹

### LOW VITALITY

- Head and beak long, thin, flat.
- Eye dull, sunken, with drooping lids.
- Comb, limp, pale.¹

¹ Hens that have been laying heavily during the year are usually lower in vigor because of the large demand upon the body for egg production. The shanks are thin and pale and the face is likely to be thin and less highly colored. If the bird has completed her laying year, the comb will be shrunken, a condition which is indicative of a low state of vigor, at the time of observation.

A fowl carries its health certificate on top of its head. The comb is the signal that shows the condition of the blood, which is an accurate index of the bird's health. One must determine whether the hen is normally a high-vitality bird and only temporarily low in vitality because of her heavy year's work, or mismanagement, or whether she is a naturally low-vitality individual by inheritance.
There is a correlation in the shape of the different sections of a fowl. For instance, a long, thin beak is associated with a long, thin head; long, thin neck; long, slender body; long, thin shanks and toes. These loose-jointed, long, slender types generally have low vitality.

3. Selecting for freedom from physical and breed defects

If the bird which is being examined possesses a high type of vigor, she should now be examined for defects. While, in some instances, birds having these defects may be retained in the laying flock, they should not be allowed in the breeding pen.

If upon examination the following defects are found, throw the bird out.

**Crooked beak.** One mandible crosses over the other or twists (Fig. 167), or is broken, so that it is likely to bother the bird when eating.

Fig. 166—Longevity.

<table>
<thead>
<tr>
<th>Band</th>
<th>Weight of Bird in July, 1924</th>
<th>Weight of Egg</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y6</td>
<td>4.1</td>
<td>26 oz.</td>
<td>5 Years</td>
</tr>
</tbody>
</table>

Trapped during and following the breeding season only in first four years. Production by months during the fifth year:

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</thead>
<tbody>
<tr>
<td>19</td>
<td>21</td>
<td>24</td>
<td>17</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>18</td>
<td>19</td>
<td>2</td>
<td>183</td>
</tr>
</tbody>
</table>

An excellent long-distance producer and breeder.

See one of her daughters, B-478 (page 356).

Nearly every egg laid during the hatching season produced a vigorous chick.
Crooked or roach back. Run the palm of the hand over the back and observe whether the back is crooked or humped.

Slipped wing. Several primaries hang below the secondaries.

Split wing. A wing so irregularly formed as to show a distinct gap between the primaries and the secondaries. A slipped wing carried to the extreme.

Decidedly wry tail. The tail is carried to one side instead of straight behind the head in line with the body.

Decidedly squirrel tail. A tail so held that when the bird stands erect the tail projects forward over the back toward the head, beyond a line drawn perpendicular to the ground.

Rumpless. Without the rump which carries the tail feathers.

Side sprig. A piece of the comb growing on the side of a single comb (Fig. 168).

Other comb defects. Pronounced fold, thumb mark, high blade on a single comb, absence of the spike, or a telescope spike on a rose comb. A telescope spike is one that appears to be pushed back into the comb.

Any bird having a split comb or a comb foreign to the breed should be discarded.

Foreign face color. Considerable white in the face, or red in the earlobe of Mediterranean varieties, or considerable white in the earlobe of American or Asiatic varieties, is not desired.

Pearl eye. A very light-colored eye.

1 From the American Standard of Perfection.
Defects of shanks and toes. A bird with crooked toes is likely to be handicapped in foraging and scratching (Fig. 169).

Stubs. Most people who purchase purebred stock do not desire stubs or down between the toes or on the shanks of clean-shanked breeds. Keeping such birds out of the breeding flock will eventually insure a flock practically free from the defect.

Other examples are:
Legs and toes foreign to standard breed color.
Red, purple, or white feathers in any black variety.
Brown or buff (usually found on the breast, neck, or shoulders or in the quills or primaries or secondaries) in white varieties.¹

4. Selecting for production

Now that the bird has passed the first three tests of a good breeder, namely, longevity, vigor, and freedom from defects, she is ready for a severe test, that of production.

There are two methods of determining the production value of a hen: (A) by studying her external characters and (B) by trapnesting.

¹ The defects mentioned are the more common ones, for which the breeder should be constantly on the lookout. For other defects of Standard Bred Poultry, the reader is referred to the American Standard of Perfection.
A. Judging birds for production by external characters. Keep in mind the factors discussed in Chapters I and II for indications as to whether the bird is in production, when she stopped laying, and whether she had a vacation during the summer.

A careful study and examination of each bird is necessary. It is well to spend considerable time studying birds, until the various points are clearly fixed in mind. After this it will be possible to progress much more rapidly with the selection.
Head. The head should be clean-cut; the face, bright, well proportioned, and wider at the top than at the bottom. A "dished face," or one with a considerable depression under the eye or an inward curve from the top of the skull to the nostril, indicates weakness.

The beak should be fairly short, deep, and well curved, showing strength.

The eye should be clear and prominent.

It will be apparent after some study that birds differ greatly in their expression. The expression of a good producer is intelligent, shows character and alertness, but seldom shows fear when the bird is handled unless she is out of laying or in heavy molt. She has a bright, alert, snappy, defiant, and challenging expression. She appears to take an intelligent interest in affairs.

Birds with bald heads are frequently found in a flock. This peculiarity often indicates a thin skin and a good producer.

The head, both in the male and in the female, is an extremely important section of the body. It is the seat of the power that drives the machinery. That power, the brain, is
the dynamo which controls the bird, and from which, through the spinal cord and its branches; energy is radiated to all parts of the body.

The head, as an indication of the brain power and nervous energy, is connected, in a very vital way, with the digestive, circulatory, assimilative, and reproductive systems. If the brain is not properly developed and active, all the other organs will fail to function as they should.

The bird with the proper nervous temperament well developed is responsive, active, and intelligent, and possesses the highest vitality and recuperative and productive powers.

Temperament is shown by a clean-cut, intelligent head, set well forward on the neck, and by the inquisitive expression of the eye. By studying the heads of birds, and simultaneously checking the results by means of other characters, one realizes that hens may be classified for egg production on the basis of the head.

**Seven types of heads.** (1) **Rugged refined.** This is the most desirable type and is associated with exceptional production of long duration over several years. This is the long-lived type of heavy producer. The head should be broad and flat across the top, wide between the eyes, and of medium
to large size but not coarse. The head shows rugged physical character, high mentality, and reproductive power—a high-powered bird. These characteristics are indicated by a substantial, smooth-textured comb, red face, and prominent, open, bright, expressive, inquisitive eye that is friendly but challenges you (Fig. 177).

The best examples of this type should be expected to lay 250 to 300 or more eggs the first year and 200 or more per year for several years thereafter. Such a bird is a rare individual.

Character and expression are difficult to describe; but even the average observer, unskilled in selection, should be able, after a little practice, to pick the birds having these qualities.

(2) Refined. This is a desirable type, associated with high first-year and possibly later production. The head is strong, well proportioned, clean cut, and not fat. There is no sign of weakness. The features are well proportioned and of good color. A bright, full, prominent eye in a well-rounded eye socket radiates character. The comb is medium to large in size, of soft texture but not thin or limp (Fig. 182).
This type should be expected to lay 200 to 250 eggs per year.

(3) Overly refined. This type may lay well for a time, perhaps for several months, but lacks staying power and is not desirable for use as a breeder (Fig. 183).

The head is usually too small, and indicates too rapid development. The face is likely to be sunken below the eye and the comb thin and limp. Extreme fineness of features may accompany a body lacking in the highest type of vitality. The overly refined hen may be retained as a layer, provided she
Fig. 178—M-3991. A fine type of production Barred Rock.

Her record for a year was 260 eggs, and she laid as follows by 4-week periods:
First egg, Oct. 19, 1923.
Note wide-awake, snappy expression, well-bleached beak, clean face, and well-proportioned, rugged, refined head.

Fig. 179—M-5249.
The record of this hen was 221 eggs, and as follows for 4-week periods:
First egg, Dec. 14, 1923.
A bright eye, clean-cut face, and refined head, which almost always are accompanied by high production.

Fig. 180
A crow head viewed from the side and front.
Note the elongated thin head, sunken eye and face, shriveled comb, and dull expression.

Fig. 181—A masculine-type head.
This hen has ceased to produce eggs and has taken on masculine characteristics. Note coarse comb, dull eye, and overhanging eyebrow. There is absence of alertness and reproductive urge. Neither masculine nor feminine. A deficiency type.

survives the culling (see Chapter I), but is not the type to use for breeding even though she may have laid 200 eggs or more in 12 months.
SELECTING BREEDERS

The production is likely to be 150 to 200 eggs per year.

(4) *Crow-headed.* The long, narrow beak and head, small limp comb, and sunken eye denote a generally weak bird and one readily susceptible to colds and disease. The type is a poor producer and seldom survives the summer culling. Such birds may lay 100 to 200 eggs.

(5) *Coarse.* The heavy, coarse head falls in this class. Overhanging eyebrows accentuate the coarseness. Refinement is lacking, and the face is wrinkled. The eyes are much less alert than in the previous classes, and the expression is dull and inactive. Birds with this type of head have a tendency to take on fat, and are usually culled during the summer. The comb is frequently over-sized, thick, and rough. A few survive the culling but should be wintered only as layers (Fig. 184).

This class is likely to produce 50 to 150 eggs per year.

(6) *Phlegmatic.* Birds of this type lack character, have a listless expression, dull eye, and lay from 25 to 100 eggs.

(7) *Masculine.* This type is marked by the large, coarse comb and wattles. It may occur in hens whose ovaries have

Fig. 182—A refined type.

Fig. 183—An overly refined type.

Fig. 184—Coarse head and sunken face. Not likely to make a high record.
been destroyed by tumors or from some other cause. Such hens develop masculinity, and for some time a person may be puzzled to determine their sex.

Production 0 to 50 eggs per year (Fig. 181).

![Image](image_url)

**Fig. 185—No. B-458.**

High production but egg underweight.

Note full, deep body; low tail carriage; alert expression.

Sept. 16, 1924. Weight, 4.9 lb.

**Weight of egg:** 23 oz.

**Body:** Remarkable width of back and depth of body.

**Heart girth:** Very wide.

**Keel:** Medium length and curved.

**Lateral processes:** Very wide.

**Head:** Small to medium; round; bald headed.

**Eyes:** Prominent; bright bay; expressive; slightly depressed.

**Comb:** Medium size, 5 points; blade raised slightly. Texture smooth and velvety.

**Beak:** Short and thick.

**Face:** Slight feathering.

**Barlopes:** Small, bluish white; slight red in lobe.

**Shanks:** Small, thin, pale.

**Abdomen:** Very full and deep; very soft and pliable.

**Plumage:** Very white.

**Disposition:** Very quiet and friendly; intelligent.

**Molt:** Slight neck molt; molted 4 primaries.

**Date of first egg:** Dec. 3, 1923.

**Production per month:**

<table>
<thead>
<tr>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>27</td>
<td>25</td>
<td>29</td>
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<td>25</td>
<td>21</td>
<td>21</td>
<td>2</td>
<td>303</td>
</tr>
</tbody>
</table>

**Body type.** The type of a bird’s body indicates her capacity as a producer rather than her immediate laying activity. The best birds, layers and breeders, must have desirable body type, but all birds having this desirable body type are
not the best layers and breeders. The right body type must have included in the make up of the hen the urge to lay or the inherited tendency to high production. Correct body type, therefore, is necessary in our best birds, but is not of itself a proof of high production.

To examine the bird for body type hold the legs as previously described, and rest the breast of the bird on the knee, head toward you. This is done in order to allow the body to relax and the bones to stay in their normal position, with respect to each other.

First measurement, heart girth. Notice the way the ribs spread and also the distance between them (Fig. 189). The greater the bulge through the central part of the ribs, the more capacity there is inside for heart and lungs and the more desirable is the type.

Turn the bird on her side, back toward you, and, with the thumb on the back near the shoulders, place the forefinger or middle finger on the front of the keel. The distance to the front of the keel should be relatively deep and the keel well forward, giving a full chest.

A high-producing bird must have a large, strong pump, the heart, and strong, elastic arteries to conduct blood to all parts of the body.

In addition, plenty of room is needed for the lungs, since large volumes of air must be used to purify the blood. Any constriction or weakness in these vital regions is disastrous and prevents the proper functioning of all parts.

Second measurement. From the small of the back to a point midway between the front and rear of the keel.

Holding the bird in the same position, move the thumb along the back and the fingers along the keel at the same time, and observe whether the keel tends to slope away from the back. The depth through the center of the body from back to
SELECTING FOR PRODUCTION

Fig. 187—Hen No. 408.

Picture snapped Sept. 16, 1924. Wing shows three primaries full grown, indicating 8 to 10 weeks' molt.

Fig. 188—Hen No. 408.

An average to low producer.

Sept. 16, 1924. Weight, 3.8 lb. Not laying.

Weight of egg: 26 oz.

Body: Medium to wide back, gradually narrowing to rear. Medium depth of body.

Heart girth: Medium.

Lateral processes: Narrow.

Head: Small to medium. Fairly short.

Eye: Slightly sunken, expressive, bright bay in color.

Comb: Small, shrunken; 5 points narrow serrations; blade slightly elevated.

Face: Fairly full, slightly feathered.

Abdomen: Soft, shrunken.

Pigmentation: Very yellow beak, face, eyes, vent, lobes, and shanks.

Molt: Nearly complete new coat. Wing primaries show 8 to 10 weeks' molt.

Date of first egg: Dec. 2, 1923.

Production per month:

<table>
<thead>
<tr>
<th>Month</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Total</th>
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<tr>
<td></td>
<td>16</td>
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<td>18</td>
<td>23</td>
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<td>24</td>
<td>23</td>
<td>13</td>
<td>0</td>
<td>148</td>
</tr>
</tbody>
</table>
SELECTING BREEDERS

keel should be as great or greater than the distance from back to front of keel. The bird which is less in the former measurement, or one in which the keel is parallel to the back, is not desirable. Depth of body is very important. (It must be remembered that this distance may vary somewhat during the year according to the production of the bird. When in full laying, the keel is pushed down, and when not laying it moves up toward the back.) (See Chapter I.) It has been found by careful measurements that during heavy production the intestines become about twice as large as when the egg organs are dormant. This is due to a stretching of the walls. The intestines do not gain in weight, but their contents decidedly increase and the walls grow thinner.

Third measurement. Back. Place the thumb on one hip and the middle or forefinger on the other (Fig. 190). Notice the width at the hips.

Notice the width and flatness of the back, all of the way to the tail and forward to the ribs. That back is best which holds the width well, and is flat and smooth. The flatness of the back varies in different breeds, varieties, and strains. The Leghorn is of the flat-back type. Any roundness between the hips may show a tendency to fatness and is undesirable.

Place the thumb and fingers again at the hips and move to the rear and downward (Fig. 191). Notice whether the hand
spreads, or is drawn together, indicating great width through the ischium, Fig. 77, which is desirable, or "cuts in," which is undesirable.

A broad back appears to be the one best character for estimating intensity, i.e., the power to lay many eggs in a given time.

Narrow hips, the ischium or pelvis tapering in rather than out, and the back from the hips to the tail sloping down tend to restrict the passageway, giving it the form of a funnel, with the result that the hen is rarely a good producer and has a low intensity.

Fourth measurement. 

Keel. Lay the bird again on its right side, and lay the palm along the keel, letting the fingers extend beyond the rear end. Move the fingers up to the pubic bones (Fig. 192). Notice the length of keel, whether the rear is curved up, and how far it extends to the rear toward an imaginary line dropped perpendicularly from the ends of the pubic bones (Fig. 77).
The medium-to-long keel, which will tend to give full support to a large abdomen, is a desirable character. Such a keel, therefore, helps to prevent sagging of the abdomen, which might interfere with digestion, affect the health of the bird, and lessen production.

The physical changes and reproductive development from the baby chick to laying pullet to dormant hen and back into production again. Note condition of head and plumage as compared with size of reproductive system during different stages of development and molt.
SELECTING FOR PRODUCTION

Molt. Review Chapter II.

Quality of skin. With the thumb and fingers, feel of the skin at the abdomen and at the side and note the texture. A thin, soft, oily, flexible, light-colored skin denotes a good producer. A thick, hard, dry, yellow skin is often underlaid with hard fat, is coarse, and goes usually with poor production.

Feathering. The smooth, tight-feathered bird, which holds the wing close and compact, is likely to be the better layer. The fluffy, loose-feathered bird, with a wing that “cuts in,” indicating loose feathering, is less desirable from an egg-production standpoint.

Activity, carriage, and temperament. The high producer, while always active, is nevertheless not flighty. She is alert and ready to avoid any possible danger, but does not “lose her head” because of fear, as a low producer so often does. When held she often “talks back.” In other words, a high producer is intelligent.

The carriage of the tail is a variable factor. It is a breed characteristic and does not appear to influence production.

B. Trapnesting. By applying the practices outlined in this chapter thus far, one can separate the flock into desirable and undesirable producing birds with considerable accuracy. To select birds according to the five important characteristics closely associated with high production one may examine the flock during the year and leg band for each character (Chapter II). However, trapping birds makes the latter selection

1 Precocity, persistency, intensity, no winter pause, and non-broodiness.
SELECTING BREEDERS

easier. Moreover, to progress more rapidly in establishing a desirable strain, one must pedigree hatch and select breeders by use of the Progeny Test. In this work trapping is essential. The authors, therefore, introduce trapnesting at this point.

![Fig. 195—No. B-347.](image)

A hen combining excellent production and high egg weight.

- **Note**: deep, full, well-proportioned body and excellent carriage.
- **Sept. 16, 1924**: Weight: 4.3 lbs.
- **Weight of Egg**: 2.2 oz.
- **Body**: Exceptionally wide back, and deep body.
- **Heart girth**: Extremely wide.
- **Keel**: Medium length and curved.
- **Lateral processes**: Wide.
- **Head**: Medium size, short, round, very broad top and back. Partly bald.
- **Eye**: Bright bay, full, expressive, snappy.
- **Comb**: Medium to large; 5 points wide at base; blade horizontal; texture very soft and velvety.
- **Beak**: Strong, well curved.
- **Face**: Very smooth and full; clean.
- **Earlobes**: Small, almond shaped, white.
- **Shanks**: Short, pale, small.
- **Abdomen**: Soft, full, pliable.
- **Plumage**: White.
- **Disposition**: Quiet, alert, intelligent.
- **Molt**: No wing or body molt.
- **Date of first egg**: Nov. 30, 1923.
- **Production per month**:

<table>
<thead>
<tr>
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<td>26</td>
<td>23</td>
<td>23</td>
<td>22</td>
<td>279</td>
</tr>
</tbody>
</table>

Daily trapnesting for twelve months is the surest method of determining a hen's production. It is necessary in order to do individual pedigree breeding. Records must be kept which show the actual egg record of the dam, and the breeding records back of the sire.
Trapnesting is often done during only a part of the year, i.e., during the breeding season, in order to secure a record of intensity (the number of eggs laid per month), or to determine the egg quality of an individual, or in order to test the birds for fertility or hatchability. This method is also used where it is desired to make a progeny test, i.e., to select breeders on the basis of what their daughters are capable of laying, both in number and quality of eggs, or what the daughters of their sons are capable of producing.

The practice of trapnesting requires considerable labor. This may be at the rate of about 1000 hens per day per person on an average for a year. The traps should be visited five to six times a day. It is not, as a rule, practicable for commercial poultrymen to use this method on the entire flock, unless it is a small one.

The production values of the ordinary run of hens can be determined more economically by physical examination. Moreover, except in the hands of a careful breeder, trapnesting may be dangerous, because of the temptation to pay greater attention to the known egg record than to the other three factors which should be considered first, namely, longevity, vigor, and freedom from defects. Selecting and mating birds on the basis of high production alone will eventually result in impaired vitality, lower egg production, smaller birds and eggs, and ultimate failure.

**Egg quality.** Only those hens which produce eggs having large size, proper shape, true color, and good interior quality for the variety should be retained in the breeding pen. If the birds are being trapnested, the quality of egg can be readily noted. In many flocks there is vast room for improvement in egg quality. Size, shape of egg, and color of shell are inherited.

All eggs produced by any one hen tend to be of a characteristic size, shape, and color, although they may vary somewhat. Trapnesting permits one to observe these characteristics of the eggs laid by each hen. An average of these characters in eggs laid by any hen gives a better idea of the type of egg
the resulting pullet will lay than does the selection of eggs only at incubation time. Eggs produced by pullets after six months of laying are reasonably close to the average size for the year.

Photograph from Van Wagenen and Wilgus.

**Fig. 196—Albumen condition of eggs.**

Individual hens differ in the albumen condition of their eggs. Each egg was broken out the day it was laid. Note the typical uniform yolk condition found in such eggs. Note also the great variation in albumen condition from very firm white in 1. to complete thin white in 9. The height of firm albumen may best be seen in the side view just beneath each top view.

It has been shown that the mother's performance in egg-quality characteristics is transmitted to her daughters with
a fair degree of regularity. Egg quality is also transmitted through the sire.

The pedigree breeder of the future may need to know not only the number of eggs and the exterior quality but the interior quality of the eggs produced at various seasonal periods of the year as well.

**Five important characteristics.** There are five factors generally accepted in research and commercial breeding work as associated with high production. They can be used to judge the value of an individual as a producer, or the daughters may be measured by them to judge the value of either the dam or the sire as a breeder. The factors are: *precocity, intensity, no winter pause, non-broodiness, and persistency.*

Precocit and persistency have been discussed (Chapter II).

The importance of possessing as many of these characters as possible is shown in the following table for Rhode Island Reds at the Massachusetts Agricultural Experiment Station.¹

<table>
<thead>
<tr>
<th>Number of Characters</th>
<th>Number of Birds</th>
<th>Percentage of Birds</th>
<th>Average Egg Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>31</td>
<td>1.35</td>
<td>149</td>
</tr>
<tr>
<td>1</td>
<td>158</td>
<td>6.87</td>
<td>157</td>
</tr>
<tr>
<td>2</td>
<td>375</td>
<td>16.30</td>
<td>174</td>
</tr>
<tr>
<td>3</td>
<td>717</td>
<td>31.17</td>
<td>201</td>
</tr>
<tr>
<td>4</td>
<td>648</td>
<td>28.17</td>
<td>227</td>
</tr>
<tr>
<td>5</td>
<td>371</td>
<td>16.13</td>
<td>252</td>
</tr>
</tbody>
</table>

The intensity of production is a very reliable index of a bird’s inherited tendency to lay. It is affected by feeding and management in about the same way as precocit and persistency.

Intensity is measured by the number of eggs per month or week, or the number of eggs that a hen will lay without skipping a day. Certain hens may have a monthly intensity of only 8, 10, 12, or 15 eggs, whereas others will lay 20 or even 30 eggs. The intensity can be measured at any time when the fowls are laying normally.

Intimately associated with intensity are *clutch* and *rhythm*. The length of the clutch is the number of successive days on which the hen lays an egg. This varies considerably among individual hens. The total production is greatly affected by the number of days in a clutch, that is, whether the hen lays one or more eggs before skipping a day.

*Rhythm* is the regularity of the clutches. One bird may skip a single day between clutches, whereas another may skip varying periods, from two days to a week or more.

The birds with the highest intensity are usually the best annual producers.

*Winter pause* may be several days skipped between clutches during the winter. It signifies a lack of power to carry on. A partial molt sometimes occurs. Days out of production mean lower annual production. Some research workers believe that winter pauses of several days, 4 to 8, are inherited and, therefore, such birds should be eliminated from the breeding flock.

*Broodiness* influences the spring, summer, fall, and annual production, but such birds may have as high or higher winter production as those that are non-broody. A bird may go broody once or several times during a season. In any event, time is lost, and the tendency should be to reduce the amount of broodiness where egg production is the aim of the breeder (pages 499 and 500).

**Standards for Selection of Breeders Suggested**

<table>
<thead>
<tr>
<th>Standards</th>
<th>By Hays for R. I. Reds</th>
<th>By Authors for W. Leghorns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at first egg</td>
<td>215 days or less</td>
<td>180</td>
</tr>
<tr>
<td>Weight at first egg</td>
<td>5.5 pounds or more</td>
<td>3½</td>
</tr>
<tr>
<td>Intensity (winter clutch size)</td>
<td>3 or more eggs</td>
<td>3</td>
</tr>
<tr>
<td>No winter pause of more than</td>
<td>7 days</td>
<td>7</td>
</tr>
<tr>
<td>No broodiness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistency</td>
<td>300 days or more</td>
<td>315 or more</td>
</tr>
<tr>
<td>Egg size</td>
<td>not under 24½ ounces for pullets</td>
<td>24 oz.</td>
</tr>
<tr>
<td></td>
<td>not under 26 ounces for hens</td>
<td></td>
</tr>
<tr>
<td>Laying house mortality</td>
<td>not over 15 per cent</td>
<td>15%</td>
</tr>
</tbody>
</table>
The broody tendency is inherited and can be greatly reduced by rigid selection.

5. Selecting for performance of ancestors, brothers, and sisters

Pedigree hatching makes it possible to carry the selection a step farther. The hen measuring up in each of the preceding requirements is an excellent performer. Her value as a breeder will be more nearly assured if it is known that the parents descended from a line noted for its ability to pass the same tests.

Similarly when a bird is found to be one of a large family, all or most of which lived and passed the tests, the selection is made still stronger.

The performance of ancestors and brothers and sisters increases the possibility of a desirable performance by the individual.

6. Selecting for performance of the progeny

The highest type of breeding work, and the one which promises the most rapid and complete success, is reached when the worth of a bird as a breeder is judged by the way the progeny perform.

The power of an individual to transmit its characteristics to its offspring is called prepotency. Animals differ greatly in their ability to do this. For example, certain hens, themselves high producers, can transmit high production to their offspring; others, though equally high producers, are unable to produce pullets which are even average in production. In fact, it sometimes happens that hens which are only medium producers are capable of getting high production in their offspring.

The value of the progeny test is at once apparent, as by it the birds with high prepotency for producing desirable or undesirable qualities are discovered. A hen must be not only a good layer but also a good producer of layers, in order to be a satisfactory breeder.

1 Described and illustrated in Chapter XIX.
More money value is represented in this quality of prepotency than in any other single quality of a bird.

It will be found when all records are brought together that the progeny of different matings differ greatly in their ability to live and survive the culling and selection tests.

To accomplish this the bird having passed the first five tests is mated. The fertility and hatchability of eggs and viability of the chicks are checked.

After the rearing season the progeny of promising families are housed and records of their performance kept.

7. Selecting breeding males

Males may be selected in either the fall or spring. If they are selected in the fall, examine them again in the spring, and vice versa.

Examine the males for longevity, vigor, and defects, as outlined for the females.

Body. The heart girth, width of back, and depth of body should be relatively somewhat similar for the males and the females.

The main difference is found in the relative width and depth of the front and rear of the body of the high-production-type male. It has proportionately a broader and deeper heart girth and not quite as much width and depth of body as the production-type female.

The body should be relatively deep in front, and as deep at the center. The rear is likely to be more shallow on a good male than on a good female.

The length of keel is important, the long, well-curved keel being more desirable.

1 Discussed in the next chapter.
**Head.** The head should be distinctly masculine, i.e., should be well proportioned, and round rather than long when viewed from the side. It should show good character and well-developed secondary sex characters (comb, earlobes, and wattles). It should be clean cut and the expression bold and alert.

The blade, on single-comb varieties, as the Leghorn and Ancona, should follow the neck rather than extend upward. The points should be wide at the base and not too high. The narrow, pencil points, small, high blade, and thin comb are usually associated with a narrow, erect body, and are not desirable characters. They are typical of the wild fowl and are found most frequently when a strain of fowls runs out or reverts to the primitive low-producing type.

**Behavior.** Always select the male for gallantry, courage, and frequency of crowing and mating. These indicate masculinity, i.e., the development and activity of the reproductive system.

The temperament is important. The good male is unafraid.
An example of excellent type and vigor, but a victim of circumstances.

Sept. 16, 1924. Weight, 5.1 lbs. Laying.
Production to Apr. 15, approximately 91 eggs. Thrown out of trapnest house because of a breed defect. Production started Dec., 1923.

**Body:** Wide back; extra deep body.

**Heart girth:** Very wide.

**Keel:** Short and curved.

**Lateral processes:** Medium width.

**Head:** Medium size, short, strong, wide, round.

**Eyes:** Very expressive, bright bay. Full of nervous energy.

**Comb:** Warm; medium size; 5 points wide at base.

**Beak:** Strong, well curved.

**Face:** Slightly feathered, slightly sunken.

**Earslopes:** Medium size; slightly red.

**Abdomen:** Full; soft.

**Pigmentation:** Lobes slightly creamy; shanks medium yellow.

**Molt:** Body, neck and tail feathers new and nearly grown. Four wing primaries shed. Had ceased shedding primaries and resumed production.

---

**Fig. 199—Hen No. B-478.**

(See Fig. 198.)

**Fig. 200—Hen No. B-172.**

A. Axial feather.

B. First primary showing 5 weeks' growth. A good producer may sometimes shed and lay at the same time over a limited period.
SELECTING BREEDING MALES

He is not necessarily one that is continually fighting, but one whose presence is respected by other males and females.

If the male is from trapnested stock and is one whose sisters and daughters have been tested, so much the better,

![Image of a chicken](image)

**Fig. 201—Hen No. B-172.**

- Low intensity; short length of laying period.
- Bird out of production 11 days. Evidently started molting neck and wing while still laying.
- Note heavy body molt which with fair body type and soft abdomen denote a moderate producer even though molting in August.
  - Sept. 16, 1924. Weight, 4.3 lb. Not laying.
  - Weight of egg: 26 oz.
  - Last egg: Sept. 5.
  - Body: Medium width of back; slopes away quickly to tail.
  - Heart girth: Wide.
  - Keel: Medium length and straight.
  - Lateral processes: Medium to narrow.
  - Head: Medium in width, rather long.
  - Eye: Very bright, flashy, prominent; dark bay.
  - Comb: Small; 6 points; blade small, slightly raised.
  - Beak: Rather long.
  - Face: Slightly sunken and feathered.
  - Earlobes: Greenish yellow.
  - Abdomen: Soft, shrunken.
  - Pigmentation: Yellow returning to vent and beak and slightly to shanks.
  - Molt: Molting heavily, body and wings; neck, nearly complete. Wing shows 5 weeks' growth on first primary molted.
  - Date of first egg: Nov. 9, 1923.
  - Production per month:

<table>
<thead>
<tr>
<th>Nov</th>
<th>Dec</th>
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provided the physical characters have not been overlooked or sacrificed for the sake of the pedigree. The records of production of own sisters and half sisters of the male are important
in determining his breeding values. If he is bred from a family of outstanding good producers and breeders, he is more likely to transmit to his offspring the qualities we desire.

Spring selection. In the spring, look over all males and females previously marked as being desirable for breeding purposes. Examine each one critically and discard any that appear to be weak or in any way are out of condition.

COMMUNITY SURVEY

1. How many poultrymen in your locality use a part of their flocks as breeders? How many use the entire flock?
2. When are their breeders selected? Is there more than one selection?
3. What points do the poultrymen consider in selecting breeding hens?
   Breeding males?
4. Arrange these points in order from most important to least important, according to the owner's estimate.
5. How many poultrymen trapnest their birds?
6. What percentage of the flock is trapped?
7. To what extent are these records used in selecting breeders?
8. Is there a state or national Poultry Improvement Plan operating in your state?
9. What are its breeding stages?
10. Do the local breeders belong to it?
11. Why or why not?

REFERENCES

CHAPTER XVII

MATING THE BREEDERS

To make the useful more beautiful and the beautiful more useful is the highest aim of the science and art of poultry breeding.

Breeding is the science and art of mating animals or plants with the expectation of securing in the offspring definite results in the development of certain specific characters. These characters may be vigor, longevity, type, habit, plumage, prolificacy, egg quality, meat quality, rapidity of growth, broodiness, etc. The forces that produce these qualities exist in the body of the individual and are increased or decreased by selection and breeding.

Improvement of poultry is brought about by the action of two great natural forces: environment, which includes food, surroundings, and climate; and selection and mating, which include both natural selection and mating and the purposeful selection of poultry practiced by man.

Natural selection and mating are the actions of the slow, uninterrupted forces of nature. They influence and modify all animal and plant life and have given rise to the phrase “survival of the fittest.” Nature secures a high type of vigor and perpetuates the race, because under natural conditions only the strongest can survive. Inbreeding is not so likely to be detrimental in the wild state as it is under domestication, because only the strong live; but the process used by nature is too slow and does not accomplish all the results desired for the purposes of man.

Under the conditions created by man, all the individuals generally have a chance to live, and man must select those best
suited to his needs and ideals. To meet with success, this selection must be rigid, severe, thorough, and for definite purposes.

The next problem is mating the breeders.

Operations:

1. Deciding when to mate the breeders.
2. Deciding the number of hens per male.
3. Eliminating the influence of a previous mating with a different male.
4. Estimating the number of breeders necessary.
5. Studying methods of mating.
7. Considering the four main systems of breeding poultry.

1. Deciding when to mate the breeders

The birds should be mated at least two, and preferably three weeks, before eggs are to be saved, although the eggs may be fertile after a particularly active male has been with a small flock three or four days, provided all environmental conditions are favorable. Eggs should not be saved more than ten days or two weeks before incubating. Since, for normal spring hatching, chicks of the Mediterranean varieties should be hatched from March 15 to May 15, in the latitude of New York State, and those of the American and Asiatic varieties from one to two months earlier, it follows that the breeders should be mated six to eight weeks before the chicks are expected. For example, Leghorns should be mated about February 15, if chicks are desired April 15, and heavier varieties correspondingly earlier.

When hatching is to be done at other seasons of the year (see page 385) mating must occur at the proper interval before the eggs are needed.

2. Deciding the number of hens per male

For Leghorns, one male to about 20 females should be allowed. Eggs have shown high fertility where one male to 30 or 40 females has been used. For American varieties, allow
one male to about 15 females. For Asiatic varieties, allow one male to about 10 females.

In order to insure satisfactory fertility early in the season, it is necessary to use a smaller number of females than would be required if hatching were done later in the season.

Sept. 16, 1924.
Weight: 3.8 lb.
Back: Medium in width, narrowing rapidly to rear.
Depth: Shallow.
Heart girth: Narrow.
Keel: Medium long.
Shanks: Thin, small, short. Well pigmented.
Head: Medium to small. Slightly elongated.
Face: Slightly white in face, smooth, fairly full.
Eyes: Alert, bright bay.
Earlobe: Medium size, smooth, slightly red.
Comb: Medium size; 5 points; wide at base; blade lopped.
Beak: Small.
Plumage: Naturally white.
The weakness of this bird lies in his poor body, especially the shallow depth at the rear, the narrow heart girth, and narrow, tapering back.

Fig. 202—A type of low-production White Leghorn male.

3. Eliminating the influence of a previous mating with a different male

If it is desired to change males during the breeding season, and have no influence of the former male in the progeny, at least three weeks should elapse from the time the first male is removed, until eggs are saved from the mating with the second male.

4. Estimating the number of breeders necessary

Good management requires that enough breeders be selected to renew the flock properly, and that no more be carried unless hatching eggs and baby chicks are to be sold. One should figure from the number of pullets he is likely to need during the year and, by making conservative estimates, decide on the
number of breeders necessary to produce the required number of pullets.

The following are conservative average figures which may be used in the absence of the poultryman's own actual results:

1 pullet to be reared for each \( 2\frac{1}{4} \) chicks hatched.

250 to 350 chicks to be brooded under each brooder.

Fig. 203—A long-lived type of White Leghorn production breeding male.

Note masculinity, alert, fearless, keen, intelligent expression, short curved beak; large, blocky body.

The following description applied to this bird Sept. 16, 1924:

**Cock No. 5, Plumage:** Naturally white.

**Weight:** 5.6 lb.

**Back:** Extremely wide and flat.

**Depth:** Medium.

**Heart girth:** Very wide.

**Keel:** Very long and curved.

**Shanks:** Medium size and flatness. Short. Well pigmented. Medium to large spurs.

**Head:** Distinctly masculine, trifle coarse.

**Face:** Clean.

**Eye:** Snappy. Bright bay. Slightly depressed.

**Earlobe:** Large, symmetrical, cream color, slightly tinted with red.

**Comb:** Thick base, straight. Six points wide at base. Blade below horizontal.

**Texture:** Very smooth and waxy.

**Tail:** Slightly high.

70 to 80 per cent of total eggs incubated to be hatched during the season.

4 or 5 suitable eggs per week per hen during the hatching season from carefully selected hens.

For example, if 250 pullets are desired in the fall, using the figures given above, we find
560 chicks needed.
2 brooders needed (280 chicks in each).
700 eggs required or 350 eggs in each of two hatches.
350 divided by 8 to 10 eggs per breeder in two weeks equals
35 to 45 breeders needed, or about 1 breeder for each 5⅓ to 6
pullets required. If the same incubators are used twice, and

Fig. 204—A high-quality White Leghorn production breeding male.

Picture taken Sept. 16, 1924. Age 4 years. Note the well-shaped comb,
aggressive active expression.

Weight: 6.9 lb.
Back: Extremely wide, carried well back.
Depth: Very deep.
Heart girth: Wide.
Keel: Long and curved.
Shanks: Heavy, roundish, short, thick; well pigmented; large spurs.
Head: Very masculine. Rather coarse; large, round, wide.
Face: Clean; somewhat sunken under eye.
Eye: Slightly sunken; light bay; aggressive.
Earlobe: Large; 5 points wide at base. Blade below horizontal. Texture, soft.
Beak: Thick and strong; heavily pigmented.
Plumage: Naturally white.
Tail carriage: About 45°.

the two hatches are about three weeks apart, a capacity of
350 eggs is needed.

It should be understood that if we hatch four times instead
of twice in the same season, as is usually done, then twice as
many pullets from the same number of breeders, or the same
number of pullets from half as many breeders, can be secured.
Thus a better average quality of stock can be reared. The
aim should be to hatch as many eggs as possible from the best breeders. This will involve a larger number of smaller brooding units and more difficulty in keeping several broods of chicks of different ages separated on range.

**CORRELATION OF CONSTITUTIONAL VIGOR AND COPULATIVE POWER OF THE DOMESTIC POULTRY**

(CORNELL UNIVERSITY)

<table>
<thead>
<tr>
<th>S.C. White Leghorn</th>
<th>Males of High Vigor</th>
<th>July 10, 14 Hrs. Observed 3</th>
<th>Number of Females-48</th>
<th>Males of Low Vigor</th>
<th>July 12, 14 Hrs. Observed 3</th>
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<tr>
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Comparison of the Three Types of Vigor for Total Period of 20 Hours

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<thead>
<tr>
<th>High Constitutional Vigor</th>
<th>Copulations 122</th>
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<tr>
<td>Medium Constitutional Vigor</td>
<td>Copulations 64</td>
</tr>
<tr>
<td>Low Constitutional Vigor</td>
<td>Copulations 69</td>
</tr>
</tbody>
</table>

Fig. 205—Strong, vigorous males are desired in the breeding pens. The high-vitality males mated nearly four times as often as the low-vitality males.

5. Studying methods of mating

There are several methods by which the selected breeders may be mated.

(1) *Large flocks.*¹ Most commercial flocks are bred by the

¹ The Breeding Labyrinth.—Occasionally the fertility is low because of the interference of a few males. If this trouble is serious, a breeding labyrinth may be placed in the pens. This consists of boards or panels about 1½ or 2 feet wide and 10 or 12 feet long, placed 6 or 8 inches above the litter. The length will vary according to the pen in which it is used. It should be within 2 or 3 feet from the front of the house and the edge of the droppings board. Mating occurs more frequently where the labyrinth is used, as the males cannot see other males at the time of mating, and therefore do not interfere with them. The labyrinth will also greatly lessen the fighting among the males and thus insure better health and mating vigor, because the males are enabled
large-flock method. A number of hens and males are placed in the pens together, sometimes as many as several hundred birds. Practically no serious fighting takes place if more than two males are in the flock and they have sufficient floor space and range. Chicks cannot be pedigreed as the male parentage cannot be known. Carefully selected females mated with males from desirable blood lines have given excellent results in the laying ability of the pullets. This method provides many hatching eggs at a very much less expense for labor and housing.

(2) Small flocks or pen matings are used when a few choice individuals are mated with a single male. The parentage of each chick is known since by trapping the identity of the female is determined.

This method permits line breeding and reaches its best possibilities on a breeding farm using several such pens.

Alternating males. If signs of preferential mating are noted, or if the flock is so large that one male cannot be expected to fertilize the eggs satisfactorily, or if one is not pedigreed, two males may be used alternately. In this case, the changes should be made about twice a week and the male not in use should be rested in a coop. This eliminates all interference and fighting.

(3) Stud mating. In large flocks it may be desired to mate certain males with certain females while the latter are running together. This may be done by trapnesting and stud mating. The males are kept in coops, about 2½ by 3 feet and 3 feet high, one male to each coop. A record is kept of the band numbers of the hens to be mated with a particular male. When

to eat and drink without being disturbed. A somewhat similar result is secured when breeding flocks are provided with sunshine walks outside the house and when mash and grain hoppers are properly placed about the floor of the breeding pen.

2 Males occasionally mate with certain hens, to the exclusion of the others, with the result that eggs from other hens in the flock are not fertile.
a hen is removed from the trapnest, she is placed in the coop with the male with which she is to be mated and released at the next trapping. To help guard against error, the males and females to be mated together may have leg bands of the same color.

If the proper records are kept, the parents of each chick will be known.

6. Securing fertility and hatchability

Perfect incubation would be obtained if every egg incubated hatched into a strong chick capable of developing into a full-grown bird. Practically every egg that is set but not hatched is a loss in several ways, viz.:

1. The egg itself is changed from a marketable to an unmarketable product.
2. It occupies incubation space, which might have been used to hatch a chick.
3. It requires the attendant's time and care, and expense for fuel.
4. There is delay in the date of hatching, due to the necessity of replacement in a later hatch if the loss is serious.

Two factors are of primary importance in the effort to secure good hatches: (1) fertility, (2) hatchability.

1 Much depends on the health and physical condition of the breeders. Birds should be completely rested and recuperated physically before the breeding season. (See page 172.)
A. Fertility. Infertile eggs may be the fault of either the hen or the male. If the fault is due to preferential mating on the part of the male, it will be necessary to mate the hen with another male. Closely confining males as in stud-mating coops for several weeks may lower fertility.

Well-selected stock, carefully housed and fed, should aid fertility. The physical condition of both the male and female at the time of mating rather than heredity is responsible for the fertility of the eggs. Gallantry may cause males to eat too little. Special grain feeders 18 inches up and on the wall may solve that problem for males.

Climate affects the mating of poultry to a very marked degree. Matings are much less frequent during very cold weather. Freezing comb or wattles may affect fertility. Dubbing or cutting off the comb and/or wattles has proved beneficial to such an extent that, even in warm climates as in the Hawaiian Islands, all male breeding birds are dubbed. The value of old males is often improved.

The points and some of the solid part of the comb are cut off with shears. Usually there is no need to check bleeding, although zinc stearate may be applied for that purpose.

B. Hatchability. Not all fertile eggs will hatch. Certain hens will show higher hatchability than others having similar treatment and care and showing similar fertility. Hatchability is inherited, is an individual trait, and, if the birds are trapped, low-hatchability birds may be removed, thus raising the flock average.

One of the distinct advantages of using trapnests is to be able to learn the hatchability of the eggs of each hen in the foundation breeding pens. It is important, therefore, that the poultry breeder know the hatchability of the eggs of his best breeders and that he take steps early to correct faulty results and secure the largest hatching efficiency. Either the breeding, feeding, housing, or incubation may be responsible for the number of chicks which a hen may produce in any season. Close
inbreeding usually results in lowered hatchability in succeeding generations.

Eggs must be gathered frequently during cold weather to prevent chilling. Nutrition is extremely important, since the factors affecting the growth of the embryo and the health of the bird must be provided.

Provide range for the breeders, or an outside sunporch, for several weeks before and during the breeding season, if possible, since eggs laid under these conditions usually hatch best.

Avoid using breeders that are in poor physical condition, because of overproduction, fighting, or as a result of improper feeding prior to or during the hatching season. This may apply to either hens or pullets.

It does not follow that high production annually, or during the breeding season, necessarily results in less fertility and hatchability. On the contrary, the highest fertility and hatching quality should be found among the highest producers.

A careful examination of the birds that show poor results in hatching will frequently disclose the cause to be underweight. The feeding should be checked. If eggs are fertile and hatch well early in the spring, they are likely to do so through the season, but not necessarily so. Therefore, trapnests may be installed in February or March, and the breeders banded and their eggs tested. A hatchability of 85 per cent or better of fertile eggs is a workable standard for the individual hen.

C. Testing for fertility and hatching quality. Mark the egg with the hen’s leg-band number, and let the first lot of eggs incubated be a trial hatch. Record the hen’s number on a sheet, with the number of eggs from each hen. Keep a record of the infertile eggs and dead germs from each hen. Just before the eggs pip, on about the eighteenth day, place the eggs from individual hens in wire baskets. When they are hatched, record the number and quality of chicks from each hen. Discard from the breeding pens any hens continuing to show low fertility, poor hatchability, or weak chicks, if upon careful
7. Considering the four main systems of breeding poultry

Selecting good breeders is but the first step in poultry breeding, for unless the birds are wisely mated the results may be unsatisfactory. The improvement of poultry through breeding depends on the sustaining hand of man. Progress is slow and laborious, and the pitfalls are many. One may mount the ladder of success, step by step, only to fall back to the starting point through one misstep—an undesirable mating.

The practices here discussed are the principal ones in poultry breeding work: inbreeding, with line breeding a special form, out-crossing, grading, and crossbreeding.

A. Inbreeding. The closest form of inbreeding is mating together closely related individuals as brother and sister, father and daughter, or mother and son. Close inbreeding is used to secure uniformity in a character, but cannot be practiced long...
in any blood line. Undesirable characters show up quickly. The failure of close inbreeding to produce desirable results each time may be due largely to man's inability to select the combinations of vigor required.

Research workers find that, in general, close inbreeding lowers production, vigor, hatchability, rate of growth, and fertility, retards sexual maturity, increases mortality, and shortens the length of laying period.

From the above it will be inferred that close inbreeding is a dangerous practice for the average breeder; but this does not mean that out-crossing is necessary every few years.

Mating together more distantly related birds, as first or second cousins, uncles and nieces, and the like, is often necessary. If selected carefully, particularly for high hatchability, the procedure is justified.

It is also possible to line breed systematically for many years, thus securing the advantages of breeding from similar blood lines, while avoiding the danger of mating closely related individuals.

B. Line breeding. Line breeding is systematic inbreeding, and is designed to avoid the possible dangers arising from the miscellaneous mating of individuals which are too closely related. It is the process of carrying along the blood of a desirable individual for several generations to produce inbred strains. The close inbreeding of brother and sister is avoided.

A male line may be established, starting with a fine male selected by physical examination, or one that has shown his ability to produce desirable pullets by a previous mating.

Plan 1. For the line-breeding work he may be mated with 12 or 15 females equally well selected. The daughters of this mating are placed in the laying flock. The sons of the mating are then mated to the main breeding flock. The second year the original male is mated to 12 or 15 females, part of which may be from the original pen and part his daughters or granddaughters. Sons from this pen are mated to the granddaughters and other fine females in the main flock.
Should the original male die or prove inferior, he should be replaced. About the fifth generation a new male should be placed in the male producing pen.

**Line Breeding. Plan 1.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>15 good females × male (original)</td>
<td>50-200 females × well-selected males</td>
</tr>
<tr>
<td>2nd</td>
<td>15 good females × male (original)</td>
<td>50-200 females from Pen B1 breeders and progeny × sons from Pen A</td>
</tr>
<tr>
<td>3rd</td>
<td>15 good females × male (original)</td>
<td>50-200 females from Pen B2 breeders and progeny × sons from Pen A1</td>
</tr>
<tr>
<td>4th</td>
<td>15 good females × male (original)</td>
<td>50-200 females from Pen B3 breeders and progeny × sons from Pen A3</td>
</tr>
<tr>
<td>5th</td>
<td>Best daughters from Pen A3 × male (new)</td>
<td>Females</td>
</tr>
</tbody>
</table>

One special breeding pen is required each year (Pens A to A3) from which cockerels are produced for the main breeding flock (Pens B1 to B4). The daughters from Pens A to A3 matings are placed in the main laying flock each year, from which some of them may be selected to make up the fifteen selected females in each following year’s special breeding pen. This practice avoids brother and sister matings, although father and daughter matings will result in some cases.

**Plan 2.** It is considered a better plan by some breeders to carry two male producing pens, using the sons from these pens in alternate years on the main flock. This method reduces the danger of loss if an original male dies or is proved inferior and avoids quite as close inbreeding. When line breeding is correctly used in a flock of several hundred individuals, it will not be necessary to out-cross for many years, and a carefully bred strain can thus be established.

**Plan 3** consists of a set-up like plan 2. Instead of alternating every other year as in plan 2, sons from the A line
matings are used for two successive years, followed then by the use of sons from the X line for a similar period.

Plan 2 alternates the influence of the male. This may be an advantage if either male 1 or 2 dies or proves undesirable. The females used with males 1 and 2 are selected as in Plan 1. The daughters are always sent to the main laying flock, but may be selected in any later year as hens to enter the main male producing pens. Plan 2 provides two lines of male-producing breeders.

Plan 4 has the advantage of a wider choice of cockerels for the main breeding flock, should any mating prove unsatisfactory. Plan 1 gives no alternative, while plans 2 and 3 provide one alternative.

Plan 4 is similar to plan 1, except five pens are used each year, from the best of which cockerels are selected for use in the main breeding flocks. In common with the other plans, the females in the original breeding pens may be trapped and the chicks banded to determine which sire and dam lines are most promising. The pullets from these matings may also be trapped.

Thus several months of trapnest results of sisters should be available to assist in selecting the cockerels from the best mat-
ings among the five original breeding pens the first year. The pullets are placed with the main laying flock.

The second year, the best two males of the original five of the first year head pens A and B. Cockerels from these two males head the other three pens. The best females from the original five pens of the first year are placed in pens A and B. Females for pens C, D, and E are selected from the remaining birds or from the main laying flock. Avoid close inbred matings of brother and sister, father and daughter, or mother and son.

1st Year

Pullets from breeding pens A to E are placed in Flock 1. Cockerels from the best of the Pens A to E are sent to Flock 2 as breeders.

2nd Year

1. Select the two best males of the first year on the basis of their progeny to head Pens A and B. Place with them the best females.
2. Use the two best cockerels from the male in Pen A to head Pens C and D, and the best cockerel from the male in Pen B to head Pen E. Place with them the best females from the breeding pens, first year; and draw the remainder from the laying flock.
3. Pullets from breeding Pens A to E are placed in Flock 1 each year.
4. Cockerels from the best of the pens A to E are sent to Flock 2 each year.
5. Avoid close inbreeding.

3rd Year

Repeat as in the second year, always selecting the two outstanding males of the preceding year to head Pens A and B.

C. Out-crossing. Out-crossing consists in mating birds of the same variety but of different strains. It is occasionally resorted to when the breeder desires to introduce new blood.

A breeder may desire to improve his strain in some charac-
teristic and will use a male or a pen of the strain he desires, and produce males for his flock. Such a pen or male may be used in a line-breeding plan, or he may discard the male after a year or two.

Fertility and vigor are likely to be increased in the first generation as a result of out-crossing. Continual out-crossing is to be discouraged, as much may be lost and little gained. It is usually better to avoid mixing the blood lines of several strains.

D. Grading. The mating of a purebred male to a mongrel flock is called grading. It is frequently used to improve the quality of a mongrel flock. Continuous grading, year after year, results in increasing the proportion of the blood of the original purebred male, and in seven or eight years the flock is nearly as good as a purebred one.

The process of grading up a flock is too slow, however. By securing hatching eggs or a few purebred birds, the desired end may be attained much more quickly and profitably.

E. Crossing. Crossing is the mating of individuals of different breeds or varieties. For the breeder of purebred stock, the practice is to be discouraged. Even though it may give an increase in vigor in the first cross, it accomplishes nothing in that respect that selection cannot accomplish equally well, and it may destroy the advantages accruing from line breeding. Crossing certain varieties enables one to determine the sex of chicks at hatching time and is becoming popular because either sex can be sold. The advantage is in early sex determination rather than superior quality of the cross over either of the pure-breeds. A popular cross is the Red male on the Barred Rock female.

The female chicks have black heads and the male chicks show some white on their heads in about 95 per cent of the cases.

A cross which is popular with broiler growers is the Barred Rock male on Rhode Island Red or New Hampshire females. The progeny are all barred at broiler age and later.
Crossbred progeny ordinarily have excellent viability and egg production. Hatchability is high. The crosses suggested above develop into large birds and have a high value as meat when production is over.

REFERENCES


TAYLOR, L. W., and LERNER, I. M., "Breeding for Egg Production," Bulletin 626, California Agricultural Experiment Station, Berkeley, Calif., 1933.

WARREN, D. C., "The Progeny Test in Poultry Breeding," Circular 168, Kansas Agricultural Experiment Station, Manhattan, Kan., 1932.
CHAPTER XVIII

RENEWING THE FLOCK.

Operations:

1. Deciding when the flock should be renewed.
2. Estimating the number of chicks needed.
3. Deciding whether to buy or hatch chicks.
4. Deciding whether to buy sexed chicks.
5. Selecting the hen.
6. Choosing the incubator.
7. Locating the incubator.
8. Preparing the incubator room.

General information:

1. Hatching several seasons of the year.
2. Types of incubators.
   (A) Small.
   (B) Mammoth.
   (C) Separate hatcher.

1. Deciding when the flock should be renewed

Points to consider are: (a) when space in the laying houses will be ready for the new pullets; (b) the hatching plan; (c) egg prices; (d) rearing conditions; and (e) breed and variety.

When pullets are hatched during the spring or normal season the flock is likely to be about one-half of the original size at the end of the first laying year. Normally, therefore, half the flock should be renewed each fall as pullets. Chicks will be needed early enough to reach sexual maturity when the space is ready.

Convenience or other conditions may require that all chicks be secured at the same time; in several lots during a certain season; or at different seasons of the year. [See General In-
ESTIMATING THE NUMBER OF CHICKS NEEDED 379

formation (1).] For small flocks the normal hatching season is best.

Highest egg prices occur during the early fall. From June or July until October egg prices advance. Hence, one may desire to have pullets start laying during the summer and to hold the old birds in production as long as possible. Pullets may be left on range or the old birds may be moved to large outdoor shelters in June or July, thus releasing the house space earlier.

The amount of equipment, brooder houses, range shelters, and range that are available and their accessibility under expected weather conditions must be considered. Brooding in hot weather is more difficult since chicks are likely to suffer from the heat and pullets may take 3 to 4 weeks longer to reach sexual maturity.

If they are to start laying in the fall, birds of the Mediterranean varieties should be hatched from March 1 to May 15 in the latitude of New York State, and proportionately earlier south of this point and later north of it. American varieties should be hatched about one month earlier, and Asiatics two months earlier, than the Mediterranean varieties.

2. Estimating the number of chicks needed

Having determined when and how often to hatch and the number of pullets needed, conservative figures are: one pullet reared for each 2½ chicks; 250 to 350 chicks under one brooder stove. (See page 364.)

3. Deciding whether to buy or hatch chicks

Chicks of nearly any quality can be purchased, either from the breeder who hatches only from his own flock or from the hatchery which secures hatching eggs from cooperating flock owners. The cost and convenience of buying chicks have made the practice very popular.

The poultryman who has the incubator space or who can buy it, and who can select from his flock the quality of breeders
RENEWING THE FLOCK

Fig. 208—Diagrams illustrating fundamental differences in heating small incubators.

1. Electric incubator, heated by radiator. (B), Electric bulbs. (V), Ventilator.
2. Hot-water incubator, heated by contact. (E), Eggs. (E'), Position of eggs when filling tray. (K), Rubber bottom.
3. Hot-water incubator, heated by radiation. (V), Ventilator. (S), Adjusting slide.
4. Hot-air incubator, heated by convection. (A), Porous diaphragm through which air currents pass. (B), Return pipe to heater. (E), Eggs. (V), Ventilator.
5. Hot-air incubator (front view), heated by convection. Air currents pass over metal radiators. (V), Ventilators. (S), Sand tray.
6. Hot-air incubator (end view). See 5 (front view). (A), Hot-air pipe. (D), Door. (E), Eggs. (M), Metal radiator. (V), Ventilator.
he desires, and who enjoys this part of the enterprise, can pro-
duce chicks at the same or a lower price than he would have to
pay for similar quality. A greater investment is needed, how-
ever, than if the chicks are purchased and he assumes the risk
of a poor hatch.

4. Deciding whether to buy sexed chicks

If chicks are to be purchased the problem of buying straight-
run, sexed, or sex-linked chicks must be decided.

![A hot-water incubator, showing heater.](image)

*Fig. 209—A hot-water incubator, showing heater. The heated water enters the machine through pipes near the top of the machine.*

From Newtown Incubator Co.

Straight-run chicks include cockerels and pullets. The
cockerels may be sold for meat purposes; when sold the re-
maining pullets automatically have more room.

Sexed chicks are separated into males and females at
hatching time by examination of the vents by trained persons.
Ninety to ninety-five per cent accuracy is often reached. The
pullet chicks are then sold at a higher price than the straight-
run chicks. The basis for figuring the price of sexed pullets is
sometimes twice the straight-run price plus the cost of sexing.
Chick sexers are paid ½ to 1 cent per chick sexed.
The cockerel chicks are sold at a much reduced figure. Buying sexed pullets is popular among those who do not want to bother with the cockerels, or when meat prices are low, or when one desires to brood more chicks than the available brooders permit. (Care should be taken not to overcrowd. At eight weeks, or before, when the cockerels would have been removed, thus giving the pullets more room, the sexed pullet flock should be divided.)

Sex-linked chicks are the result of certain variety or breed crosses. Their progeny can be sorted accurately into males or females by differences in color of plumage or other characteristics. Many crosses are desirable as layers or as meat birds, but are not desirable as future breeders.

5. Selecting the hen

If one is to hatch by natural methods, the choice of the hen is important. There is as great an opportunity for choice among hens as among incubators. Select a hen in good health, of medium size, and quiet disposition, and without feathered shanks. The ideal sitting hen can be found best among American breeds, such as the Plymouth Rock, the Wyandotte, the Rhode Island Red, and the New Hampshire. Sitters chosen from the heavier breeds, such as the Cochin, the Brahma, and the like, are usually faithful but clumsy. Hens selected from the breeds kept especially for egg production, such as the Leghorn, the Hamburg, or the Ancona, are too small except for hatching game eggs, and are frequently found to be untrustworthy. Very large hens, and those that are nervous and excitable, often break the eggs and sometimes injure the chicks by stepping on them. A ruffling of the feathers when approached, clucking, and use of the beak are signs of a sitter.

6. Choosing the incubator

A knowledge of the principal types of incubators is necessary to enable the poultryman to choose the one best suited to his conditions. But the experience of personally known suc-
cessful users should be considered before deciding finally which type of machine to buy.

When one has decided the number of chicks needed, and the number of hatches best suited to his situation, he is ready to determine the type of incubator required. If chicks are to be purchased, an incubator will not, of course, be needed. For a few hundred chicks a small-type machine should do. When 1500 or more chicks are to be hatched, the operator may well consider one of the larger-capacity machines. Comparative investment, available space, convenient size, labor and costs of operating, and possible future expansion should be considered.

![Diagram of incubator components]

**Fig. 210—A regulating device and four-bar thermostat.**

1. Connecting rod.
2. Adjusting nut.
3. Counterpoise arm.
5. Regulator arm.
6. Thermostat.
7. Thermostat supporting rod.
8. Knife edge casting.

When the business warrants selling chicks from one's own flock, or a hatchery business is contemplated, the large or mammoth machines are likely to prove best adapted.

7. Locating the incubator

*Still-air machines* need a room temperature of about 70 degrees F. The cooler the outside room is, the greater will be the difference in temperature between the top and the bottom of the eggs in the incubator. Hatches are spoiled by too cold or too hot air in the room. The average incubating temperature will be either too low or too high, respectively, though the temperature reading on the thermometer is correct. Hence,
the more even conditions found in a basement or cellar are preferred.

*Cabinet or forced-draft machines* are less affected by room temperature than *still-air machines* because of more rapid air movement and more uniform temperature between top and bottom of the machine. Hence, rooms above ground are more often used. To prevent fuel loss, and to provide comfortable conditions for the operator and chicks, these rooms are often well insulated when above ground and are kept at 70 to 75 degrees F.

A room with ceiling 3 feet or more above the top of small incubators and having windows near the ceiling for ventilation is desirable. The windows may be sliding or tip-in types. Air should enter and leave the room without blowing on the incubators. Curtains should prevent the sun from shining on the incubators.

Dimensions governing the size and ventilation of rooms for mammoth incubators vary with the size and type of machine. Directions should be obtained from the manufacturers of the
machine in which one is interested and they should be followed carefully.

The type of incubator will govern its place in the room. Small incubators and cabinet-type mammoth incubators are often placed a foot or two from the wall, while sectional types which open on both sides must permit handling the trays between the wall and the machine.

8. Preparing the incubator room

In addition to having the incubator in place, and the various items of equipment checked, the room should be cleaned and disinfected, and the windows cleaned and arranged for easy adjustment.

The next step is hatching the eggs (Chapter XIX).

GENERAL INFORMATION

1. Hatching several seasons of the year

The idea of hatching during the spring has so long prevailed that with some it has become a custom not to be disputed. However, the increasing demand for chicks at other seasons, the introduction of better-controlled incubators, and the newer knowledge of feeding and breeding for hatchability and growth have given rise to the practice of hatching the year around.

The hen and the native birds which are forced to do their sitting at a time when food is abundant for both sitter and young work under different conditions from the modern poultryman. He, through scientific discoveries, has learned how to supply necessary feed ingredients to both old and young stock at other than the spring season. Better knowledge of chick disease control has also helped to remove the risk.

In a normal laying flock mortality and culling gradually reduce the number of birds. This varies in different flocks. An average percentage might be: during 4 months laying, 8 per cent; during the next 4 months, 8 per cent; and during the third 4 months, 34 per cent.

By using the records from one's own flock a plan for hatch-
ing may be formulated so that pullets will be ready to place in the laying houses two or more times during the year, thus bringing the flock back to its original size. Less brooding equipment is needed and the flock may be held to not less than three-fourths of its original size instead of one-half, as is often the case.

Figures from one successful farm show the following results:

<table>
<thead>
<tr>
<th>Hatches</th>
<th>Start Production</th>
<th>Average Production per Hen</th>
<th>Production During Sept., Oct., Nov.</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>October</td>
<td>204</td>
<td>50</td>
</tr>
<tr>
<td>July</td>
<td>December</td>
<td>203</td>
<td>52</td>
</tr>
<tr>
<td>November</td>
<td>April</td>
<td>196</td>
<td>50</td>
</tr>
<tr>
<td>January</td>
<td>July</td>
<td>192</td>
<td>51</td>
</tr>
</tbody>
</table>

Comments accompanying these results:

1. Heat was not used on any hatch after 8 weeks.
2. Chicks were allowed out of doors at will after 5 weeks.
3. Hatchability was slightly poorer during the summer.
4. Pullets hatched in June, July, August, and September take 3 to 4 weeks longer to reach sexual maturity. They start laying larger eggs.
5. There is no difference in brooding or rearing mortality. (Reared in colony houses.)
6. No significant difference in adult mortality.

Advantages in hatching during several seasons of the year are: less brooding equipment needed and more efficient use of it, house capacity better utilized, production more uniform over the year, more chicks from the same breeders and better yearly labor distribution.

2. Types of incubators

Incubators can be roughly classified as: (1) hot-water radiation from pipes in the egg chamber; (2) hot-air infusion, or warm air pouring directly into the egg chamber; (3) hot-air diffusion, or warm air passing through a diaphragm; and (4) forced-draft, where the air is driven by fans or agitated by paddles.
(A) *Small incubators* can be divided also into moisture and non-moisture types. One moisture type is equipped with a tray of sand in the bottom, which is kept wet. The moisture prevents excessive evaporation of the eggs while continually changing the air within the machine. The non-moisture type reheats and redistributes the air, thus preventing excessive drying of the eggs.

Heat may be supplied by kerosene, gas, or electricity. Sizes are available from 50 eggs to several hundred.
In addition to the well-insulated wall, the heater, the ventilation and moisture systems, and the egg chamber, the regulating device or thermostat is a vital part. In kerosene- and gas-heated incubators, as the heat expands the thermostat, the latter pulls down on the connecting rod, raises the disc, and thus allows the surplus heat to escape. As the amount of heat decreases, the thermostat contracts, allowing the disc to drop down on the heater, thus directing more heat into the machine.

In electric incubators the current is turned on or off, as the case may be, thus supplying heat only when needed.

(B) Mammoth incubators. The small incubator was the stepping stone from hen-hatching to the deck and then to the cabinet machines. The coming of mammoth incubators not only enabled the breeder to incubate several thousand eggs with greater economy, and to diversify his business by selling baby chicks, but it gave rise to the important hatchery industry.

Mammoth incubators can be divided into the sectional and cabinet types.

The sectional type is a long machine consisting of several sections, which may be added to or removed from the machine as required. Later types followed the same principle, but added the double- and triple-deck idea, as more hatching space was needed (Fig. 211). Water is heated by coal, oil, or gas and distributed in pipes. Although more compact than the same capacity in small machines, a long, wide room is required. There are also many different units to regulate and clean.

The cabinet type is a compact room (Fig. 212). Eggs are placed in trays from the top to the bottom of the machine. The temperature is evenly distributed through the entire machine either by paddles or fans; hence, the name “forced-draft” machines. The machines can be placed in almost any part of the room that is most convenient for the operator. It is easier to heat one large room than many small rooms, and there is less wall area; and, hence, less exposed area per given number of eggs.

Cabinet-type machines are heated with coal, oil, gas, or
A forced-draft type. Two units are shown. The interior of all units are like Unit 1. Each unit is separate except that the turning mechanism operates the full length of the machine. Each of the six turning gears (extreme right) turns two trays of eggs throughout the length of the machine, even though they are separate units. Known as a twice-a-week hatcher, two trays are set each 3½ days, the two-tray hatching compartment $J$ operating twice weekly after hatching commences.

**AIR CIRCULATION**

The fan $A$ and motor $C$ are enclosed in an airtight hood $B$. The baffle sheet $D$ forms air channels $E$ and $F$ leading down to the bottom of the incubating chamber $H$ and up into the hatching chamber $J$ respectively. Air is drawn into the machine through tube intakes $G$ by fan suction, mixed with the air in the incubating chamber by the fan and forced into channels $E$ and $F$. Circulation and recirculation of the air among the trays in $H$ occur. The air exhaust at $I$, lower right, is controlled by hand. Air in the hatching compartments $J$ passes from the lower to the upper trays, through a down collector, and out of an exhaust at the top of the machine.

*Courtesy The Jamesway Incubator Co.*

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electricity. When electric current is dependable, it is most often used.

Most of the modern forced-draft, cabinet-type incubators provide humidity control by spraying water into the machines or by passing humidified air into the machines and determining relative humidity by the use of wet-bulb hygrometers.

(C) Separate hatching-compartment machines. This feature provides units for incubation up to the eighteenth day inclusive, and separate units for hatching, thus permitting a slightly lower temperature from the eighteenth day. It also permits the two compartments to be fumigated or disinfected separately. In the deck-type machine the separate hatching compartment is less necessary since no other eggs are involved.
at hatching time. With a machine in which all stages of incubation including hatching are in one compartment, it is necessary to fumigate and disinfect the machine while all the stages of incubation and hatching are in progress.

COMMUNITY SURVEY

1. At what date does incubation of Leghorn eggs begin in your locality?
2. What makes of small incubators are in use near by?
3. What makes of mammoth incubators are in use near by?
4. Sketch one of the best incubator cellars near by and list the favorable points, as given by the owner or operator.
5. Are there any poultrymen starting chicks at other than the spring season?
6. If so, when?
7. Why are they doing this?
8. What hatching season gives the best pullets for laying purposes?
9. Ask one or more poultrymen how they figure the number of pullets they will need in a year.
10. What percentage of the poultrymen hatch their own chicks?
11. What percentage of the poultrymen buy their chicks?
12. Do any of the poultrymen buy sexed chicks? Why do they get them?
13. Are crossbred chickens grown? Ask the poultrymen why they rear them.
CHAPTER XIX

HATCHING THE EGGS

The process of incubation, by which, in the space of three weeks, a microscopic germ is changed into a downy chick, capable of walking, eating, and expressing its needs by its voice and actions, seems nearly magical in its results. With such rapid development and change within the egg (see Chapter XX), great care must be exercised to provide correct conditions if a good percentage of strong chicks is to be hatched. No detail should be overlooked in giving the egg every chance to hatch, and each chick a chance to live, since upon their ability to do this may rest the success or failure of the poultry enterprise.

Operations:

1. Selecting hatching eggs.
2. Caring for hatching eggs.
3. Testing the thermometer.
4. Preparing the small incubator.
5. Preparing the mammoth incubator.
6. Starting the hatch.
7. Maintaining the proper temperature.
8. Maintaining the proper humidity.
9. Turning the eggs.
10. Ventilating the machine.
11. Cooling the eggs.
12. Testing the eggs.
13. Taking off the hatch.
15. Hatching with hens.
1. Selecting hatching eggs

Each egg is a potential chick. We desire it to be fertile, to hatch a chick that will live and grow into a desirable meat bird, or into a pullet that will produce the right kind of market eggs. Breeding plays an important part. The breeders having laid the eggs, our job is to select the best eggs we can.

Select eggs that are uniform in size, shape, and color, that have strong shells, and that weigh about 2 to 2 1/2 ounces each or 24 to 28 ounces to the dozen. Abnormally large or small eggs (over 30 or under 23 ounces to the dozen) should not be used.

Certain eggs that are undesirable in size, shape, and color from a marketing standpoint may hatch well, but should not be used, because the resulting pullet is very likely to produce the same undesirable type of egg. Everyone selecting eggs for hatching should remember that careful sorting for incubation means less sorting of eggs from the resulting pullets and a higher price for market eggs, and offers an opportunity for efficient management that should not be overlooked.

This selection should be preceded by selecting breeders, if possible. The average size, shape, and color of eggs laid by any breeder is a fair measure of the eggs her daughters will lay.

2. Caring for hatching eggs

If the best results are to be obtained, several points should be observed in the handling of eggs for incubation from the time they are laid until they are set.

A. Gathering the eggs. Collect hatching eggs at least three times daily, to protect them from extreme heat or cold.

B. Producing clean hatching eggs. Clean eggs are best for hatching. If the eggs are very dirty, bacteria are likely to have gained access to the inside of the egg, with harmful results.

C. Holding the eggs. Best results are usually secured when eggs are incubated the week they are laid. In a series of ex-
periments to determine the influence of age of eggs upon hatch-
ability, the Maryland Station obtained the following results:

<table>
<thead>
<tr>
<th>Age of Eggs</th>
<th>Hatchability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10 days</td>
<td>55.14</td>
</tr>
<tr>
<td>11-20 days</td>
<td>41.77</td>
</tr>
<tr>
<td>21-28 days</td>
<td>17.94</td>
</tr>
</tbody>
</table>

Eggs should not be held more than seven days, or two weeks
at the most. Egg cases may be used for holding them. These
prevent excessive evaporation and afford an
easy way of turning. To
keep the yolk from ris-
ing and bringing the
germ in contact with the
shell membrane, all eggs
for hatching should be
turned daily if held
longer than five days.
The container may be
turned from side to side,
thus accomplishing the
result with little effort.

A cool, well-venti-
lated cellar provides ex-
cellent conditions for
holding eggs. The temperature should be from 50 to 55 de-
gress F. and it must be kept below 68 degrees, since the germ
will develop slowly at that temperature.

3. Testing the thermometer

Test the thermometers each season to make certain that
they register accurately. Secure a thermometer known to be
correct, such as a physician's clinical thermometer, and hold
it near the one to be tested. Rotate both in water at about 103
degrees F. If there is any difference between the readings of
the two thermometers, make a distinct mark that cannot be
misunderstood on the incubator thermometer, in order to make
a correction when using it.
4. Preparing the small incubator

Clean and disinfect with a 2 or 3 per cent solution (preferably in hot water) of a cresol disinfectant (3 ounces of the compound to 1 gallon of water). Do this even though the machine has been thoroughly cleaned at the close of the previous season, as it should have been. After brushing out the remains of the previous hatch, if any, use a sprayer or a scrubbing brush, and saturate the interior of the machine. Clean the heater with a brush or a piece of cloth on a stick. If the insulating glass in the heater is dirty, clean with a cloth dampened in vinegar. See that the lamp is clean and the burner and gauze free of foreign material. Level the machine. Renew the wick after each hatch, to avoid danger of its being too short to reach the oil at any time during the hatch.

5. Preparing the mammoth incubator

All parts of the machine must be in working order. Sectional machines will need to be started, thermostats checked, compartments cleaned and disinfected, if necessary, and the heater carefully examined. After the eggs are in, it is too late to find the equipment in need of repair.

Cabinet machines must be oiled, lights checked, and the heater, air distributors, moisture apparatus, and electrical connections made ready.
6. Starting the hatch

Eggs may lie on the tray on their side or on end, with the large end up. They should never be placed with the small end up. Eggs may be placed on the incubator trays as they are brought to the egg room, or just before they go into the incubator.

Placing cold eggs in the machine lowers the temperature. From ten to twelve hours is usually required to warm the eggs through and restore the desired temperature in the egg chamber in still-air machines. In the forced-draft incubators, readjustments in the temperature take place more quickly. The temperature may drop 3 to 4 degrees, but will regain the normal point again in 3 to 4 hours.

Eggs are sometimes held in a room at 70 degrees F. for several hours before they are placed in the machine. This practice makes the change in temperature more gradual and requires less time for the machine to warm the eggs.

Higher temperatures result in earlier hatches and lower temperatures in later hatches. If the eggs are not pre-warmed and the still-air incubator is set at night, the next day is called the first day of incubation. The hatch should be complete the morning of the twenty-first day. Pre-warming the eggs may advance the hatching time slightly.

In forced-draft incubators, which include both eggs and hatching chicks in the same room, pre-warmed eggs in at 7 A.M. on the first day should complete the hatch the morning of the twenty-second day.
7. Maintaining the proper temperature

Small, or sectional incubators. The egg chamber is warmest near the top and coolest near the bottom. A hanging thermometer or one with the bulb above the eggs should register higher than a contact thermometer or one with the bulb on a level with the eggs.

Temperatures should be about as follows, for still-air machines:

<table>
<thead>
<tr>
<th>Period</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>First week</td>
<td>102.5°-103° F.</td>
</tr>
<tr>
<td>Second and third weeks</td>
<td>102° F.</td>
</tr>
<tr>
<td>18th day to end of hatch</td>
<td>100°-101° F.</td>
</tr>
</tbody>
</table>

Cabinet mammoth or forced-draft incubators. The temperatures vary in different machines. When hatching is done in the same machine where eggs are being incubated, the temperature cannot be lowered at hatching time because of the harmful effects on the eggs. Such machines are kept constantly at about 99½ degrees F., unless otherwise specified by the manufacturer, because of the location of the thermometer.

When eggs are transferred to the separate hatcher the temperature to the eighteenth day is 99.5 to 100 degrees F., dropping the eighteenth day to 98 to 99 degrees F.

8. Maintaining the proper humidity

The relative humidity should be the same in all types of incubators, namely about 60 per cent. However, for best results it should be 55 per cent to the eighteenth day and increased 5 to 10 per cent from the eighteenth day until the end of the hatch.

In still-air machines the reading could be made by a reliable hair hygrometer, while in forced-draft machines the wet-bulb reading could be made. In the latter case the reading should be 84 to 86 degrees F. and 88 degrees F. at hatching time. If the machine is fumigated, the wet bulb reading should be 90 degrees F., thus increasing the relative humidity
398 HATCHING THE EGGS

to 65 or 68 per cent. (See page 407). The high humidity assists the action of the fumigant and reduces the spread of dust in the machine.

Fig. 218—Incubator record sheet for student or commercial work with small machines.

The temperature curve may be plotted as the period progresses.

In order to insure accurate wet-bulb readings, there must be rapid circulation of air. This is impossible to secure in still-air machines. The hair hygrometers may be used in the
still-air machines. They are fairly accurate when the hair is long enough. The hygrometer should be at least 4 inches in diameter. Metal spring hygrometers are less accurate.

The wet bulb is contrived by covering the bulb with a muslin or silk wick, one end of which is inserted into a cup of water. If there is an absence of moisture in the egg chamber, the evaporation of moisture from the wick around the bulb increases. Since the evaporation is a cooling process, a lower reading results. The higher the humidity in the egg chamber, the slower will be the evaporation and therefore the higher the reading.

To increase the moisture in the outside air, the floor should be kept damp. Incubators that are equipped with moisture pans or troughs should receive water in accordance with the manufacturer’s directions unless this method has been given a fair trial and found unsuited to the prevailing climatic conditions.

**STATEMENT ON THE QUESTION OF MOISTURE AND TEMPERATURE**

**What is humidity?** Humidity is the moistness of air. Also, technically speaking, humidity is saturation of atmospheric air with water in form of vapor. When we use terms “high humidity” or “low humidity” of air we mean that the air holds relatively large or small amounts of water.

**How humidity is measured in the incubator.** Humidity is measured by the comparison of a given humidity condition with the condition of air when it is fully saturated. Full saturation of air is taken as 100 per cent. One-half saturation, therefore, would be equivalent to 50 per cent; or so-called relative humidity. One-quarter saturation would be equivalent to 25 per cent relative humidity, and so forth. In practice,

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1 Alexis L. Romanoff and Royal A. Sullivan, Laboratory of Experimental Embryology, Cornell University Agricultural Experiment Station, Ithaca, N. Y.
humidity of air is determined either by direct reading with the aid of a hair hygrometer or indirect reading from the differences in readings of wet- and dry-bulb thermometers. The actual readings of wet-bulb thermometers at various temperatures and humidities are shown in the table.

**What is the relation between humidity and temperature?** The higher the temperature is, the greater the amount of water at full saturation of moisture in the air. And the lower the temperature is, the smaller the amount of water at full saturation. Therefore, air at 50 per cent relative humidity and high temperature would contain a proportionately larger amount of water than air at 50 per cent relative humidity and low temperature. This relation between the temperature and the holding capacity of air for water is shown below.

### Relative Humidity Wet-bulb Reading at Various Temperatures
(Calculated for average atmospheric pressure of 29 in.)*

<table>
<thead>
<tr>
<th>Relative humidity</th>
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*Prepared by Alexis L. Romanoff and Royal L. Sullivan, Cornell University.

9. **Turning the eggs**

Turn the eggs three to four times daily, from the first to the eighteenth day of incubation inclusive. Turning is
very beneficial. The hen turns her eggs several times during the day and night.

Most modern machines are equipped with quick turning devices which work without removing the eggs. It is not necessary to turn the eggs completely over. When turning by hand with small machines, if the trays are full, remove a few eggs, and with the palms of the hands shuffle the eggs back and forth until all have been moved. Also, turn the trays end

for end one time and from side to side the next, if the compartments hold more than one tray. This practice helps place all eggs under any different temperatures that may exist in the egg chamber.

**10. Ventilating the machine**

Follow the manufacturer’s directions carefully. Oxygen is an important element. The embryo uses about \( \frac{1}{4} \) cubic foot of oxygen (\( O_2 \)) during incubation and produces about \( \frac{1}{4} \) cubic foot of carbon dioxide (\( CO_2 \)). The amount of each is small at first, increasing gradually until toward the end of the period the exchange of gases is considerable. The chick is very sensitive to \( CO_2 \).
During the entire period of incubation it is well not to exceed \( \frac{1}{2} \) of 1 per cent of CO\(_2\).

Still-air machines need more ventilation near the end of the hatch.

Mammoth machines of the forced-draft type have the air well equalized and no excess of CO\(_2\).

11. Cooling the eggs

Experiments indicate that special cooling is unnecessary, except if the eggs should become overheated.

12. Testing the eggs

Dead embryos give off harmful gases. In forced-draft machines these gases are easily driven away and, hence, it is not necessary to test and remove them. However, some operators do so on the eighteenth day while changing the eggs to the separate hatcher or earlier to conserve space. It is customary in still-air machines to test twice; white eggs on the fifth or sixth day and brown eggs on the seventh or eighth day. Both are again tested on the fourteenth day. Best results in testing are secured if the room is darkened. Hold the eggs before the tester with the large end up (Fig. 219). A position about twelve inches in front of and below the eye makes it easier to see the contents. Give the egg a gentle turn and the contents will move. If the egg is infertile, the yolk will appear as a dark shadow moving with the egg. The air cell will be considerably larger than that in a fresh egg.

The fertile egg, at the first test, will have a darkened spot on the yolk, with several red blood vessels radiating from it.
resembling a spider. The larger and more distinct the embryo appears, the stronger is the germ.

Fig. 221—Testing eggs from a mammoth incubator.

Four steps in testing and removing eggs to the separate hatcher tray. 

A. Wire bottom tray of eggs over the tester box. Removing infertiles and replacing from a second tray. 

B. The tester box with light bulbs in place. 

C. Placing the hatcher tray over the original tray. The special crepe paper is laid on first and will push into place at the bottom of the hatcher tray. 

D. Hatcher tray has been pushed down over the original tray, the trays are being turned, after which the original tray will be lifted out, the eggs rolled or turned to lie on their sides or with large end up, and the new tray with its eggs placed in the separate hatcher.

If the germ appears without the radiating blood vessels, and with a whole or partial ring of blood around it, the germ is dead and the egg should be removed.
At the second test, on or about the fourteenth day, remove any eggs in which the germs have died since the first test. In an egg that contains a live germ large blood vessels are usually seen near the air cell, and frequently the chick is seen to move. Eggs having a dark center, with a clear area near the edges, are probably dead embryos. The beginner should break open several eggs that appear dead at this test, in order to check up on his judgment.

13. Taking off the hatch

Still-air machines. When dry, the chicks may drop into a nursery below the tray or be hardened by lowering the temperature slightly or by opening the incubator door about one-eighth inch and fastening it.

Forced-draft machines permit the chicks to remain in the hatching trays until all are dry. The chicks are then either sorted directly from the trays to boxes, or baskets, and carried to brooders, or they may be counted from the hatching trays.
into boxes, carried to the sorting table, and boxed for the brooders or for sale, as the case may be.

**Caution:** When chicks are removed from the incubator, there is danger of chilling, especially if they are not thoroughly dried.

14. Cleaning and disinfecting

The practice of fumigating either just before, during the time chicks are hatching, or afterward has become general. Manufacturers of incubators have prepared directions for fumigation of their particular machines at these periods.

**Plan 1. Forced draft.**

Determine the cubic feet of incubator space. For each 100 cubic feet use 20 cubic centimeters (\( \frac{3}{3} \) ounce) of formalin. Cut a piece of cheesecloth, approximately 1 yard for each fan, soak in the formalin, and hang under the fans. The cloth may be partially twisted and suspended by the ends to hooks so that it hangs loosely.

Fig. 223—Sorting chicks into boxes for brooders or for sale.

Fig. 224—Sexing chicks in a commercial hatchery.

Organized companies provide "sexers" who work at a certain rate per chick.
Fumigation is started when there are a few chicks on the trays and repeated every 12 hours until the hatch is finished. The wet-bulb reading should be about 90 degrees F.

Fig. 225—The sorting and sexing room, with several thousand chicks ready to be shipped.

Fig. 226—The battery room in a commercial hatchery. Surplus chicks are often held in batteries for a few days until sold.
CLEANING AND DISINFECTING

After the chicks are removed, the floor is cleaned with a vacuum cleaner, the trays brushed clean with a wire brush, and returned to the incubator.

The shells and unhatched eggs are taken to a dump.

**Plan 2.** When the eggs are transferred to the separate hatcher, measure out the potassium permanganate crystals into a jar or crock. Add the formalin. Place in the machine and close the door. Leave at least 30 minutes.

"A simple way to determine the required amounts of chemicals is to use the following chart:

<table>
<thead>
<tr>
<th>Cubic Feet of Air Space</th>
<th>Amount of Formalin</th>
<th>Amount of Potassium Permanganate</th>
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<tbody>
<tr>
<td>10</td>
<td>1 teaspoonful</td>
<td>( \frac{1}{2} ) teaspoonful</td>
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<tr>
<td>20</td>
<td>2 teaspoonsful</td>
<td>1 teaspoonful</td>
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<td>50</td>
<td>5 teaspoonsful</td>
<td>( 1\frac{1}{2} ) teaspoonsful</td>
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<td>100</td>
<td>( \frac{1}{2} ) cup</td>
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<td>200</td>
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<td>400</td>
<td>1 cup</td>
<td>( \frac{1}{2} ) cup</td>
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"The chemicals are combined in a wide-mouthed earthen- or enameled-ware jar. The jar should be large enough to hold at least ten times the amount of chemicals placed in it, so that the chemicals will not boil out over the jar." ¹

For fumigating still-air compartments after the hatch is completed, clean thoroughly, determine the amounts (use above table), and leave in the machine for 30 minutes.

"The air in the compartment must be warm and moist before the fumigant is placed. The dry-bulb reading should be between 99 degrees and 100 degrees F. and the hair hygrometer reading should be around 68 per cent relative humidity. Moisture and temperature play an important part in determining the efficiency of the gas." ¹ Remove the hygrometer while fumigating.

After the hatch, clean out the interior and disinfect the compartment and the trays.

Fig. 227.

A. Fumigating with formalin and potassium permanganate in the separate hatcher on the 18th day. The mixture is placed in the container, which is then put onto the floor of the machine. B. Cleaning the floor of a mammoth room type incubator after the hatch. C. Disinfecting incubator trays.
15. Hatching with hens

Making the nest. The general requirements of a nest are that it be roomy, cool, well ventilated, protected from enemies, sanitary, secluded, and safe for the newly hatched chicks. The nest should be 12 to 16 inches square and a few inches

Left: Before removing the hen be sure she has laid. Remove the egg before the hen and thus take no chance of leaving the egg in the nest.

Right: Catch the bird by the shoulder as she leaves the nest.

Left: Move the hen to the right or left side, her head under the operator's arm. In this position the number on the leg band may be easily read.

Right: The hen is then released carefully so that she will land on the floor litter without being injured.

Fig. 228—Steps in trapnesting.
HATCHING THE EGGS

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deep. A good nest can be made by removing the bottom from a dry-goods box and placing it on the ground or floor in a secluded corner of some building or shed.

Coops are used out of doors for one or more hens. In any case the hen may be given freedom to the extent of a small yard, which should be shady. The nesting material used when setting hens is generally oat straw, wheat straw, fine hay, cut straw, or clean chaff, placed on a sod or several inches of moist earth and packed well into the corners and hollowed in the center to hold the eggs.

Setting the hen. When a good sitter is found, she should be gently transferred to the hatching room or hatching coops.

The transfer should be made at night. The hen should be thoroughly dusted with a good lice powder, and this dusting should be repeated three or four days before the eggs hatch.

It is well to set the hen on several eggs that are not to be

Fig. 229.

Left: The hen number and also, when desired, the pen number are written on the large end of the egg when eggs are saved for hatching.

Right: The hen number is then recorded on the pen sheet. Recording the hen number rather than a straight or cross mark is safer as it lessens the danger of marking in the wrong space, thus giving credit to the wrong hen. It also takes less time since the eye does not have to travel back across the sheet to locate the number of the hen.
used for hatching, until she becomes accustomed to her surroundings. If she does not leave the nest except for food or for water during the following day, it is generally safe to place the eggs for hatching under her the following night. The number of eggs to be set will depend upon the size of the hen and the weather conditions, and will usually range from twelve to fifteen eggs in early spring, and two or three more during warmer weather.

**Feeding the hen.** During the entire hatching period, feed the hen once daily with grain only. In addition, plenty of fresh water and a small amount of grit should be supplied. Do not give wet and dry mashes or cooked and sloppy feeds.

**Important details.** If eggs are broken in the nest, they should be removed at once and fresh nesting material supplied. If the remaining eggs are smeared, they should be washed with warm water.

At the end of the first and second weeks, the eggs should be tested and those that are infertile or contain dead germs should be removed. If several hens are set at the same time, the eggs from two hens may often be placed under one after the undesirable eggs have been removed. The extra hens may then be set again or placed in a special coop for breaking up broody hens. Sitting hens should be looked after daily, especially if they show a tendency to stay off the nest too long.
Fig. 231—Steps in pedigree hatching and wing banding.

A. The eggs from each hen are placed by themselves in the egg holding room. Transferring to the incubator tray. B. On the 18th day the eggs from the same hen are placed together in one or more compartments of the pedigree tray. A lid covers the entire tray. C. When hatching is concluded, the hen number of the chicks is determined by the number on any shell in the same compartment. D. Each breeding hen is credited with each chick hatched from her eggs. A number is given to the chick and recorded at the same time. E. The chick number is stamped on a wing band. (Bands may be purchased with part or all the figures stamped.) F. The chick is wing banded with the proper band.
Care at hatching time. If the hen becomes restless, it may be necessary either to confine her or to remove some of the chicks. If the latter is done, the chicks can either be given to a

![Fig. 232—Chick wing bands arranged in order and pliers used in fastening the band to the wing.](image)

hen that has completed hatching or held in a warm box for a few hours. When the chicks are thirty-six hours old, they may be transferred from the nest to the outdoor brooder coop. The nest should be cleaned, and the litter burned; if the nest box is to be used again, it may be well to disinfect it thoroughly.

16. Pedigree-hatching (Figs. 228–233.)

In order to know the parentage of each chick, it is necessary to pedigree-hatch the eggs. It is necessary for progeny testing. It is essential if one aims to make the most definite and rapid progress in breeding for egg production.

Some of the essentials for pedigree-hatching are:

1. That each breeding female and male be banded so that the numbers can be easily read.

2. That a group of females be mated with a single male throughout the breeding season.

3. That the birds be trapnested during the breeding season.

![Fig. 233.](image)
(4) That a breeder's record book be used in which to record the number of each bird, her annual production, and hatching record.

(5) That each egg be marked on the large end with the pen number and the number of the hen, at the time the hen is removed from the trapnest. *Example*: 1128 (Hen number) 15 (Pen number)

(6) That before the eggs are placed in the incubator they be systematically arranged in the order of the hen numbers, the eggs from each hen being grouped together in order that they may be placed in the machine and on the incubator record sheet for quick reference.

(7) That on the eighteenth day the eggs from each hen be placed in a separate basket, in order that the chicks from each hen may be correctly identified and banded.

(8) That each chick be wing-banded with a special clinched or sealed band so that, from the band number of each chick, its parentage can be quickly determined, by referring to the incubator record sheet and the breeder's record book (Nos. 4 and 6).

(9) That a book of pocket size, properly ruled, be provided, and the wing-band number of each chick entered therein, in order, from the first to the last chick banded in each season, and that space be provided for entering, during the season, such information as will be helpful.

**COMMUNITY SURVEY**

1. Spend a period or more with a local poultryman and note the various operations performed in caring for the incubator.
2. What points are emphasized in the selection of hatching eggs? Why?
3. What attention is given to moisture within the machine?
5. What temperature is used each week in still-air machines? In the forced-draft machines?
6. How long are chicks left in the machine after hatching?
7. How many poultrymen pedigree-hatch their chicks?
8. List the various steps used in pedigree-hatching.
9. Which give the best results in pedigree-hatching, bags or baskets?

REFERENCE

CHAPTER XX

FORMATION OF THE EGG AND CHICK

A knowledge of the means by which nature surrounds the developing embryo with the conditions necessary for its life and growth and of the manner in which the embryo responds to these conditions is essential in arriving at an understanding of the principles of incubation. It will add interest to the daily task of running the incubator to realize that the egg, although perhaps incubated miles away from the sire and dam that gave it life, contains within the shell in microscopic form the germ of life capable of producing a perfect chick, when given the proper conditions for incubation.

General information:

1. Formation of the egg.
2. Structure of the egg.
3. Formation of the chick.

1. Formation of the egg

There are two parts of the hen's body that are chiefly concerned in the development of the egg, namely, the ovary and the oviduct (Figs. 234, 235).

A. Growth of the yolk. The yolk of the egg is the first part to develop; its development takes place in the ovary, which is located close to the backbone of the fowl. The ovary contains many hundreds of minute yolks (Fig. 235). If a normal fowl is killed while in laying condition, these yolks are found in all stages of development. Each yolk is enclosed in a sac, or follicle, through which it obtains its nourishment while developing.
The yolk is gradually built up in the "cell body of the egg cell" by the addition of concentric layers of yellow yolk around an inner case of white yolk. The nutriment for these growing ova, or yolks, is supplied by the hen from the products of her
digested food, brought by the blood vessels to the cells in the follicles and transferred by them to the growing ova.

According to Lillie,¹ the yellow yolk is laid on daily in regular layers, separated by very thin strata of the white yolk.

"The principal accumulation of white yolk lies in a central flask-shaped area, the latebra, which extends toward the germinal disc from the center of the yolk. This tube of white yolk flares out under the germinal disc into a mass known as the nucleus of Pander." ²

As the yellow yolk is laid on, the germinal disc moves gradually onward, always remaining close to the vitelline membrane, and leaving behind it the tube of white yolk, across which no yellow yolk is deposited (Fig. 139, "Cross-section of an egg").

At Cornell University, A. L. Romanoff ³ found that about seven days are required for the full development of the yolk from its original minute size. The layers vary in thickness, probably owing to the physical condition of the bird, rate of laying, and the like. When the yolk is mature, the germinal disc appears as a light-colored spot on the surface. This may be seen when carefully breaking an egg into a saucer.

B. Yolk released at maturity. When the yolk becomes mature, the funnel-shaped opening of the oviduct rises and envelops the yolk sac. The yolk sac then splits along the suture line (Fig. 234) and allows the yolk, enclosed in its vitelline membrane, to escape and begin its passage through the oviduct (Fig. 235).

As soon as the yolk escapes from its yolk sac, the sac contracts and usually remains as unabsorbed tissue, although so much decreased in size that it is difficult to distinguish the yolk sac after a few weeks.

C. The albumen. As the yolk continues its passage, the

¹ F. R. Lillie, Development of the Chick.
² B. M. Patten, Embryology of the Chick.
various glands lining the oviduct secrete the albumen. About 40 per cent of the albumen, or white, of the egg is supposed to be laid on as the yolk passes down through the upper half of the oviduct (Fig. 235).
The time occupied in passing through this region is about three hours.¹

The first albumen to be deposited on the yolk is the very thin layer of dense albumen, close to the vitelline membrane and continuous with the chalazae. Next to the dense inner layer there is a layer of inner thin, surrounded by a thicker middle layer. Fig. 139, page 283.

D. The isthmus. After the yolk has reached the half-way point in its progress down the oviduct, it enters the isthmus (Fig. 235), where the shell membranes and 10 to 20 per cent more albumen are added. By this time the egg is beginning to assume its final size and shape. About three hours are required for the passage through the isthmus.¹

E. The uterus. The uterus is the next portion of the oviduct into which the developing egg passes. Here the remainder of the albumen is drawn in through the shell membranes. The shell is also deposited in this section. The egg is ordinarily laid from twelve to twenty-four hours after it enters the uterus.¹

F. The vagina. The egg then passes through the vagina, where some of the shell pigment and the outer gelatinous coating of the shell are probably added.

G. The cloaca. The completed egg is now ready for expulsion through the cloaca.

2. Structure of the egg

In the cross-section of an egg shown in Fig. 139, the various parts may be seen. Many of these parts may also be seen in a hard-boiled egg that has been cut through longitudinally.

The layers of light-yellow yolk and the tube of white yolk may often be observed.

The chalazae and the four layers of albumen can best be seen by opening a fresh egg into a saucer. The chalazae are attached to the dense albumen layer surrounding the yolk and on opposite sides of it. They extend out into the albu-

¹ F. R. Lillie, Development of the Chick.
men toward the ends of the egg, or may be twisted up close to the vitelline membrane. A chalaza consists of a white, fibrous thread of albumen. The size of the chalazae varies in different eggs.

The chalazae prevent any rapid change in the position of the yolk, and cause the yolk to revolve on the long axis of the egg, thus keeping the germinal disc on the upper side, nearest the heat, during incubation.

The dense layer of albumen surrounds the yolk and is transparent. It may be seen by looking across the yolk on a tangent. The other three layers of albumen are easily seen in a fresh egg, the second layer being more dense and standing up more firmly than the outer layer. Cutting the second layer releases the inner thin.

The inner and outer shell membranes consist of a network of organic fibers, the inner one being of finer texture.

The shell consists of three layers.¹

When the egg is laid, it is completely filled; but after cooling the contents contract and an air space is formed, usually at the large end of the egg and between the two shell membranes.

¹F. R. Lillie, Development of the Chick,
3. Formation of the chick

The several stages in the formation of the chick are briefly described in the following paragraphs.

A. Fertilization. Through copulation with the male, countless numbers of spermatozoa are emptied into the oviduct of the hen. These spermatozoa make their way along the oviduct to the upper end. They will remain alive and fertilize eggs for two or three weeks after copulation.

Fertilization takes place in the upper end of the oviduct, just after the yolk passes into the funnel-shaped end of the oviduct and before any albumen is laid on (Fig. 235). In order that fertilization may occur, the nucleus of the female cell must fuse with the nucleus of the male cell. The female nucleus is located in the germinal disc, and the male nucleus is in the head of the spermatozoön.

From six to twenty-four sperm cells penetrate the germinal disc, but only one enters the egg cell and fertilizes the egg.

Nature has many devices for preventing the entrance of more than one sperm cell. Before fertilization, the sperms are attracted, but after one has entered and fertilized the nucleus the other sperms are repelled. The exact means employed for repelling the sperm cells is unknown.

As soon as the fertilization of the two nuclei is accomplished, the development of the embryo begins; and as the yolk passes down the oviduct, gathering albumen, on its way to the cloaca, the division of cells proceeds.

B. Cleavage (Fig. 236). The first division of cells occurs immediately after fertilization. This division is called cleavage.

The cells form on the germinal disc. The two fused cells divide and form two cells, each with part of the nuclear material. Each of these cells again divides at right angles to the first division, making four cells. After this each cell continues

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1 This description was gleaned largely from the author’s notes, taken from lectures by Dr. Kingsbury of the Medical College, Cornell University. Patten’s Embryology of the Chick was also freely consulted.
to divide and the number of cells is increased very rapidly. This group of cells in the germinal disc is called the blastoderm. The cells of the blastoderm are smaller in the center of the group and somewhat larger at the outside.

C. The blastula stage. The blastoderm, by the rapid formation of the new cells, is raised slightly in the center, forming a cavity between the yolk and the blastoderm (Fig. 237). This cavity is the blastocoele, or segmentation cavity.

The blastoderm touches the yolk on all sides except one, and here it is raised slightly. That section of the blastoderm which remains on the yolk is termed the area opaca. The central part, which is raised from the yolk, is called the area pellucida.

![Fig. 237—Gastrulation in form with telolecithal egg containing large amount of yolk—birds.](image)

Schematic diagrams to show the effect of yolk on gastrulation. Abbreviations: bld., blastocoele; bld., blastoderm; blp., blastopore; ect., ectoderm; ent., entoderm. From Patten's Embryology of the Chick.

The layer of cells as it exists at this stage is called the blastula.

D. The gastrulation stage. Immediately after the blastula stage, the free edge of the blastoderm turns under and starts to grow inward (Fig. 237).

The blastoderm might be likened to a pancake lying flat on the surface of a large ball. Later the pancake is raised slightly in the center but remains attached at the edge, except along
one side. The cavity thus formed is called the blastocoele; the section that remains attached to the yolk is the area opaca, and the raised section of the mass, the area pellucida (Fig. 247).

Still later, the free edge of the mass turns under, forming the beginning of the gastrulation stage.

The space between the yolk and the edge of the folded blastoderm is called the blastopore (Fig. 237). This folding under gives rise to two so-called germ layers, the upper surface of the blastoderm being the ectoderm, and the lower layer, or the one growing in under, the endoderm (Fig. 237).

The blastopore section is the rear of the embryo as it continues to develop.

The cells of the blastoderm continue to develop, spreading out over the yolk, except the part that is turned under. The sides continue to grow out and around until they come together

\[ \text{Fig. 238.} \]

\begin{center}
\textit{Note the rapidity of growth and large size at the head end.}
\end{center}

\textit{Drawing from Duval's Atlas.}
behind the opening, or blastopore, in the meantime gradually pinching the lips of the blastopore together.

The stages described above are passed through before the egg is laid, and while it is passing down the oviduct to the cloaca. Up to this point, development is very slow. The embryo is so minute that all that can be seen with the naked eye is a slightly enlarged germinal disc, and possibly what may appear to be one or two rings of somewhat darker or lighter material on the disc.

**First day of incubation.** By the time the egg is laid, the lips of the blastopore have been compressed; and but a few hours of incubation are necessary before a streak known as the primitive streak is formed out of these compressed lips.

![Diagram of primitive streak](image)

Fig. 239—Cross-section through primitive streak. Thirty-six-hour chick.

The growth of the embryo takes place at the front of the primitive streak (Fig. 238), the various parts growing out of it or coming from the space it has occupied. The primitive streak remains at the rear of the embryo throughout the development and finally becomes the tail bud (Fig. 238, right).

The growth developing out of the primitive streak may be compared to a stick which is drawn through the water. The ripples and waves grow out from the place where the stick has been. In a similar way, the embryo develops just ahead of the primitive streak.

**The mesoderm.** We have spoken of two germ layers, ectoderm and endoderm. A third germ layer (mesoderm) soon develops. From the sides of the fused lips of the blastopore and in the space between the ectoderm and the endoderm,
formed by turning under during the gastrulation stage, a growth takes place, extending out between the two germ layers. This is the mesoderm (Fig. 239).

This completes the three germ layers characteristic of all vertebrate embryos. All the organs develop from these three layers.

**Function of ectoderm.** The ectoderm forms the outer covering of the body, the feathers, nails, skin, etc., together with the nervous system and the sense organs.

**Function of endoderm.** From the endoderm is developed the lining of the digestive tube, of the respiratory organs, and of the glands associated with them.

**Function of the mesoderm.** The muscles, the lining of the body cavity, the organs of the circulatory system, the blood, the lymphatic organs, and the urinary system are formed from mesoderm.

![Diagram of embryonic development](image)

**Fig. 240—Cross-section ahead of primitive streak. Thirty-six-hour chick**

**The notochord.** As the primitive streak moves backward, an elongated, circular growth of mesoderm, known as the notochord, is left (Figs. 238 and 240). Around this is later formed the bony axis or vertebral column of the body. The notochord itself largely disappears.

**The neural groove.** A thickening of the ectoderm above the notochord occurs also. It is caused by rapid growth of the cells there, and forms the neural plate. The center of this plate becomes depressed, forming a groove (Figs. 238, 239). This formation is the first indication of the central nervous system. Later, the groove deepens and the outer edges of
it come together, fuse, and separate from the neural groove, thus leaving it below the surface and above the notochord (Fig. 240).

**The head.** At twenty-one to twenty-two hours of incubation, the front end of the embryo shows a thickened area, raised above the blastoderm. This is the beginning of the head.

**The area vasculosa.** At twenty-four hours, the area opaca appears somewhat more dense near the area pellucida. This is due to the growth of mesoderm, which has reached the point where the blastoderm meets the yolk. The mesoderm collects in clusters, forming blood islands. This is the first step in the formation of blood vessels and corpuscles. The darkened area is the area vasculosa (Fig. 248).

**The somites.** On either side of the neural groove, outgrowths of mesoderm appear, developing in pairs. These are called somites (Fig. 238). In all, there are forty-two somites that persist. The first three or four go into the head. Some
of those at the extreme rear end of the series of somites degenerate. Nerves develop later for every somite, whether it has degenerated or not.

As the chick develops from the head end toward the rear, some of the older somites are converted into vertebrae before the last somites are formed.

Fig. 243—Cross-section through vitelline arteries. Forty-eight-hour chick.

In 95 to 98 per cent of all cases, the embryo lies with the head at right angles to the long axis of the egg: i.e., the tail is toward you if the large end of the egg is at your left and the small end at your right (Fig. 248).

Second day of incubation. An interesting feature, illustrating the rapidity of the development of the chick, is the growth of the heart (Figs. 238, 248). On the second day, growth is so far advanced that on opening an egg into a saucer the heart may be seen to beat. Beating usually starts at forty-four hours.

The embryo continues to elongate, and the neural groove becomes closed over (Fig. 242).

The walls of the head project, and the formation of the eye is started.

The three parts of the brain begin to develop (Fig. 238). (See page 146 for the relation of the brain to killing.)

The auditory pits, or sensory parts of the ear, may be seen developing from the ectoderm of the head.
The formation of the urinary system is begun on this day. During the second day, the chick's body turns on its left side, and the head end is bent around toward the tail (Figs. 238 and 248). Later development shows the end of the beak and the tail close together.

The fetal membranes. During the early development of the chick embryo, certain fundamental life conditions are necessary. In fact, one of these life conditions, namely, heat, must be present before development will start. These life essentials are:

1. Protection.
3. Food.
5. Oxygen.
6. Care of waste products.

With the exception of heat, these essentials are all supplied by growths of the fetal membranes from the inside of the egg and from around the developing embryo. These growths are four in number.

The yolk sac. The yolk sac supplies food and water to the developing embryo. It starts to form when the three germ layers commence to develop. As the germ layers progress outward and downward over the yolk, and the embryo grows,
other parts develop, forcing the embryo up and the yolk down, until a thin stalk extends from the under side of the embryo to

Fig. 245—Schematic diagrams to show the extra-embryonic membranes of the chick.

The embryo is cut longitudinally. The albumen, shell membranes, and shell are not shown.

Left: Embryo early in the second day of incubation.
Right: Embryo early in the third day of incubation.

From Patten's Embryology of the Chick.

the yolk (Figs. 243, 245, 246). This is the yolk stalk and is the connection from yolk to embryo.

Fig. 246.

Left: Embryo of five days.
Right: Embryo of nine days.

From Patten's Embryology of the Chick.

The inner layer, or endoderm, and the inner layer of the mesoderm grow down and around the yolk.

The yolk sac and contents are drawn into the body of the chick at about the nineteenth or twentieth day. The yolk,
thus enclosed, acts as food for the chick during three or four days after hatching. In about six days after hatching, the yolk and sac are largely absorbed.

The amnion. The amnion gives protection to the developing embryo from the upper side. It starts to grow at about thirty hours and is fully developed at $3\frac{1}{2}$ days.

![Fig. 247—The blastoderm at eighteen hours of incubation.](image)

The shell and shell membrane have been removed just above the blastoderm.

It is formed from the outer layer of ectoderm and mesoderm (somatopleure) (Fig. 241). The somatopleure starts to bend up and over the embryo (Figs. 243, 245), finally joining and fusing, above the embryo and separated from it as shown in Fig. 246, left. The amnion is just over the embryo and consists of two germ layers, which are folded over and fused, leaving the mesoderm above and the ectoderm below.

The space between the amnion and the embryo is the amniotic cavity and is filled with a fluid which acts as a protection to the embryo as the egg is moved about.
The serosa. As soon as the amnion is formed, the fusing from either side of the embryo causes the release, or severing, of the layers there, and a new membrane (the serosa) is left around the entire embryo and amnion. In this membrane, the ectoderm is the outer, and the mesoderm the inner, layer (Figs. 244 and 246). Thus the folding of the somatopleure has formed two membranes, the amnion and the serosa.

The serosa, with the allantois, carries oxygen to the embryo and carries away the carbon dioxide.

The three membranes remain in communication, in the region of the yolk sac, until late in the development of the embryo.

Third day of incubation. The allantois. Late the third day, the splanchnopleure (Fig. 243) close to the yolk sac and toward the rear of the embryo, forms a hollow bud which
grows out rapidly and develops into the allantois (Figs. 246, 249, 250). As it grows, it becomes filled with a fluid, which distends it. This rapid growth continues until the tenth day and until the allantois takes up the space between the amnion and the serosa. The outer layer of the allantois is mesoderm. It fuses with the mesoderm of the serosa and becomes filled with blood vessels. The serosa is pressed close to the porous shell and in this way oxygen is taken in and carbon dioxide given off. The allantois also helps to absorb the albumen of the egg and stores up non-gaseous waste matter.

Thus, the four fetal membranes accomplish several of the fundamental life conditions, as follows:

1. The yolk sac furnishes food and water.
2. The amnion provides protection.
3 and 4. The serosa and allantois supply oxygen and remove waste products.
These membranes function only during the incubation period and are discarded before the chick is hatched.

Wings and legs. The wing and leg buds appear during the third day and may be seen at the side and well toward the rear of the embryo (Figs. 249, 250).

During the third and fourth days, there is rapid growth of those internal organs which have already begun to develop.

Fig. 250—The embryo at 5½ days of incubation.

Others, such as the lungs, trachea, esophagus, liver, pancreas, and cloaca, together with the rudimentary sexual organs, start their development at this time.

The development of the embryo during the fifth day and thereafter consists in the further growth of buds or organs already started. By opening two or three eggs each day one can readily observe this growth.

Sixth to tenth day. By this time the mouth opening has taken on the form of the beak, and the slightly roughened
surfaces of the body show where the feather tracts will be formed.

On the sixth day, the movements of the chick may be seen, through the shell.

Daily observations show the growth of wings, legs, toes, nails, feathers, head, and tail. The internal organs, of course, keep pace, in their growth, with the external parts.

Fig. 251—Embryo about seven days.

The weight of the embryo has caused it to sink into the yolk, making it impossible to see it distinctly. Note the size of the eye.

The fluids in the egg gradually evaporate. On the nineteenth day, the air cell is very large, approximately one-fifth to one-quarter of the egg, and the chick fills the remainder of the shell.

Just prior to hatching, the yolk is drawn into the body, and the body wall closes over it. The fetal membranes are cast off. The chick breaks the shell, at the large end, with its beak, turning in the shell as it breaks. Finally, by pushing
and pounding as it gains strength, it forces the top off and thrusts out its head and neck.

When the chick breaks through the shell and secures access to fresh air, the lungs take over the function of blood purification, which until then has been carried on by the serosa and allantois. The period of transition from the embryonic to this final stage is a critical period in the life of the chick. The rapid breathing of the chick during its effort to break through the shell calls for a larger amount of pure air than has been required in the earlier stages. This fact must be taken into consideration in the construction and operation of incubators at hatching time. In nature, this requirement of the chick is taken care of by the circulation of pure air through the feathers of the hen and by the instinct which leads the newly hatched chick to seek the pure outer air.

Usually, the chick rests for a while and pants from its efforts, until with a final kick and plunge it is free. As the heat dries the down on its body, it gains strength and in a short time is walking about, a live, downy, alert chick, following its natural instincts of picking for food.

It has started on its comparatively short, eventful life. Its future achievements are largely in the hands of the poultryman.

REFERENCES


CHAPTER XXI

BROODING THE CHICKS

Brooding is one of the poultryman's most difficult problems. It is a part of the business that must not be slighted. If the chicks are not properly brooded they may never make as successful layers as properly brooded chicks of the same breeding.

The necessity of renewing approximately one-half of the flock each year, owing to the short normal life of the domestic fowl, is one of the most important causes of failure in poultry keeping. None of the other domestic animals require one-half flock replacement each year. Each chick that dies represents an economic loss which cannot be fully overcome in the same hatching season.

The ability to rear well-developed pullets at a reasonable cost may mean the difference between profit and loss on the poultry enterprise.

Operations:
1. Choosing the brooder.
2. Selecting the place for the brooder.
3. Preparing the brooder house and heater.
4. Operating the heater.
5. Putting the heater to the test.
6. Providing protection.
7. Moving the chicks to the brooder.
8. Feeding the chicks.
9. Letting the chicks out of doors.
10. Training the chicks.
11. Brooding with the hen.

General information:
Principles of brooding.
Brooder house construction.

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1. Choosing the brooder

The quality of the stock reared should be the main consideration in any brooding system. The size of the flock and the brooder house influence the type of brooder used. If but 50 or 100 chicks are to be brooded, one of the small indoor or outdoor lamp brooders may suffice.

The lamp brooders are usually heated with oil lamps. Fresh air is warmed by coming into contact with a heated surface and is released in the hover chamber. The chicks are thus given fresh, warm air to breathe.

All of the small lamp-heated brooders holding 50 to 150 chicks require considerable attention in proportion to the number of chicks brooded, and none of them are to be recommended where 200 or more chicks are to be brooded.

A. Long-pipe brooder. This system of brooding provides conditions somewhat easier for the operator early in the season when the weather is cold or for brooding to 8 or 10 weeks of age. It is more economical of fuel. Hand-controlled radiators leading from the main pipe lines into each brooding pen and covered with a hover are popular.

While the large permanent brooding system is not practical for a small commercial laying plant, it may be justifiable and desirable where a broiler business is conducted or many thousands of chickens are to be reared.

Pullets for laying or breeding should be reared after 8 to 10 weeks under less crowded range conditions. This necessitates range houses and results in extra investment when the long-pipe brooder is used.

Modern methods are likely to result in a greater tendency toward brooding in large permanent houses and rearing in shelters when the pullets can be removed from the heat (Fig. 298). The size of the house will be governed by the job to be done.

B. Colony brooder. The colony method of brooding is cheap, easy to operate, allows superior range conditions, and involves small overhead expense. The equipment used in this
CHOOSING THE BROODER

method consists of colony houses, with coal or coal-oil stoves or electric brooders to furnish the heat (Figs. 253, 254). From 250 to 350 chicks under one hover provide excellent conditions. Larger flocks may be brooded, sometimes as many as 600 to 800 under one hover. The large number, however, requires more careful handling. The tendency is toward the smaller number where quality is a major consideration.

![Fig. 252—A large battery brooder.](image)

The chicks are transferred to colony houses at an early age. Ample room, large, warm, and well-ventilated quarters have helped chicks through this battery period for a number of years on this New York State farm.

The colony brooder is portable, thus permitting chicks to be grown on fresh ground each year.

C. Oil heaters. Oil heaters are being used in larger numbers. They are not used as extensively as coal heaters. During very warm weather they are easier to operate than coal stoves (Fig. 255).

Many modern oil heaters give excellent results. Desirable features are provision to prevent surplus oil from spreading
440 BROODING THE CHICKS

and causing fire, thermostat control of the oil feed, and a convenient method of cleaning carbon from the heater.

D. Confinement brooding and rearing. 1. The floor method. Chicks are brooded and pullets reared in colony houses on wire floors with or without an outside wire run (Fig. 264), or in laying houses 20 feet or more wide, which they will eventually occupy as layers. Overcrowding must be avoided, and ample feed and water space are essential. Escape from the intense heat of the brooder stove and of the sun must be
CHOOSING THE BROODER

provided. Chicks grown in confinement, with all the benefits of good brooding and rearing except for free pasture range, but with an ample supply of green feed, develop into desirable pullets.

While range-reared pullets are preferred, when proper range is available, many fine pullets are reared in confinement each year either because of necessity or choice.

2. Battery brooders. The use of batteries for brooding chicks is an attempt to decrease labor by reducing travel in brooding. It undertakes to economize space by confining chickens in compartments several tiers high (Fig. 252). The more completely the battery provides the essential factors of natural brooding, the more successful it is. These essential principles are: (1) access at all times to a comfortable temperature without wide extremes and with opportunity for a choice of heat; (2) abundance of feeding and watering-space in proportion to the floor area; (3) ease of cleaning and disinfecting; (4) portable parts; (5) economy of fuel; (6) convenience in handling chicks in and out of the brooder; (7) suitable control of heat, ventilation, humidity, and sunlight.

Even under the most favorable circumstances, conditions are distinctly artificial and require skillful handling in order to secure satisfactory results.

The field of usefulness of battery brooders is exceedingly limited. Their chief value is as a short-time nursery for holding chicks not more than one or two weeks at most, except for broiler purposes.

The sooner properly developed battery baby chicks destined for layers can be placed on the floor near the hover of a colony house brooder, the better it will be for the chicks. Within a day or two they should be allowed the freedom of the house; and within a week or so to go outside on a wire-floored sun-porch, or better yet, upon a clean grass sod.

The chief objection to battery brooding is the indoor sedentary life of the chicks, owing to lack of exercise because of close confinement. For the production of broilers of the
lighter weights, the best types of battery brooders serve a useful purpose, provided they are properly managed. The best-quality broiler is sunshine grown, with freedom of action, which factors are not provided in battery brooding.

A failure on the part of many types of battery brooders to provide proper choice of temperature, humidity, and sunshine accounts for much of the difficulty of rearing chicks to maturity in close confinement.

**Battery Capacity**

There is a tendency to over-rate the capacity of batteries beyond the first week or two. Crowding should be avoided since it results in

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1 From a mimeograph by L. M. Hurd and J. H. Bruckner, Cornell University, Ithaca, N. Y.
CHOOSING THE BROODER

retarded growth and poor feathering and leads to feather picking and cannibalism.

A 3 × 3 foot battery compartment will provide ample room for 100 chicks for 10 days or 2 weeks. After that double the floor space about every 2 or 3 weeks. The following table gives the average capacity recommendations at different ages.

Number of chicks for a 3 × 3 foot battery compartment:
1st to 3rd week ........... not over 75 to 100 chicks
3rd to 6th week ........... not over 35 to 50 chicks
6th to 12th week ........... not over 18 to 25 chicks
12 weeks and afterward ....... not over 15 chicks

Some operators allow a little more space for heavy breeds like Plymouth Rocks and R. I. Reds than for light weight breeds like the Leghorn.

E. Electric brooders are being more generally used. They appear less desirable for early brooding, as auxiliary heat is sometimes required for maintaining a room temperature of 45 to 50 degrees F. in the fall, winter, and early spring. They are much better adapted for later season work and they are considered superior during warm weather because the temperature beneath the hover may be completely controlled.

An essential is low-cost per kilowatt-hour. Coal appears to be cheaper for early-season brooding and electricity for warm weather, providing the current costs not over 2 to 3 cents per kilowatt-hour. The saving of labor and lessened danger from fire are advantages.

Fig. 255—Chicks two days old learning to eat from a reel feeder.

Note provision for keeping the litter dry around the fountain. Water dishes are left on the floor for 2-3 days, until the chicks become more adventurous, when all waterers are moved onto the wire-top stands. Note guard boards and tank supplying oil to the heater. Shavings were used for litter. Numerous box lids and quart jar waterers supplied food and water for two days.
More desirable conditions of humidity and ventilation are secured by placing the brooder on a platform of 1-inch boards supported on cleats 1 inch high. A central ventilation tube in the brooder is helpful.

Electric brooders differ greatly in their efficiency. They are destined to increase in popularity as they become improved and the cost of electric current is reduced.

2. Selecting the place for the brooder

During the first two or three weeks, the brooders may be drawn to within a few feet of each other, to save labor in caring for both chicks and brooders. Temporary yards 25 to 50 feet square may be used for a few weeks, if necessary, to separate chicks of different ages. Chicks will do better if the brooders are later moved farther apart. They should be spaced approximately 100 to 150 feet apart on free range.

Both shade and range are important. Bare yards should never be used, as the danger from soil contamination is great.

The cost of feed and, therefore, of rearing may be reduced by growing on specially prepared pasture which is mowed several times during the season. (See page 112.)

It never pays to overcrowd chickens on the range to the point where there is little or no green feed growing. When chickens appear to develop well on bare yards or overcrowded ranges, they do so not because of the congestion, but rather in spite of it. Inferior stock and ultimate failure are the common
results of overcrowding. At least one-quarter acre to each 125 pullets is desirable. Give more room if possible.

Use ground on which poultry has not run for at least two years, and on which no poultry manure has been spread within that time.

Excellent rearing conditions are provided by a 3 to 4 year rotation of crops in which chickens are one crop during that time. For example, where these crops can be profitably produced: First: chickens on one- or two-year sod. Second: cultivated crop, as corn, beans, or potatoes. Third: grain crop seeded to clover and alfalfa or native grasses. Fourth: chickens or hay.

Another desirable combination is a good sod pasture, bordered by shrubbery and trees, and through which a brook flows. This provides the green feed, shade, and coolness which chickens so much desire, together with an abundance of fresh water. Where serious trouble from foxes, vermin, or stealing is not experienced, this condition is nearly or quite ideal.

A grove or young orchard or a woodlot of light soil with ample sunlight sifting through is excellent. A cornfield provides ideal shade when green feed is supplied. It may be planted on part of the range. Colony houses are often arranged on green pasture along the edge of a cornfield.

An asparagus bed may be utilized as a young-chicken range, to the mutual advantage of the crop and the chickens. The chickens destroy the asparagus beetles and larvae.

After wheat and oats or other grain crops have been harvested and considerable grain has been lost, the colony houses may be placed about the field and moved from time to time. In this way the chickens will pick up and utilize to good advantage grain which might otherwise have been wasted.

After the chicks are 5 or 6 weeks old arrange for them to get out early in the morning unless local conditions make this procedure unwise. Chickens prefer to forage during early morning and late afternoon and to rest in the shade during the warm midday.
Do not place the brooder houses near piles of rubbish or stone walls or rat-infested buildings.

3. Preparing the brooder house and heater

Raise the house about a foot above the ground. Boards should be placed on all sides to prevent the chicks from running under the house during the first two or three weeks. After that, the boards may be removed. The chicks should then be old enough to find their way back into the brooder, and the raised building provides a place beneath which the chicks may run for shade and shelter.

See that the floor is tight. If there are cracks between the boards it will be advisable to cover them with a non-burning roofing paper and lay boards on the paper to hold it in place and provide extra warmth, especially beneath the hover.

Regardless of the kind of brooder house used, be sure it is thoroughly cleaned and disinfected before the chicks are placed in it. Scrape all sediment from floor and walls and sweep clean. Next scrub the floor, using a stiff broom and scalding hot water into which lye has been placed at the rate of 1 ounce ($\frac{1}{12}$ can) to 12 quarts of water. After the house is dry, disinfect well (page 34). Examine the roosting quarters and along cracks, to see if there are grayish specks denoting the presence of red mites. If found, take the precaution to eliminate them. (See page 254.)

Next, overhaul the heating apparatus, making certain that all parts are present and workable. Do this several days in
PREPARING THE BROODER HOUSE AND HEATER

advance; never leave it until the chicks are ready for the brooder. Broken parts may cause several days' delay.

Fig. 258—Four stages in brooding and rearing broilers in the Del-Mar-Va peninsula region.

A. The first job is to thoroughly clean and disinfect buildings and equipment. B. Week-old chicks in their brooding quarters. Pens 12' X 20' hold 250-300 chicks each. C. At two weeks, out on range adjacent to the building. Often all the chicks from a long house are allowed out together in a large yard or onto free range, previously seeded to corn, oats, or rape. D. Approaching the age of 13-15 weeks when they are marketed as large broilers or fryers.

Set up the brooder, taking care that all parts are properly adjusted, that the pipe extends 2 or 3 feet above the roof, and that the roof cannot leak. Cover the floor near the heater
with \( \frac{1}{2} \) or \( \frac{3}{4} \) inch of litter which is free from all mustiness. Clover or alfalfa, cut into 1-inch lengths, or clean straw or shavings may be used, scattered over the entire floor.

Hayseed or chaff is not desirable.

Ten-inch guards of boards, roofing paper, muslin, or galvanized iron or tin should be placed around the hover to keep the chicks within 15 to 18 inches of it for the first day and to prevent floor drafts. These guards should be drawn back, giving more space daily, and removed entirely about the fourth day.

Place a board or strip of roofing paper or a bank of straw in each corner of the house to make it round. If it is left square, the chicks are likely to crowd into the corners and smother, or acquire the dangerous habit of crowding in the same place each night.

Provide shallow trays for feed and several water fountains for the first two days. Small “reel” feeders may be used after two days, one 4-foot feeder for 100 chicks.

4. Operating the heater

For both oil and coal heaters regular attention is necessary night and morning. Check the oil supply and flame condition in the oil heater at least twice daily and the carbon accumulation each 2 or 3 days. The electric brooder may need the least attention. Shake the coal stove at night and in the morning until live coals are seen at the grate. Then fill to the top with coal. Either pea or chestnut coal may be used, the latter being preferred. Remove ashes twice daily in cold weather. In certain models, the hover is arranged to be lifted. It is not necessary or desirable to raise the hover during the first two or three weeks, unless the temperature under it should become too high. In this event it will be necessary to adjust the regulator, since lifting the hover and cooling the heater would turn on the draft and cause the fire to burn faster.

During very warm weather, it is desirable to raise the hover
during the day in order to keep the fire from going out. This lets the heat escape and causes the regulator to allow sufficient draft to keep the fire burning.

When first starting the stove, watch the thermostat, and, by means of the thermometer, regulate it so that the dampers will operate at approximately the correct temperature. Avoid too high a temperature since this may destroy the thermostat, especially if it is of the wafer type. Once it is operating correctly, it may be regulated to suit the chicks by slightly turning the adjustment nut.

5. Putting the heater to the test

With everything ready, start the brooder and run it for one or two days before the chicks are put in the house. This precaution may avoid injury to valuable chicks.

![Colony houses placed 100 feet apart on grass, with a strip of oats 30 feet wide on the left of the buildings. Shade and abundant range are available. The forage would have been improved by mowing occasionally to a height of 3 to 4 inches.](fig259)

The temperature at which to run the stove will vary with the season and the brooder. The chicks should be comfortable.
If too warm or too cold, they will not develop properly. In general, the temperature at the outer edge of the hover and about 2 inches above the floor should be approximately 100 degrees F. As the chicks grow, this temperature may be decreased until artificial heat is entirely discarded.

The best thermometer is a healthy chick. The successful brooderman pays little attention to the registered temperature but is guided by the actions of the chicks. When comfortable, the chicks, early in the evening, are spread out around the edge of the hover, some alone and others together in little groups. Their heads are often lying on the litter and their wings spread out. This attitude in sleep denotes, "chick comfort." If the chicks are huddled together or are all under the hover, more heat is desirable. It is well to use a thermometer when first testing the brooder, in order to be somewhere near correct; after this it is not needed.

6. Providing protection

The life of young chickens is beset with many dangers. Time and money will be saved if the poultryman anticipates the chick hazards and takes proper precautions to prevent them. These hazards are many and difficult to overcome completely. An experienced poultryman will have no difficulty in recalling at least a score of preventable ways in which he has lost chickens.

Among the dangers to be overcome are losses from the depredations of dogs, cats, rats, weasels, skunks, foxes, crows, hawks, owls; losses due to chicks falling in holes, barrels, and pails, getting caught in wire, chilled in the rain, overheated in the sun, destroyed by fire, stepped on by farm animals, poisoned by drinking sour milk from galvanized dishes, by eating poison intended for their enemies, or by having access to old paint cans, and stealing of chicks by chicken thieves.

The brooding season, therefore, should be preceded by a clean-up campaign to destroy natural enemies and to prevent accidental losses.
7. Moving the chicks to the brooder

If the chicks are all hatched on the twenty-first day, they may be transferred the evening of the twenty-second day. The majority are then thirty-six hours old. Use long, shallow boxes, or baskets, and cover with a flannel cloth or burlap when moving the chicks. Use care, as very little cold is needed to chill the chicks; although the effects of cold are not noticeable then, they may later cause diarrhea and death. On the other hand, do not smother the chicks by piling boxes of chicks one on top of the other. They are delicate and must be handled with judgment.

Watch to see if they settle down to sleep around the rim of the hover, and make sure they are comfortable before leaving for the night.

8. Feeding the chicks

The first feed should be given the chicks when they are not more than 36 to 48 hours old.
A MODIFIED CORNELL CHICK RATION AND METHOD OF FEEDING

THE CHICK RATION

Mash mixture (36-48 hours to maturity).—
40 lb. yellow cornmeal
10 lb. wheat bran
20 lb. flour wheat middlings
10 lb. fine ground heavy oats
10 lb. meat scrap, 55 per cent protein
25 lb. dried milk products
2 lb. pulverized limestone or oyster shell
\( \frac{1}{4} \) lb. salt
\( \frac{1}{4} \) to 1 lb. cod liver oil.

Grain mixture (6-8 weeks to maturity).—
50 lb. cracked yellow corn
50 lb. wheat

Possible changes in the ration. The dried milk may be omitted from the mash when it is desired to use liquid or condensed milk products.

THE METHOD OF FEEDING

Mash feeding. Allow the chicks constant access to the mash in hoppers until they reach maturity. Provide 4 ft. of feeding space to 100 chicks.

Grain feeding. At 4 to 6 weeks begin feeding the grain mixture in hoppers. Keep it constantly before the chicks, the same as the mash mixture. However, they should not eat as much scratch grain by weight as mash until three months old. Occasionally it may be necessary to restrict the grain in order to get proper mash consumption.

Grit and oyster shells. Fine grit may be given from the start. Hard grits are most satisfactory. Provide oyster shells after the chicks are four months of age or when they begin to show evidence of reaching maturity.

Manganese is necessary to prevent perosis (slipped tendons). Under ordinary conditions the ration above will furnish enough of this mineral. However, if perosis develops, \( \frac{1}{4} \) pound of manganese sulfate or manganese carbonate is added to 1 ton of the mash.

Cod-liver oil. When sunshine enters the house through glass mix \( \frac{1}{4} \) pound or \( \frac{1}{2} \) pint of cod-liver oil into every 100 pounds of mash during

the period when mash only is fed. Afterwards feed enough cod-liver oil to equal $\frac{1}{2}$ pound per 100 pounds of total feed consumed.

**Further feeding factors.** A. *Feed only high-grade wholesome feeds.* It is false economy to feed anything but the most wholesome feeds to growing stock. Therefore know what you buy.

B. *Keep the litter clean and dry.* Stir the litter with a rake each 2 to 3 days. When the litter gets damp or lumpy

![Image](image_url)

**Courtesy Dr. L. C. Norris, Cornell University.**

**Fig. 261**—A growing bird suffering from perosis or slipped tendon disease.

$\frac{1}{4}$ lb, manganese sulfate thoroughly mixed in one ton of mash greatly reduces the number of chicks in a flock having this trouble.

renew it. Dampness and filth may lead to serious trouble. Place the water dishes on wire top stands.

C. *Keep the water fresh and clean* by emptying the dishes daily and scrubbing at least weekly.

D. *If skim milk or buttermilk is given,* feed in earthen fountains. Do not feed it in galvanized dishes as this may cause poisoning.

E. An excellent method of supplying both green feed and exercise, as well as furnishing instruction to the onlooker,
### Suggested Changes in the Chick-Mash-Mixture

Fish meal, soybean oilmeal, or corn gluten meal, singly or in combination, can replace part of the meat protein.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Modified chick mash mixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. 1</td>
</tr>
<tr>
<td></td>
<td>Pounds</td>
</tr>
<tr>
<td>Yellow cornmeal</td>
<td>750</td>
</tr>
<tr>
<td>Flour wheat middlings</td>
<td>400</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>200</td>
</tr>
<tr>
<td>Ground heavy oats</td>
<td>200</td>
</tr>
<tr>
<td>Alfalfa meal, low fiber</td>
<td>100</td>
</tr>
<tr>
<td>Dried skim milk or dried buttermilk</td>
<td>100</td>
</tr>
<tr>
<td>Dried whey (milk-sugar feed)</td>
<td></td>
</tr>
<tr>
<td>Meat scrap (55 per cent protein)</td>
<td>200</td>
</tr>
<tr>
<td>Fish meal</td>
<td>100</td>
</tr>
<tr>
<td>Soybean oilmeal</td>
<td></td>
</tr>
<tr>
<td>Corn gluten meal*</td>
<td></td>
</tr>
<tr>
<td>Limestone or oyster-shell flour</td>
<td>40</td>
</tr>
<tr>
<td>Salt</td>
<td>10</td>
</tr>
<tr>
<td>Fish oil when confined</td>
<td></td>
</tr>
</tbody>
</table>

*Because of the use of corn gluten meal in mash mixtures, Nos. 6, 7, and 9, it is necessary to limit the quantity of corn fed in order to maintain superior protein quality.
is to throw in strips of onion, lettuce, cabbage, beets, dandelions, or similar green feed relished by the chicks. Throw in a little at a time. The chicks will chase each other about in their attempt to secure the material. This is nature’s way.

F. Cod-liver oil, milk, and green feed are rich in vitamins which, with their other properties, make them exceedingly important in the chick ration. They are all important factors, and either they or their equivalents cannot be omitted if best results are to be secured.

G. Infertile eggs if thoroughly boiled can be used to advantage. Mix in the moist mash at the rate of 1 egg a day to 40 or 50 chicks.

9. Letting the chicks out of doors

Give the chicks more space inside the house each day by moving the guards, until at four or five days they have the run of the whole house. By the time they are a week to 10 days old, the chicks should run outside.

A frame of muslin or other tight material may be used in cold weather to make a small sheltered pen outside. A mound of earth at the entrance will let the chicks in and out from any side, and is better than a run board (Fig. 262). But look out for rats.

Enlarge the outside yard occasionally as the chicks grow. Then, before the yard is taken away, place boards between the runners to prevent the chicks from getting under the house, open up one side and let the chicks run at large. Leaving the enclosure up for a few days is helpful in getting the chicks back into the house.
If *clean ground* is not available, let chicks out on platforms of $\frac{1}{4}$-inch mesh wire suspended 1 foot above the ground. The ground under the platforms should be covered with concrete or boards.

10. Training the chicks

Chicks sometimes have a tendency to huddle together, even if there is sufficient heat. For this reason, a trip to the brooder should be made each night to make sure that the brooder is heating properly and the chicks are comfortable. If they are huddling, use a broom or your hands and spread them out. The warmth of the brooder should take the place of the warmth they obtain by contact with each other's bodies.

A 10-watt light burning all night reduces the danger of crowding.

Early roosting should be encouraged. In about two weeks, place perches a few inches above the floor. Chicks should be using these perches when four weeks old. At six weeks of age, move the perches 2 feet above the floor.

If the weather is mild, the windows should be adjusted to permit free circulation of air. This will tend to harden the chicks. At eight or ten weeks of age, the heat usually may be discontinued. Leave the stove in the house, however, for a few days, to be used in the event of a cold snap or cold wet weather.

11. Brooding with the hen

Natural brooding offers a relief from many of the trials of artificial brooding and may be used where only a few chicks are reared. If a large number are brooded, the cost of equipment and labor is considerable and the artificial method is to be preferred.

A. Select the hen for brooding. Where several hens are set at the same time, the chicks should be given to those hens which appear to be the best sitters, and the other hens broken
up or reset. Usually, the American varieties, Rocks, Reds, or Wyandottes, are the best mothers. The Mediterranean varieties are not dependable, and the Asiatics are too clumsy.

B. Number of chicks per hen. In very early spring, 12 to 15 chicks to each hen are sufficient. Later, 18 to 25 chicks may be given. The number will depend somewhat on the size of the hen and chicks.

Hens will not always accept chicks which they themselves have not hatched, particularly if they are of a different color. It is well, therefore, to place any extra chicks under the hen at night, if they are not of the same appearance; otherwise they may be given to her when hen and chicks are transferred to the coop.

C. Select a brood coop. The brood coop should be roomy and well ventilated. It may be built on skids or set on blocks of wood, stones, or bricks, to avoid the danger of having a damp floor. Build the coop 2½ or 3 feet square and about as high. The front may be wired or slatted, but should never be solid or of glass. A hood may be built on the front to protect it from sun or rain, but an opening should be provided above the hood and at the rear, near the roof, for ventilation.

D. Range and shade for comfort and safety. It is usually better to keep the hen confined during the forenoon, until the chicks are several weeks old. This prevents their being led through wet grass and insures plenty of feed. The chicks are better suited when given free range.
BROODING THE CHICKS

If necessary to confine them, the yard may be made of high boards at first and later of slats or wire. Shade should be provided.

E. Destroy the lice, mites, and disease germs in advance. Treat the hen with sodium fluoride before the chicks are given to her. (Pages 254-255.) Watch for lice, and repeat the treatment when needed. Spray the coop with a coal-tar disinfectant before using it, or paint with carbolineum. (See page 255.) Repeat in one month, to be sure that the red mites do not gain a foothold.

GENERAL INFORMATION

1. Principles of brooding

   It is desirable, though not always possible, to observe all the following rules in brooding.

   A. Maintain a proper temperature. The brooder should provide heat from the top, and be sufficiently warm to prevent the chicks from crowding. For the first few days, the chick's lungs are protected from the outside air only by the down and thin skin on its back. It is there that the cold is most quickly felt. If the brooder temperature is too low, the chicks push in under the others because a chick is warmer than the outside temperature.

   The more pushing and crowding there is, the warmer the pile becomes and the more the chicks continue to crowd. As a result, smothering occurs, or the chicks remain standing and pushing, lose sleep, and develop poorly.

   B. Provide pure air without drafts. The chick is a quick-growing, quick-breathing animal, requiring rapid digestive and assimilative changes, and therefore suffers seriously and quickly when closely confined and compelled to breathe impure air. Pure air is the cheapest and certainly one of the best means of producing vigorous stock. A constant change of air, without dangerous drafts, within the brooder compartment is necessary.
C. Give the chicks a wide choice of temperatures. After the first few days continuous high temperature saps the vitality. Fear of chilling the chicks often results in keeping the room and the chicks dangerously warm. Cool, fresh air is invigorating and healthful and the chicks enjoy it, if they can quickly get back to the heat. Because of this fact, the ideal brooder house or room should be large enough to allow the chicks to find a temperature several degrees cooler than that under the hover. The biggest bump in a chicken's head is the "bump of location."

D. Remember that exercise is the elixir of health. A chick cannot develop normally under close confinement. The muscles and digestive organs need exercising. A range of temperatures and roomy quarters are incentives to exercise. These are provided in the colony system of brooding, when the floor is kept well covered with litter and the chicks are required to work for their living. No heat is more invigorating to the chicks than the animal heat created by active exercise in cool, pure air.
E. Hit the chicks with sunbeams. Sunlight is a splendid disinfectant, adds warmth, and makes the house cheerful. It is indispensable. Too much heat and sunshine together may be injurious, however. Guard against this by ventilation and shade during very hot days.

During the first few days in early spring, it is necessary to let the sunlight shine through the glass windows. After that, the chicks are able to stand a cooler temperature and on fine days it is well to open the windows, so that part of the sunshine and its ultra-violet rays will enter the house through the open space. This combination of fresh air and direct sunlight has an almost magical influence on the growth and health of chicks, which cannot be secured in any other way.

Fig. 265.
A ring bolted to each runner of the colony house is convenient for hauling the building.

F. Allow ample room for attendant. A system of brooding which provides space enough for the attendant to enter the brooder house to do the work is a great advantage particularly during bad weather.

G. Guard against fire. There is always a certain element of danger from fire wherever any heating device is used. With the coal-stove brooders the danger is very slight. The base holds the ash pan and should be deep, bringing the stove proper several inches above the floor. Litter may be put around the stove and seldom catches fire. Empty the ash pan daily and keep the ash pit clean.

2. Brooder-house construction

A brooder house should be well proportioned, of convenient size and weight, and of solid construction, to permit moving about the farm with an ordinary farm team or with a tractor.
For convenience in doing the work when several houses are placed on the range, it may be desirable to have the door placed in the left end on some of the houses. The door should be placed on the end of the house opposite the direction of prevailing winds, to prevent the wind from blowing on the chicks.

1 From Department of Agricultural Engineering, Cornell University, Ithaca, N. Y.
Fig. 267—Cornell Colony Brooder House.
For convenience in hitching on to the house when moving it, some large clevises should be made with \( \frac{1}{2} \)-inch bolts, which can be slipped through the holes at the ends of the runners. Several strands of No. 12 galvanized wire, or even hay-baling wire, serve the purpose.

To prevent the runners from decaying rapidly and from freezing to the ground in cold weather, block them up an inch or two with some short pieces of plank, with flat stones, or cinder blocks. The house should be level when in use.

It will be an economical investment to paint the runners with a good wood preservative. Write your state college for plans of brooders recommended in your state.
Fig. 269—Cornell Colony Brooder House. Window and exit door detail.
Bill of Material for 10' x 12' Colony Brooder House

2 4" x 6"—12'
4 2" x 4"—14'
25 2" x 4"—12'
13 2" x 4"—10'
1 2" x 2"—2'
4 pcs. 1" x 6"—12'
3 pcs. 1" x 6"—10'
172 lineal ft. 1" x 4" pine or similar material
12 lineal ft. 1" x 3" pine
14 lineal ft. 1" x 2" pine
44 lineal ft. 3" x 3"
500 bd. ft. 13/8" x 31/2" edge grain fir flooring—select grade
or
1" x 4"
182 bd. ft. 1" x 6" matched roofers

Hardware

4 6 it. 8" x 10"—11/2" glazed sash
11/2 rolls 3 ply roofing.
8 turn buttons
6 pr. 4" strap hinges
2 set hasp and staples
1 set door latch and fastener
5# 16D common nails
7# 10D common nails
5# 8D common nails
10# 6D flooring nails
1# 3D roofing nails
Approximately 1 gallon—white lead and oil paint

Community Survey

1. What percentage of the farmers in your community brood chicks by
the colony system? By the long-pipe brooder?
2. Are the houses easily moved? What preparations are made before
moving the houses?
3. What percentage use coal stoves? Oil stoves? Electric brooders?
4. How many brood 300 or less under one stove?
5. How many brood more than 300 under one stove?
6. What range conditions are provided for the young stock by the best
poultrymen of the community?
7. How do the poultrymen tell whether the temperature of the brooder is correct?
8. Outline the ration and feeding practice for chicks used by a successful local poultry keeper.
9. Is he using cod-liver oil, milk, green feed, and unfiltered sunlight (not through glass)?
10. At what age are chicks allowed to go outdoors?
11. Do the time of year and outside temperature influence this? How?

REFERENCES

KENNARD, D. C., CHAMBERLAIN, V. D., RECORD, P. R., “High Points in Chick Rearing,” Ohio Agricultural Experiment Station Bulletin 172, 1935.
CHAPTER XXII

PREVENTING AND TREATING CHICK DISEASES, PARASITES, AND VICES

Little chicks, like little children, are subject to diseases and other troubles peculiar to their age. Because of the rapidity with which chicks grow, their serious troubles are concentrated over a few weeks, instead of several years as with children. Happy is he who handles chicks in such a way that these troubles are avoided, or who, after the flock is attacked, knows how to diagnose the symptoms and where to go immediately to find and correct the cause of the disorder. It is always best to go immediately to the cause of trouble and remedy it, at the same time giving treatment. The best way, of course, is to so handle the flock that troubles do not occur.

A chick, because it is a small thing, is subject to many disadvantages in life, and for the first several weeks its life is in constant danger. The troubles that arise may be due to defects in the breeding stock, to errors in the management of it, or to faulty incubation or brooding. Careful attention should be given each season to these possible sources of danger.

"An ounce of prevention is worth a pound of cure." After the chicks are hatched, many of the ordinary troubles may be prevented if care is given to the points mentioned in Chapters XXI and XXV.

GENERAL INFORMATION

Diagnosing and treating chick troubles

When we call a doctor and he comes into the patient's room, the first thing he does is to find out what is wrong. He determines this by means of certain symptoms which indicate to
# Recognition of the More Important Chick Diseases in the Field

<table>
<thead>
<tr>
<th>Usual age in weeks</th>
<th>External symptoms</th>
<th>Internal symptoms</th>
<th>Disease Suspected</th>
<th>Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–3</td>
<td>Sudden deaths following exposure; huddling.</td>
<td>Congestion of lung and other organs, enlarged gall, leg bones soft, no food in intestinal tract, kidneys normal in size but pale, liver yellowish.</td>
<td>Chilling or over-heating (exposure).</td>
<td>(1)</td>
</tr>
<tr>
<td>1 or less</td>
<td>Swelling in navel region; stunted; sudden death.</td>
<td>Tissue in navel region bloody or water-logged; adherent large egg-yolk; enlarged yellow liver.</td>
<td>Navel ill (mushy chick disease).</td>
<td>(2)</td>
</tr>
<tr>
<td>0–3</td>
<td>Wet and dirty around eyes. Whitish diarrhea; pasting-up; droopiness; gasping.</td>
<td>Large streaked liver; large cheese-like egg yolk; nodules on heart or in lung; air sacs normal; cheese-like material in blind guts; kidneys swollen.</td>
<td>Sore eyes.</td>
<td>(3)</td>
</tr>
<tr>
<td>1–3</td>
<td>Yellowish diarrhea; pasting-up; droopiness.</td>
<td>Large egg yolk containing dirty-yellow fluid, enlarged gall.</td>
<td>Fullorum disease (Bacillary White Diarrhea).</td>
<td>(4)</td>
</tr>
<tr>
<td>1–4</td>
<td>Dumpish, sudden deaths.</td>
<td>Swollen pale kidneys, whitish material on heart sac.</td>
<td>Common diarrhea.</td>
<td>(5)</td>
</tr>
<tr>
<td>2–7</td>
<td>Large crops, droopiness, poor growth.</td>
<td>Thick whitish to grayish false membranes in crop; ulcerated gizzard.</td>
<td>Infectious bronchitis, page 243.</td>
<td></td>
</tr>
<tr>
<td>2–8</td>
<td>Eyes shut. Gasping.</td>
<td></td>
<td>Sour crop (fungous infection), page 249.</td>
<td>(6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Gape worms.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bloody diarrhea.</td>
<td>Blind guts filled with blood or cheesy material, carcass anemic.</td>
<td>Bloody (cecal) coccidiosis.</td>
<td></td>
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<td>-----------------------------------------------------------------</td>
<td>-----------------------------</td>
<td></td>
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<tr>
<td>4</td>
<td>Diarrhea, droopiness, poor growth.</td>
<td>Reddish to whitish dots or streaks on the outside of intestine; swollen mucous membrane of intestine tinged with blood.</td>
<td>Intestinal coccidiosis, page 240.</td>
<td></td>
</tr>
<tr>
<td>4—10</td>
<td>Lameness in both legs.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>6—10</td>
<td>Poor growth.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6—10</td>
<td>Lameness usually in one leg, droopy wing, paralysis of crop, blindness.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6—</td>
<td>Greenish diarrhea, poor growth.</td>
<td>Large cheese-like material in blind guts, cartwheel-like yellowish round areas in liver.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any time</td>
<td>Bloody toes, tail or abdomen. Blisters about head, comb, and wattles, later turning black and resembling warts.</td>
<td></td>
<td>Blackhead.</td>
<td></td>
</tr>
<tr>
<td>Any time</td>
<td>Head retractions. Somersaults.</td>
<td>Good flesh; body organs normal; small brain enlarged, watery, showing hemorrhages. Rose chafer poisoning.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>Sudden deaths after ranging.</td>
<td>Rose chafer in crop.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Taken largely from Bulletin 202, Storrs Agricultural Experiment Station, by permission of Dr. Erwin Jungherr.
him the nature of the trouble. The poultryman is in exactly the same position with respect to the health and condition of his flocks. In his daily work with them he must be constantly on the watch for signs or symptoms of trouble. The preceding chart of the common symptoms of chick ailments will aid the poultryman in keeping on the lookout for troubles and in diagnosing diseases when certain symptoms are observed.

Diseases and troubles to which chicks are susceptible are discussed in this chapter and in Chapters XI and XII. The pages and disease numbers are given for quick reference.

1. Mushy chick disease (navel ill or omphalitis)

Losses from this disease are generally small. Infection of the navel may occur at time of hatching. No treatment is known. Prevention is recommended by the formalin evaporation method, page 405, and by thoroughly cleaning and disinfecting the incubators between hatches.

2. Sore eyes

Frequently a flock of chicks will develop sore eyes. The eyes water freely, dust clings to them, and hence the eyes have a dirty, pasted appearance.

The trouble results from material getting into the eyes and irritating them.

Using fine chaff or barn floor sweepings for litter is a frequent cause of the trouble. Certain seeds have prongs which are sharp and rough. Because of this, hay chaff is not a desirable litter.

When litter becomes dirty, dusty, or damp, it should be renewed.

3. Pullorum disease or bacillary white diarrhea

This is very troublesome in many sections, but is seldom found in others. When a flock of chicks is once infected, the disease proves to be very destructive. Most of the mortality occurs during the first week, although losses may continue for three or four weeks or longer, in fact throughout life.
Symptoms: The symptoms are the same as those listed under ordinary diarrhea, except that there is sometimes more of a tendency for the chick to utter a peculiar chirp or twitter when attempting to void the excreta. This is apparently a cry of pain. The chick breathes hard. The presence of the unab­sorbed yolk and the fact that the chick does not grow properly cause the body to assume a short, round, blunt appearance which, with the drooping wings and sleepy attitude, enables one quickly to detect the presence of the disease (Fig. 270).

![Fig. 270—Chicks infected with pullorum disease.](image)

Cause: Pullorum disease is caused by the organism called *Salmonella pullorum*. The chicks that start the trouble are infected with the organism when hatched. This occurs as follows: When a chick that is infected with the organism survives and develops into a layer, the organism may, and usually does, localize in the ovary, which is the principal seat of the trouble. When an egg is laid by one of these “disease carriers,” the organism is in the yolk. Hence the chick when hatched has the disease germs in its body and on its down, as *Salmonella pullorum* is present in the liquid surrounding the embryo in the egg. The diseased chick quickly spreads the infection to the other chicks in the incubator through the droppings, and through their breathing the germ-laden air, especially during the first four days (Fig. 271).

Remedy: The only sure way to prevent the disease is by using eggs from stock that is not infected. If no trouble has
been experienced, it can come only through the introduction of new stock, chicks, or eggs.

A means of testing hens has been found by which those infected with pullorum disease can be detected. The "slow tube agglutination test" is a blood test of each individual; it is made in a laboratory. Blood is drawn, serum is separated, antigen is added, and the results are read. Several days are required to make the test.¹

Experiments prove that the test is reliable, but that it may be necessary to test two or three times, in order to locate definitely all birds having the disease. One test will tell whether the flock is infected; if it is found to be so, other arrangements may be made accordingly.² Breeders should be tested if chicks from the flock have died from a disease diagnosed as pullorum disease. It would be unwise to hatch eggs from breeding stock known to be infected.³

¹A description of the test will be found in the Report of the New York State Veterinary College, Cornell University, 1925-1926, pages 131-144.

²Follow directions issued by the laboratory of poultry diseases in your state.

³Several methods of testing have been tried. The whole blood rapid test is nearly as accurate as the slow tube test, and is in wide use because of its rapidity and reduced handling of birds. Results are read.

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Fig. 271—Diagram showing how pullorum disease perpetuates itself in the breeding stock.

*From Univ. of Conn.*
Although the appearance of the infected chick is a good indication of the presence of the disease, the only sure way of determining whether chicks have pullorum disease is through a bacteriological examination.

There is no known cure for the chicks that have the disease. All the sick chicks should be removed immediately and destroyed, and the house and quarters thoroughly cleaned and disinfected. As new cases develop, remove them and clean and disinfect daily until the trouble seems to have disappeared. Pullorum organisms are comparatively easy to kill by disinfection.

After each hatch, fumigate the machine or room. (See page 407.) For each 100 cubic feet of space, place 35 cubic centimeters of formalin in a large earthenware dish. Add 17.5 grams potassium permanganate. Close the room or machine tight for 30 minutes. If the entire room is to be fumigated, open the machine doors. Keep the incubator at hatching temperature while fumigating. The air should be highly saturated with moisture. Air the machine or room well before entering.

4. Ordinary diarrhea

Symptoms: The first symptom noticed in trouble of this kind is a listless attitude; the wings droop, and the chick appears sleepy. The feathers around the vent become pasted up with a whitish or yellowish material, which may accumulate into a large amount. Usually there is a considerable mortality, several chicks dying at night, under the hovers. The chicks lose their appetite and fail to grow; in fact, they appear to become smaller.

This disease is often confused with pullorum disease.

Cause: The trouble is due principally to overheating, chilling, or other mismanagement which lowers the resistance and permits certain bacteria to gain a foothold.

before the bird is released. The rapid serum test consists in applying antigen to the serum and reading soon afterward. It is nearly as accurate as other methods.
Remedy: Correct the conditions. Provide clean brooding. Flush the chicks by adding 1 or 2 level teaspoonfuls of Epsom Salts to a gallon of water or by adding 20 per cent dried skim-milk to the mash. Give one or the other for 1 day.

Get chicks outdoors on sod, or place sods in the houses. Supply green feed; it is nature's best corrective for digestive troubles.

5. Gout

This disease is thought to be due to insufficient vitamin A or to an excess of protein. (See page 128.)

6. Gape worms

Symptoms: The neck is stretched out and the chick gasps for breath. It may shake its head and cough. Often it will stand or sit for hours, with its eyes shut, gasping at regular intervals.

Cause: The trouble is caused by a worm which fastens itself to the inside of the windpipe, or tracheal tube. It causes inflammation of the tube and death by suffocation.

The worm is in two parts, the male and female being joined together. The size when full grown is 1/16 to 1/4 inch.

The infected chicks cough up worms, which later disintegrate, releasing the eggs on the soil. These eggs may later be picked up from the ground by other chicks. It has been found that mature turkeys play an important part in the spread of this worm.1

Remedy: Raise chicks on other ground for one or two years and keep mature stock from the rearing range. Cultivate and lime the soil and sow a crop.

Individual treatment: The worms may be removed by holding the chick's legs between the knees, stretching the neck upward, and holding the beak open with one hand, while with the other a twisted horsehair, having a loop at the lower end,

1 Ransom, "The Turkey an Important Factor in the Spread of Gape Worms," Bulletin 939, U.S.D.A.
is pushed down inside the windpipe. Twist slowly as it is pushed in, and when in the full length draw out slowly, twisting at the same time. The worms may be attached to the hair and the chick relieved. Instead of the horsehair, a quill feather or stripped timothy head is sometimes used.

A piece of red-top grass is excellent for the purpose. Remove all side projections except the last four or five near the tip. Shorten these to about \( \frac{1}{4} \) to \( \frac{1}{2} \) inch in length, and use as described above.

Chemicals inhaled by chicks have not been found effective in removing gape worms, except in a laboratory test where barium antimonyl tartrate was used. This was 98 per cent effective.\(^1\)

7. Acute coccidiosis \(^2\)

The acute form is a common disease. Two important sources of coccidiosis are the soil and old birds which harbor the disease without showing any external symptoms. The adult carriers release the organisms through the feces, contaminating the soil and surroundings. The organism may live outside the body for several months. Under moist, warm conditions they go through a necessary period of development (24 to 48 hours), after which they can infect chicks if picked up.


\(^2\) Chronic coccidiosis is discussed on page 240.
Symptoms: In mild cases, the chicks appear listless and droopy, the feathers rough and shanks and beak pale. The chicks die, according to the severity of the disease, from one to several each day. In bad cases the chicks may appear normal in the morning and be dead in twelve to twenty-four hours. The droppings are frequently bloody. Bloody droppings may not be positive evidence but are very indicative of the presence of coccidiosis.

Post-mortem examination usually shows enlarged caeca. The color of the contents varies from a bloody brown to a light yellow, and the consistency from a pasty to a cheesy mass. The only definite way of determining whether or not the disease is present is by a microscopic examination of a minute quantity of the caecal contents (Fig. 274.). There is seldom any difficulty in diagnosing the disease by the appearance of the chicks considered in relation to their age.

Cause: Acute coccidiosis is caused by a microscopic organism which works in the intestines, destroying the mucous membrane of the caeca. The infection must enter the body through the mouth, large quantities of the parasites (several thousand) being necessary to produce trouble. Coccidiosis, once started, spreads rapidly.

Remedy: As soon as the disease is noticed, mix regular mash and dry skimmilk, at the rate of 6 pounds to 4 pounds, respectively. Feed 2 to 3 days. Give plenty of water but no scratch feed during the treatment. This physics the bird, provides available nutrients to the chick, and is detrimental to coccidia. Then clean the houses well.
Prevent damp places in the brooder. Place the water dishes on wire-covered stands. Outdoor wire sunporches relieve congestion. Feed and water chicks on these porches to prevent contact with their own droppings. Wire-screened floors in the brooder houses may help. Select range carefully (page 444).

8. Blackhead

Losses among chicks is not great. The organism is carried by old birds and given off in the feces either by themselves or in the eggs of caecal worms.

Treatment, if necessary, is the same as for acute coccidiosis.

9. Intestinal worms

(See pages 256 and 259.)

10. Lice

(See page 252.)

11. Mites

(See page 254.)

12. Rose chafer poisoning

In localities where this trouble has occurred it may be necessary to confine the chicks to the brooder houses during the one or two weeks chaferes are prevalent.
COMMUNITY SURVEY

1. What causes the greatest chick loss in your locality?
2. At what age does the greatest chick mortality occur?
3. List the diseases that are prevalent.
4. List the mechanical ways in which local poultrymen have lost chicks.
5. What means have been taken to prevent these mechanical losses?
6. Ask the local veterinarian if he has had occasion to use the agglutination test, and how he does it?
7. What per cent of the chicks are missing or die during the rearing season?

REFERENCES

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"Bacillary White Diarrhea of Young Chicks," Bulletins 60, 68, 74, and 77, Connecticut State University, Storrs, Conn.
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CHAPTER XXIII

CAPONIZING

When the chicks are approaching the age of four to six weeks, one must decide upon the best way of disposing of the cockerels. There are four principal ways:

1. Retaining the most promising for breeding purposes on the plant or for sale as breeders.
2. Selling as broilers, alive or dressed.
3. Selling later as fryers or roasters.
4. Caponizing, keeping for several months, and selling as capons.

A capon is a male bird with the reproductive organs removed. It bears the same relation to a cockerel as a steer does to a bull, a wether to a ram, or a gelding to a stallion.

There are two main reasons for caponizing. It may be done for financial gain, as the capon brings a higher price per pound and is a heavier, better-quality bird. It also enables the poultryman to hold birds for table use for a considerable period, with less trouble and expense than if they were not caponized.

Operations:

1. Selecting cockerels.
2. Preparing the cockerels for the operation.
3. Preparing the caponizing board.
5. Choosing a place for operating.
6. Performing the operation.
7. Caring for the birds after the operation.
8. Preparing capons for market.
9. Marketing capons.
General information:
- Caponizing instruments.
- Characteristics of a capon.
- Breeds for caponizing.
- What is a successful operation?
- Possibilities in capon production.

1. Selecting cockerels
Select only strong, vigorous, healthy birds for caponizing. Good results cannot be expected from inferior stock. Birds that have been bred for large size and high-quality meat production are best.

Age and size. Plymouth Rocks, Wyandottes, Rhode Island Reds, Orpingtons, and similar breeds are likely to be in condition for caponizing at the age of 5 to 6 weeks, when the cockerels weigh about 3/4 to 1 pound (Fig. 275A). With the Brahmas, Langshans, Jersey Giants, and other heavy breeds, the proper age will be about 6 to 7 weeks, and the weight under 2 pounds. Leghorns mature rapidly sexually and must be operated on sooner, or when weighing about 3/4 pound.

For best results, the testicles should not be much larger than a large kernel of wheat, in the case of any breed, when the operation is performed.

2. Preparing the cockerels for the operation
Keep the cockerels in a well-ventilated coop or pen. Discontinue the food approximately 14 to 18 hours before the operation, but water may be given. If a bird has not been properly starved, the intestines will keep pushing out into the opening, and the operator will experience considerable difficulty and probably will fail to locate the testicles. Starving also results in less bleeding.

3. Preparing the caponizing board
There are many types of caponizing boards and tables. Some are on a pivot, so arranged that the surface may be tipped at any angle. A board which is serviceable, and at the same time easily and quickly constructed, is made as follows (Fig. 275B):
Fasten two boards of \( \frac{3}{8} \)- or \( \frac{1}{2} \)-inch material together with cleats on the under side, making a surface 1 by 1\( \frac{1}{2} \) feet. Along the upper 1\( \frac{1}{2} \)-foot edge, on the under side, nail a 2-inch strip edgewise. This allows the board to slant when placed on a box or barrel.

Nail a 2\( \frac{1}{2} \)-inch "ship cleat" on the lower left-hand corner of the upper surface. The center of the cleat should be about 5 inches from the left side and it should be nailed on the lower edge. Three and one-half inches from the lower edge and the same distance from the left edge, cut an opening through the board, parallel to the bottom and large enough to permit a \( \frac{1}{4} \)-inch strap to slide easily. One and one-fourth inches above this cut, tack the end of the strap and allow the loose end to go through the opening in the board.
Lay a bird, of the average size of those to be caponized, on its left side on the board the legs to the left and the hock joint near the lower left-hand strap.

Stretch the bird diagonally toward the upper right-hand corner. Take a strap 1½ feet long, with sliding buckle, and nail the buckle end to the board about 2 inches to the right of the junction of wings and body.

The board is now ready for use.

4. Arranging materials

The surface of the caponizing board, or of the box or barrel on which the bird is to lie, should be about waist high and sloping down toward the operator. A box or other surface should be at the right and about the same height, to hold the instruments. Some operators prefer to place them just under the caponizing table. The location of the instruments is largely a matter of personal choice, and the operator will quickly find where they are most convenient.

Arrange the instruments in the order of their use, as follows: (1) knife; (2) spreader; (3) hook; (4) remover (Fig. 275B).

A small dish of water will be found convenient for moistening the feathers where the cut is to be made.

Place a dish of disinfecting solution, such as 5 per cent solution of carbolic acid and water, near by, in which the instruments may be dipped.

5. Choosing a place for operating

Either too much or too little light is unsatisfactory. Direct sunlight is dazzling, and a better view of the interior of the body may be had by keeping under the shade of a tree, or just inside of a barn or other building, where the direct sunlight cannot shine on the bird. If in a building, stand with the back toward the light and in a position which allows the light to shine into the body of the bird. On a cloudy day, or when the sun is not bright, the best place may be out of doors. A very cloudy or a dark day is likely to make the operation impossible.
6. Performing the operation

It is best to practice first on a dead bird until one is familiar with the operation. Fasten the bird to be caponized on the board as follows: Pass the legs under the lower left strap, having the right leg above the left, to stretch the muscles of the body. Pull the strap tight, bring the strap up over the lower edge, and slip under the cleat. Pass the upper right strap under and over the wings and through the buckle, drawing up until the bird is held firmly.

The board may now be moved into any position (Fig. 276A-B), and the bird will be stretched in the best manner for operating.

The operation consists of several definite steps which should be followed in regular order after the bird is laid on the caponizing board.

1. Remove the feathers in front of the hip. If those remaining persist in getting in the way, moisten them with water.

2. Place the middle finger of the left hand on the hip and draw the skin to the left by pressing with this finger (Fig. 276C).

3. While still holding the skin back with the middle finger, use the forefinger of the same hand and locate the last two ribs nearest the hip. Keep the finger there as a guide (Fig. 276C).

4. Locate a point between the last two ribs and about \( \frac{3}{4} \) inch below the backbone, and, with the sharp edge of the knife toward the operator and the handle sloping away (Fig. 276C), and while the skin is still drawn back, press the point quickly through the skin and the flesh \( \frac{1}{2} \) to \( \frac{3}{4} \) inch. This drawing of the skin results in completely covering the opening between the ribs when the skin slips back after the operation has been completed.

If the cut is made between the second and third ribs, the lungs may be injured and it may be impossible to remove the lower testicle. If made between the last rib and the hip, it
A., Note position of legs and the straps holding legs and wings.

B., The bird on the board ready for the operation.

C., Ready to cut. Note position of hands and knife. Point of knife is inserted between the two ribs nearest the hip bone.

Fig 276.
PERFORMING THE OPERATION

is too far back for easy work and may cut the large muscle controlling the leg, thus injuring the bird.

(5) With one or two more cuts, make an incision about 1 inch in length, keeping between the ribs, cutting through flesh and into the body cavity. (If the birds are properly starved there is little danger of cutting the intestines. One or two good clean cuts are better than several hacking cuts which do not go through to the body cavity.)

(6) Place the spreader with each hook around a rib. Push the points of the spreader together, insert them, and then turn the handle to the rear and let them hold the cut open ⅛ to ½ inch. Now, with the knife, continue to cut between the ribs until the opening is 1¾ to 1½ inches long. Do not cut too near the back as the arteries are near that point. Pull the wound apart gradually with the spreader, until an opening ⅛ to ½ inch is made. Fasten the spreader jaws to hold at that point (Fig. 277A). On the smaller birds, care must be exercised not to open the spreader so far as to break the ribs.

(7) With the hook, tear away the thin tissue covering the intestines (Fig. 277A).

The upper testicle should now be seen, a light-colored, elongated body about the size of a kernel of wheat or a small bean, lying near the back and against an artery (Fig. 277B). The under testicle should be removed first, if both are to be removed from one side. Then, if any bleeding occurs, the upper one may still be seen; whereas if the order of removal is reversed and bleeding occurs, it may be impossible to secure the under testicle without making an incision on the other side of the bird.

The most difficult part of the operation is to secure the lower testicle. The exact way to go about it will depend on the particular style of remover used. The following method applies to the style of instrument known as the “Farmer Miles” remover (Fig. 275B).

(8) With the remover, reach under and slightly to the rear of the upper testicle, press upward carefully, and, with the
CAPONIZING

instrument close a nd using the ring on the remover, pull the under testicle into view.

(9) Still pushing carefully upwards, open the remover \frac{1}{2} inch. Let the testicle slide off the ring and catch on the solid lip beneath. Then push in carefully and close the remover (Fig. 277C).

(10) Slip the remover sidewise once or twice to let any blood vessels slip out, then close firmly, twist the remover to wind the cord holding the testicle, and gently tear it out (Fig. 277D). The testicle and its sac should be removed from the body cavity.

(11) Remove the upper testicle in the same manner.

If considerable difficulty is experienced in securing the under testicle, the bird may be turned over and a cut made in the left side, whereupon the testicle may be easily removed. Some persons always remove from each side. It is usually better to learn to secure both testicles from one side, as this method consumes less time and requires less cutting of the bird.

(12) Release the bird. The skin should slide forward and the muscles completely cover the cut in the body (Fig. 277E).

Mark the capon, either by cutting off a toenail or slitting the web of the foot with a knife, by filing a small notch on the top of the upper beak, or by wing or leg banding the bird.

7. Caring for the birds after the operation

Place the birds in a pen by themselves for a day or two at least. Supply food and water. Regular rations of grain and mash may be given if the birds seem unaffected by the operation. If they appear dumpish, soft food may be given for two or three days. After a few days, they may be turned in with the rest of the young stock. A separate range from the uncaponized male birds, however, is desirable.

Within twenty-four hours the wound made in caponizing will be closed, and in a few days only a shiny scar will show where the cut was made.
FIG. 277.

A, Using the hook to tear the tissue covering the intestines. B, Note position of the upper testicle. C, Note upper testicle. The lower testicle is grasped by the remover, and is ready to be torn loose. D, Removing the testicle. Note the cords and tissues connecting the testicle with interior. These should be removed or cut off. E, The operation completed. The cut into the body is covered.
Wind puffs. Watch the young capons carefully during the first week. A few of them may bloat near the part of the body where the cut was made, and, if not attended to, the bloating may extend down the legs and over that half of the body until the bird is deformed. When any swelling is noticed, pick up the capon and, with a coarse needle or sharp point of a pocket knife, puncture the skin and let the air escape.

8. Preparing capons for market

Capons should be especially fattened about ten days to two weeks before marketing. (See Chapter XV, for fattening rations and method.) Most markets require that the capons be killed and picked and sent to market as dressed poultry. Special methods of preparation may be needed to meet the requirements of certain markets. Capons may be plucked by the dry or wax methods. Formerly certain feathers were left on capons to distinguish them more easily (Fig. 278). More recently the market is demanding all feathers removed. Undeveloped comb and wattles mark the dressed bird from the ordinary roaster.

9. Marketing capons

Capons are usually marketed plucked and packed in boxes when many are sold. For local or small sales they may be packed in baskets.
GENERAL INFORMATION

1. Caponizing instruments

The particular type of instrument used is an important, but not a determining, factor. It is more a question of becoming accustomed to a certain kind of instrument, as the operator will be likely to do better work with the one he is in the habit of using than with some other. The four instruments mentioned under 4 of this chapter are the main ones needed.

Several kinds of caponizing sets may be found advertised in the poultry periodicals. The various sets differ mainly in the type of remover.

One type of remover consists of a hollow tube, with the lower end compressed, leaving two small openings through which a fine wire is run. The wire is placed over the testicle and drawn up until the spermatic cord is cut. Another type consists of two halves of a small spoon so arranged that the half having an inner cutting edge will slide over the other and sever the cord, after the spoon has been slipped under the testicle and the cord carried between the jaws. Still another type is a spoon with a slit in it. This is operated like the one described above, but the cord is severed by twisting.

A type which is successful if it is carefully used, and which tears, but does not cut, is known as the “Farmer Miles.” This consists of two arms hinged scissors-fashion. One arm terminates in a flat, thin surface about \( \frac{1}{2} \) to \( \frac{3}{4} \) inch in diameter. The other terminates in a ring which fits over the outside edge of the flat surface of the other arm when closed.

There are one or two variations of the “Farmer Miles” type of remover on the market. In general, this type is easy to operate after one becomes accustomed to it.

Homemade instruments may be used if desired. The knife, a hook, and a spreader are necessary, but may be made or assembled if an entire set is not purchased. Any small, sharp blade, such as that found on a jack-knife, will answer for the
knife. A hook may be made by bending the end of a piece of hay-baling wire at right angles and filing this end until a sharp hook a little less than \( \frac{1}{8} \) inch is obtained. The spreader is more difficult to make, but may be bent from a piece of wire having a spring to it. Use a wire about 8 or 9 inches long. On each end make a hook by first bending back \( \frac{1}{8} \) inch of the wire at right angles. Starting \( \frac{1}{8} \) inch back from the main wire, bend the other \( \frac{1}{8} \) inch down in the form of a semicircle. File the end blunt. When both ends are finished, bend the wire in the center until the backs of each semicircle are within \( \frac{1}{8} \) inch of each other. There should be sufficient spring to the wire to open the cut as desired. (See Fig. 277.)

A blunt probe is sometimes useful in holding back the intestines. The handle of a spoon will usually do this satisfactorily.
2. Characteristics of a capon

A true capon does not crow, but clucks and sings like a hen. The growth of comb and wattles practically ceases, and the head thus takes on a long, undeveloped appearance. The hackle and saddle feathers continue their development. The bird loses all desire to fight, becomes very quiet and peaceful, stands confinement well, does not bother other birds, and will often mother a brood of chicks.

Capons keep increasing in weight for several months after the cockerels of the same age and breed have practically completed their growth. While the flesh of the cockerel commences to take on hard, "staggy" qualities, the capon retains the fine flavor and texture of flesh, characteristic of broiler meat or of the flesh of a pullet just before she comes into laying. Capons are easily fattened.

3. Breeds for caponizing

The wholesale market for capons pays a higher price for birds weighing 9 pounds or over. Markets differ in the size of capon desired. It is always well to cater to the demands of a particular market and select such varieties as command the highest price.

In most American markets, yellow skin and legs are preferred. (See Chapter XXVII for skin color.)

Since the highest-priced capon market opens about January 1, and continues until about Eastertime, it is possible to select the heavier, slower-maturing breeds if a heavy capon is desired. For a capon weighing 9 to 12 pounds or higher, the Light Brahmas, Orpingtons, or similar heavy varieties may be used. The Black Jersey Giants have been developed for a large roasting bird and make heavy capons. The Langshans are heavy and may be used. The American breeds, such as the Plymouth Rocks, Rhode Island Reds, and Wyandottes, produce a smaller capon, weighing 7 to 10 pounds each.

The Leghorns, which are especially good for the production of small broilers, make a small capon, weighing 5 to 7 pounds. Such a capon is too small for the general wholesale market,
and may not demand the highest prices. Generally it would be more profitable to sell the Leghorn cockerels and buy others of a heavier breed to caponize for market or family use.

Various crosses between these varieties, and of these varieties with others, are regularly made by some growers, in the belief that larger size and more rapid growth are secured than would be the case if any single pure breed were used. There appears to be some reliable evidence to support this policy. On the other hand, greater variation in size and type of progeny is likely to result from crossing. Moreover, it is necessary to mate together two pure breeds each year in order to secure the possible benefits of crossing. Most capon growers will be likely to follow the practice of using a pure breed.

4. What is a successful operation?

If any of the testicle is left in the bird, it will grow, and the bird will be neither capon nor cockerel. Such
5. Possibilities in capon production

The production of capons is probably most profitable as a side line, either as an extra industry connected with an established farm or poultry business, or as a means of disposing of surplus cockerels, or possibly as an additional means of serving customers who are already buying some of the farm products.
There are no exorbitant profits in the production of capons. Both capons and cockerels will make about the same rate of growth until the cockerels approach maturity, when the capon usually makes slightly better gains on about the same amount of feed (Fig. 281). This means that the flesh is somewhat more economically produced at that time, and because of the higher price per pound which usually prevails for capons, the net return is greater.

When capons can be farm-reared or have the advantage of practically free range the gains will be much greater.

Careful records kept by the capon grower, including data from which one may determine the profit per pound and per bird, and a comparison between capons and broilers, will do much toward helping the individual to determine if the practice is adapted to his particular conditions.

COMMUNITY SURVEY

1. How are surplus males disposed of by the largest poultry keepers in the vicinity?
2. Are there any poultrymen who make a practice of caponizing surplus males?
3. At what age do they caponize?
4. What instruments are used?
5. What breeds give best results?
6. What is the local charge for caponizing?
7. Are the capons given free range or confined?
8. How long are the capons held before marketing?
9. What is the difference in price received for capons and cockerels?
10. What are the reasons given for this difference?

REFERENCE

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CHAPTER XXIV

MAINTAINING EGG PRODUCTION DURING THE SUMMER

An important problem which every poultryman has to face is keeping the birds in the best physical condition and in continuous production, at least during June, July, August, and September. There is a tendency, under most conditions, for production to drop during these months.

Very frequently, flocks are culled and a large percentage of the birds removed as low producers, when the real trouble is not with the birds but with the conditions under which they are kept. Good birds will often continue to lay notwithstanding adverse conditions, but medium and poor birds are often unable to do this. Many of the birds that cease to lay because of the handicaps of the season and lack of care would continue in production longer under better conditions of management. Therefore, each person keeping poultry should become familiar with the causes of low production and endeavor to overcome them.

Good production during the summer and fall months adds materially to the income. This should be the season of greatest net profits. Eggs are advancing in price, and every additional dozen secured because of improved methods at this season means increased profits at the close of the poultry year.

Operations:
1. Feeding during the summer.
2. Using artificial illumination in the summer.
3. Keeping up the mineral supply.
4. Providing plenty of cool, clean water.

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5. Keeping the flock vermin-free.
6. Ventilating poultry houses in summer.
7. Furnishing shade during the summer and shelter from the wind during the cool fall.
8. Breaking up broody hens.

General information:
1. The broody condition.
2. Broody records.
3. Forcing the molt.

1. Feeding during the summer

(See Chapter VIII for the use of artificial illumination on the laying flock in late summer.)

Hopper-feed dry mash all summer.

It is important that sufficient mash-feeding space is provided. There should be at least 1 foot of feeding space for each 5 birds, or 10 feet of mash hopper for 100 birds when they feed from both sides. More is better.

Dry mash should contain 18 to 20 per cent of meat scrap or its equivalent in other animal protein.

Animal protein should be fed even though the birds have unlimited range as some flocks do.

To encourage higher food consumption, milk or water should be fed daily on the dry mash. Start this in May or June. A wet mash may be mixed or 2 quarts of milk or water for each 100 birds may be spread over the dry mash in the feeders. Since the chickens usually prefer moist mash to the same kind of mash fed dry, it may be used in this way to induce them to consume more. Flocks on range will sometimes eat large quantities of seeds, such as ragweed, and as a result eat too little mash.

Give all the grain they will consume at night, at least.

2. Using artificial illumination in the summer

When the amount of daylight and sunlight gets less, the bird receives less stimulation from those sources. At such
times, or about August 15 to September 1, in the latitude of New York, artificial illumination should be given to the flock of old birds. (See page 169, No. 2.)

3. Keeping up the mineral supply

Good poultry husbandry requires a plentiful supply of grit and oyster shell always before the birds. Place shell in several hoppers about the pen and grit in at least one.

4. Providing plenty of cool, clean water

In summer, fresh water is necessary for the cooling effect it has upon the body, as well as for supplying the necessary moisture demanded for egg production during heavy laying. A lack of a constant supply of water may be the principal cause of a drop in production.

5. Keeping the flock vermin-free

A flock of fowls may easily be thrown out of production during the summer months, if body lice or red mites gain a foothold.

Examine the perches and nests frequently for signs of mites, and examine the birds for body lice. If found, take immediate steps to get rid of them. (See pages 252 to 255 for a discussion of the pests and methods of combating.)

6. Ventilating poultry houses in summer

One of the fundamental principles of poultry-house construction is that of building so as to avoid extremes of temperature. For good production, it is necessary to keep the interior of the houses cool during the summer. Unless the windows are removed and the building otherwise properly ventilated, the inside of the building may become too warm both day and night.

Excessive heat during the day or night may cause a serious slump in egg production and sometimes death. The reason for this is clear when we consider the effect of heat on the birds. In the effort to keep their bodies cool, they spread their wings and stand with open mouths, panting. Because they cannot
sweat, as do most other domestic animals, and hence are prevented from cooling their bodies through evaporation of moisture, their normally high temperature coupled with the heat of the house makes them decidedly uncomfortable. Practically the only way of cooling themselves is by rapid breathing. When the air they breathe is hot, the birds breathe faster in the effort to make themselves more comfortable. Much energy is lost in this way. Hence, food consumption is very low and the natural result is a drop in production. Hens do not eat as freely during hot weather.

Sprinkling the litter and walls with water will produce evaporation and hence a drop in temperature. On very warm days sprinkling may be done several times.

Warm air is pushed up by cooler air. A method of ventilation which will help to cause a circulation near the roof and remove this warm air will also prevent, to a considerable extent, the radiation of heat from the roof into the house. This is accomplished in a shed-roof house by the use of front and rear ventilators under the eaves. (See page 40.) Window openings at the ends of the building aid greatly in cooling the house.

In buildings where the space over the plate is closed, the air must escape through the windows or other openings, which are lower, and hence the escape is retarded and the building cools less rapidly. Both front and rear ventilators should be opened during the summer. Insulated houses are cooler in summer. (See page 78.)

7. Furnishing shade during the summer and shelter from the wind during the cool fall

Cultivated crops, such as corn, sunflowers, and tree fruits, provide satisfactory forms of shade.

8. Breaking up broody hens

Broodiness is a great handicap to production in some flocks. In certain varieties, a large number of birds are frequently broody at one time and remain so for a considerable period.
This means that many birds are out of production at all times during the summer. Unless hens are needed for hatching and to mother young chicks, they should be "broken up" as soon as possible.

At this season an extra trip should be taken through the buildings each night, shortly after feeding, and any hens found on the nests should be confined in a broody coop. Supply these birds each day with plenty of water and mash. At feeding time in the evening of the third or fourth day they may be returned to the flock. The majority will be over their broodiness and will go on the roosts. Any hens that go back to the nest will be confined that evening and will remain another three or four days. (See page 59 for plans of broody coops.)

**GENERAL INFORMATION**

1. The broody condition

Hens seldom go broody unless they have been laying. When confined immediately, they will often lay a few eggs in the broody coop. Supplying them with water and egg-making feed causes the egg yolks to resume their development and thus tends to keep the birds in laying condition, with the result that after a few days' confinement they may be released. They are likely to return to laying within one or two weeks. On the other hand, if a bird is left on the nest for several days her broody tendency increases and therefore a longer confinement is necessary. While on the nest she goes without the necessary egg-making food, and is partly nourished by absorbing the egg yolks. If a bird is opened after being broody a considerable time, the yolks are seen to have been practically re-absorbed. Therefore, when a hen has been broody for several days, more time is required to break up her broodiness and to redevelop egg yolks to the point where she will be laying again. Under these conditions three weeks to one month, or longer, may be lost.

It frequently happens that food is kept from the broody birds with the expectation that they will get over their broodi-
ness more quickly. The lack of food means more rapid absorption of yolks within the body and hence a longer time to regain a laying condition.

2. Broody records

Birds that become broody four and five times in one season are losing too much time to be profitable. As an aid in recording the number of times a hen is broody, the following plan may be used. Secure leg bands of a certain color or number, representing broodiness. (Spiral celluloid leg bands always of the same color are satisfactory.) Place one on the bird’s shank each time she is found broody. In this way each hen carries her season’s broody record with her. If a bird is found with three or four broody bands she may be viewed with suspicion. Examine her carefully by means of external characters (see Chapters I and II) to determine whether she should be kept or culled.

While it is true that high producers may go broody several times in a season, it is doubtful if the poultryman should breed from such a bird. The policy should be to breed broodiness out of the flock. (See page 3, “Preparing to cull,” for relation of summer care of fowls to culling.)

3. Forcing the molt

Birds to be used the following season as layers or breeders should be made to molt and rest some time in the late fall (page 170). As periods of highest prices for eggs may precede this period, some poultrymen “force-molt” their birds in early summer, expecting them to complete their molt and lay during high-price periods.

However, egg production during the summer, when prices are rising, is lost, culls are molted along with the high producers, and, therefore, held over when they should be marketed and the return over a full year period may not be increased.
COMMUNITY SURVEY 501

**Forced vs. Normal Molt**

<table>
<thead>
<tr>
<th></th>
<th>First group</th>
<th>Second group</th>
<th>Third Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eggs</td>
<td>Gross income per year</td>
<td>Eggs</td>
</tr>
<tr>
<td>Forced molt, June 1</td>
<td>163†</td>
<td>4.22</td>
<td>170</td>
</tr>
<tr>
<td>Forced molt, July 1</td>
<td>171</td>
<td>4.44</td>
<td>198</td>
</tr>
<tr>
<td>Normal molt</td>
<td>179</td>
<td>4.65</td>
<td>215</td>
</tr>
</tbody>
</table>

† From June 1 to October 1 of the following year (16 months).

These results show no gain financially by early forced molting. The desirable practice appears to be one which attempts to hold birds in production until late fall (November or early December). (See page 169.)

COMMUNITY SURVEY

1. How many local poultrymen feed a moist mash in late summer to the laying flock?
2. How many use artificial lights in late summer to keep up production, and how are the lights used?
3. At what time of the year are they discontinued?
4. How are the birds fed and cared for immediately after lights are discontinued?
5. Are there any flocks that receive neither dry nor wet mash during the summer?
6. Compare the percentage production between flocks that receive mash and those that do not.
7. What provision is made to ventilate properly the houses in summer?
   To keep the birds vermin-free?
8. What plan is followed?
9. Ask the poultrymen how important they consider green feed in summer for the flock.
CHAPTER XXV

MID-SEASON CARE OF YOUNG STOCK

The growing pullets and a selected flock of growing cockerels are the pride of the poultryman's heart. In them is represented his future business. There is nothing that brings him a greater joy than to watch a flock of partly grown stock having healthy, smooth-feathered bodies and clean-cut, intelligent heads, and to realize that the dangers and uncertainties of rearing are largely past. To watch such a flock feeding or resting in the shade of a proper range, and to visualize the fine prospective egg producers and breeders he has labored for, is the delight of every true poultryman, and is an experience that he has earned a right to enjoy.

With proper rearing conditions, it is cheaper to grow stock than to buy it. Pullets of equal quality will ordinarily cost about one-third more than their rearing cost if purchased, and breeding cockerels will cost several times as much.

Operations:

1. Selecting the range.
2. Supplying shade.
3. Locating the colony houses.
4. Separating the sexes.
5. Using the catching crates.
6. Disposing of the surplus birds.
7. Feeding the young stock for healthy growth.
8. Providing ample ventilation.
9. Practicing eternal vigilance against lice, mites, and natural enemies.
10. Keeping the houses clean.
11. Guarding against theft.
12. Educating the pullets in nesting habits.
13. Providing a cool, clean, constant water supply.

1. Selecting the range

A range should provide exercise, shelter, green feed, water, shade, sunshine, and safety (Fig. 282). (See page 445.)

2. Supplying shade

Some provision should be made for shade on every range where natural shade is lacking. After the chicks are five or six weeks old, remove the runner guards. This allows the chicks to run under the house for shade and also makes the structure less likely to harbor rats. The runners should be raised about a foot from the ground and rested on cinder blocks or stones.

Place burlap or brush on a frame supported by poles if it is
necessary to provide shade artificially. Plant corn or sunflowers along the border of the range for shade.

3. Locating the colony houses

When chicks are five to six weeks old, the colony houses should be at least 100 feet apart. This will require about one acre for each four houses. A trip to the various houses can be made in less time if they are arranged in a square rather than in a row. The nature of the range will determine the best arrangement. Move the houses about the range several times during the rearing season.

Keep the chickens of different ages on separate ranges or on widely separated parts of the range until they are two or three months old. The best results cannot be secured where young chickens of different ages, extending over a period of several weeks’ hatching, run together. This is particularly true during the early stages but applies throughout the rearing season. The older birds misuse the younger ones and eat their feed.
4. Separating the sexes

Pullets develop better when by themselves.

Leghorns and other rapidly growing varieties develop sexually very early and the males soon become annoying to the

FIG. 285.

Crates, with both ends removable, placed end to end at the exit. The birds are then driven into the crates.

Fig. 286.

Other crates are available and the pullets graded, cockerels removed, etc.

pullets. For this reason, and also because they are taking up room, the cockerels should be removed from the flock when they are three to six weeks old. At this age the cockerels can easily be detected by their larger combs and wattles, red faces,
and actions. Keep the cockerels in separate pens and market as broilers when they weigh 1½ to 3 pounds, unless they are to be retained for further observation as breeding males or are to be sold as roasters or capons.

In the heavier varieties sexual development is slower. The cockerels should be separated at 5 to 8 weeks of age.

Starting with 250 to 350 chicks in a colony house, and allowing for the usual mortality, there should be left, after separating the cockerels, 110 to 160 pullets per flock.

5. Using the catching crates

Keep the chicks confined the morning the flock is to be separated. Place the catching crate at the lower exit door of the colony house. Open the exit door and let the chicks run out into the crate. When a sufficient number are in the crate close both the exit and crate doors. The work will be simplified if several catching crates are available, two or more of which have doors at both ends.
The chicks are now ready to be sorted. Remove both pullets and cockerels that are not developing properly, that show low vitality, are not properly feathered out, or otherwise do not measure up to a high flock standard of quality. Place the culls in other crates or carrying boxes and release the desirable pullets. Only a short time will be required for each house (Figs. 285, 286, 287).

**Fig. 288—Cockerel heads.**

A study in development of masculine characteristics. Same age. For future breeders cockerels should develop steadily with the size of body fully accompanying the sexual development.

Handle all birds carefully while doing this work. Serious injury is likely to result if chickens, especially pullets, are handled roughly.

6. **Disposing of the surplus birds**

The culled birds should be either sent to market at once or fattened. The cockerels which are to be retained for further observation and from which the future breeders are to be selected should be placed in a colony house on free range and fed for rapid growth, like the pullets, but on a separate range.
7. Feeding the young stock for healthy growth

(See page 452 for the rearing ration.)

In addition to the grain, mash, grit, shell, and water, two feeds are indispensable for best results with growing stock, namely, skimmilk or milk products, and green feed. The importance of skimmilk or milk products as a factor in building

---

**TOTAL GRAIN AND MASH TO DATE**

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<thead>
<tr>
<th>Week</th>
<th>S.C.W. Leghorns</th>
<th>American Breeds</th>
<th>Week</th>
<th>S.C.W. Leghorns</th>
<th>American Breeds</th>
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<tr>
<td>1</td>
<td>14.9</td>
<td>11.2</td>
<td>13</td>
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<td>1067.9</td>
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<tr>
<td>2</td>
<td>36.4</td>
<td>29.1</td>
<td>14</td>
<td>937.0</td>
<td>1197.1</td>
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<tr>
<td>3</td>
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<td>57.5</td>
<td>15</td>
<td>1050.2</td>
<td>1320.4</td>
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<tr>
<td>4</td>
<td>102.9</td>
<td>97.7</td>
<td>16</td>
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<td>1457.3</td>
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<tr>
<td>5</td>
<td>153.0</td>
<td>155.4</td>
<td>17</td>
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<td>1605.6</td>
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<tr>
<td>6</td>
<td>210.4</td>
<td>228.1</td>
<td>18</td>
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<td>7</td>
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<td>19</td>
<td>1503.2</td>
<td>1807.5</td>
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<td>8</td>
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<td>20</td>
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<td>647.4</td>
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<td>11</td>
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<td>23</td>
<td>1980.2</td>
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<tr>
<td>12</td>
<td>612.9</td>
<td>922.3</td>
<td>24</td>
<td>2106.8</td>
<td>2589.1</td>
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</tbody>
</table>

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*Weight changes in chickens, Bulletin 24, Cornell University.*

*Average weekly food consumption, in pounds per 100 birds. Mash only until 8 weeks of age.*
FEEDING THE YOUNG STOCK FOR HEALTHY GROWTH

up the strength of the chick’s body and making it better able
to throw off the chick diseases and other troubles (see Chapter XXII) is such that one should not think of attempting to grow
chickens without skimmilk or a suitable milk by-product.

A liberal supply of green feed for chicks of all ages is also an
indispensable factor in successful rearing. With the proper
range, this factor will be taken care of after the chicks are old

![Fig. 291.](image)

The low-vitality cockerel on the left should be culled. He is far inferior to the other cockerel. The latter shows promise.

enough to forage. Both milk and green feed contain minerals
and vitamins which are essential for the best growth. Fish
oil should be given in most cases.

If chicks are fed as recommended above, there does not
appear to be any valid reason why they should be fed yeast
or any other commercial or proprietary remedy or so-called
growth promoter.

After chicks are raised to one to two months of age on a
good range and are not crowded, both grain and mash may
be hopperfed. Outdoor hoppers (Fig. 297), having compart-
ments for grain, mash, grit, and shell, should be placed between
each pair of houses.

Grain may be hand-fed if desired, on clean soil in dry
weather but hopper-feeding is more sanitary.

Pullets should always go into laying quarters well de-
veloped and fat.
Birds such as these should be culled when they are found to be developing undesirable qualities.

8. Providing ample ventilation

It is scarcely possible to overemphasize the need for an abundance of fresh air, day and night. Developing pullets should never be compelled to pass the hot summer nights in an overcrowded and poorly ventilated house. Such treatment prevents normal growth and development, and may be the chief contributory cause of disease. It is hardly possible to get too much summer ventilation in a colony house. During summer and after the chicks are through with artificial heat remove all windows and screen the openings with ¼-inch mesh wire to keep out sparrows and other undesirable visitors. Open both front and rear ventilators. Leave the windows and ventilators open until the pullets are moved to their permanent quarters early in the fall. One hundred to 150 pullets are enough for an 8- by 12-foot house. Eight perches should be provided in such a house.

If possible, place the house where it will be in the shade during the middle of the day. Face the house so that the front will be best sheltered from the wind and rain. In many locations, this will mean that the house should face toward the east. This will also make the house cooler than if it faced south. There should be practically no danger from colds if the birds are housed and fed in the manner outlined.

All that is needed after the brooding days and during the summer is a shelter that will protect the chickens from the heat and storms. In southern states, and wherever the weather is extremely warm, it will be found an advantage to provide a wire door in place of the wooden door in the colony house and to cut another window in the opposite end near the front,
Production bred cockerels such as these should be saved for breeders or for sale as breeders, so long as they retain their desirable characteristics.

A. A high quality, deep-bodied, masculine bird with excellent temperament and carriage.

B. Good head; large frame; low tail carriage.

C. Good head, somewhat angular body but holds promise of splendid future development.

D. Well-proportioned head, low blade and broad points at base; deep body; full chest.
covering the opening with wire. A window opening in the same end of the house as the door will make it unnecessary to.

![Diagram of water supply system](image)

**Fig. 295.**

A constant supply of water may be assured by an automatic valve. As the water in the trough (A) is used the weight on the arm (B) lessens and the spring (C) pulls the arm up, thus letting water flow into the trough.

*Manufactured by White Manufacturing Co., Gardena, Cal.*

![Image of hens and tub](image)

**Fig. 296.**

Running water piped to this tub placed on wire over a hole provides clean, dry surroundings for the range.

provide a wire door and is less expensive, more convenient, and about as efficient.
If the brooding houses are not portable, or if more roosting room is needed, the shelters shown in Figs. 298 and 299 are useful. Where colony houses are used, such shelters are necessary only when it is desired to divide the flock.

Fig. 297—Range feeder.

This feeder is sanitary, compact, light, and efficient. The top is flat, which makes it convenient to carry to and from the range and for storing away. The top is made of 6-in. and 3-in. boards, as shown in B, and covered with galvanized sheeting.

The feeder box is 18 in. wide and 4 ft. long overall. A ½-in. × ½-in. lip helps prevent wasting. The sloping sides extend about 1 in. below the top level of the side boards, are 6 in. wide, 9 in. apart at the bottom, and 11 in. at the top. Side boards 6 in. wide. Two 2-in. × 2-in. skids run lengthwise.

When chicks are small, a 2-in. × 2-in. board may be placed along the front for them to stand on while eating. A lath placed 1 in. to 2 in. above the side board prevents the chicks when small from standing on the sides.

1—3 in. × 1 in.—10 ft. Top
1—3 in. × 1 in.—8 ft. Lighting boards
2—6 in. × 1 in.—8 ft. Top, ends, sides and sloping sides
1—6 in. × 1 in.—10 ft. Bottom
1—7 in. × 1 in.—12 ft. Corner posts and bottom
1—2 in. × 2 in.—12 ft. Skids
1—2 in. × 2 in.—8 ft.
1—½ in. × 3 in.—8 ft.
2—lath
Galvanized tin, 2 ft. 1 in. × 4 ft. 7 in.

Frequently the most natural, safest, and most satisfactory place for pullets or cockerels to rest during the day and roost at night, until the time when they are placed in winter quarters, is in the trees of an orchard. Provided the trees are large, the colony houses may be placed among them for this purpose (Fig. 301).
Fig. 298—Open-air shelters.
Note ideal conditions of shelter, coolness, and opportunity for wide range.

Fig. 299—A cheap, serviceable range shelter.
Sides are of wire. Four sheets of 2' × 10' metal roofing cover the 8' × 8' shelter. Two men can easily carry it to a new location.

Fig. 300.
Leave the pullets on range until they commence to lay. Do not attempt to retard production. Hopper-feeding grain and mash promotes desirable growth without premature production.
Frequently birds will leave the houses and roost in trees. This shows their good sense. Note the cockerels at rest in all parts of the apple tree. An abundance of fresh air is necessary for best development.

A homemade cockerel stand is an important factor in preventing fighting and keeping future breeding males on range from remaining inside the houses. The stand placed against a tree provides shade and high roosting. Its chief value is in providing open-air roosting and a quick "get away" from pursuing males.
9. Practicing eternal vigilance against lice, mites, and natural enemies

(See pages 252 to 255.)

10. Keeping the houses clean

Sand, shavings, or straw make fine colony-house floor covering. Clean out the droppings frequently and supply fresh litter. Range shelters should be moved several times during the growing season, or have wire floors, to keep the pullets from the droppings.

11. Guarding against theft

In many localities the danger of losing chickens by theft is great. Where stealing is likely to occur, it is a wise investment in time and money to safeguard the year's crop of pullets and cockerels, a crop which it would be practically impossible to replace in kind and quality.

A 58-inch standard horizontal wire fence, with spaces between the wires graduated from top to bottom, with a 1-foot, 2-inch mesh hexagonal galvanized iron poultry netting on top, and above this one or two strands of 4-pronged barbed wire, solidly stapled near and on the top of the posts, provides a very effective barrier against the intrusion of chicken thieves. This type of fence requires 9-foot posts set 2 feet in the ground and approximately 15 feet apart. Such a fence should enclose the space where the brooder houses are located and permit the chickens to forage at a greater distance from the houses by going under
the fence at proper places, which can be closed during the night to prevent the entrance of predatory animals. The brooder

Fig. 304.
Water drips from the barrel into the water receptacle.

houses should also be provided with a hasp and padlock, with chain which cannot be removed without breaking the hasp (Fig. 305).
A good watch dog, either chained to a kennel or at large, is likely to be a profitable investment.

Wire electric alarms, either opened or closed circuits, connecting the rearing houses with the caretaker’s room have proved desirable.

Tattooing the web of the wing with an identification number, recorded with the state police and sheriffs, is effective. Such organized tattooing plans are in use in many states.

**Fig. 306**—The tattoo marks are left on the web of the wing by the marker.

Tattooing may be done at the time range birds are vaccinated for chicken pox, or at any other convenient time.

Consult your state poultry husbandry department, or the state police (Fig. 306).

When it is generally known throughout the neighborhood that the above special precautions against stealing have been taken, that fact, in itself, is the best insurance that would-be chicken thieves will consider it safer to steal elsewhere.

**12. Educating the pullets in nesting habits**

To avoid the later difficulties of floor eggs, egg breakage, egg-eating habits, and cannibalism, train pullets while on range by providing suitable nesting places for any early layers (Fig. 303).
13. Providing a cool, clean, and constant water supply

Natural or piped running water is best (Fig. 296). Other methods are a water pan and float on wire-covered floor, Fig. 295, or a water barrel with faucet set to drip or used as a supply to fill shaded pans (Fig. 304).

Fig. 307—The range on a breeding farm in New York State.

There is opportunity for sunlight to reach the range. Ample shade and air drainage are evident.

COMMUNITY SURVEY

1. What is the largest number of pullets grown on a single local farm?
2. How many chicks were required for each pullet reared to laying age?
3. What percentage of the chicks at start were males?
4. What provision is made for summer range?
5. Describe the type of range house used.
6. What method is employed for keeping the rearing houses cool and well ventilated at night during the summer?
7. Do the pullets roost in trees?
8. If so, how are the pullets caught when placed in the laying houses in the fall?
9. Describe the rearing ration and method of feeding used by local poultrymen.
10. At what age are the cockerels separated from the flock?
11. How many poultrymen transfer to "Bachelors' Hall" cockerels that are to be used as future breeders?
12. What is the basis upon which these cockerels are selected?
13. Are the young birds culled during the rearing season?
14. What points are regarded as desirable? As undesirable?
15. Inquire if poultrymen have experienced any losses from chicken stealing.
16. If stealing has occurred, were the thieves apprehended, and how?

REFERENCES


CHAPTER XXVI

FITTING, EXHIBITING, AND JUDGING POULTRY

Operations:

1. Selecting birds for exhibition.
2. Preparing birds for the show.
4. Conducting a poultry show.
5. Conducting an egg show.

1. Selecting birds for exhibition

The selection of birds for exhibition differs from ordinary selection in the fact that the poultryman is choosing from the best of his birds, after their number has been greatly reduced by a most rigid process of elimination. The equipment which it is advisable to secure includes the following articles:

(1) A portable wire enclosure for rounding up the birds in the houses or on range, where they can be observed, caught, and handled with the least possible disturbance because of fright.

(2) A long catching hook of wire with short wood handle.

(3) A catching net.

(4) Two or three catching and carrying crates.

(5) A book in which to write the numbers of the birds handled and the descriptions of their more important characteristics.

2. Preparing birds for the show

To show to the best advantage, birds must be clean. Occasionally pullets and cockerels reared on free range can be placed on exhibition in perfectly satisfactory condition, so far
as cleanness is concerned, without washing. With most young and old stock, however, a thorough cleansing of the plumage will make so much improvement in their appearance that it will pay well to wash the birds before exhibiting them.

**Material for Washing Birds for Exhibition**

- Three ordinary washtubs
- Ivory soap
- Sponge
- Scrub brush
- A room heated to approximately 90 degrees F.
- Clean, soft water.

Arrange three tubs containing clean, soft water on a bench at convenient height. The temperature of the water in tub No. 1 should be about 90 degrees, in No. 2 lukewarm, and in No. 3 ordinary air temperature. Dissolve one cake of ivory soap in tub No. 1, and form suds. Submerge the bird completely, except the head. Sponge the plumage thoroughly and make certain that all the dirt has been removed, clear to the skin, by squeezing gently, but not rubbing, with the hands. With the scrub brush, remove all dirt and old scales from the shanks and feet. When the bird is thoroughly cleaned, transfer it to tub No. 2, submerging and withdrawing, permitting the water to remove all the suds from the plumage. Then dip the bird in tub No. 3 for an additional rinsing and to accustom it to the cooler temperature of the room.

The use of bluing in the water is not necessary on pure white birds and is not justifiable on any others.

Provide clean litter in clean coops in which to place the birds while drying. Do not place them in a draft.

Place the birds in a partly darkened room until nearly dry; then give more light, so they will dress their plumage.

Provide a temperature not lower than 70 degrees or higher than 90 degrees. A lower temperature would be uncom-
comfortable for the birds, because of rapid evaporation of moisture, and a higher temperature would be likely to dry the plumage too quickly and leave it in a crumpled condition. The birds can be depended upon to put their plumage in proper order during the drying process.\(^1\)

A. **Training birds for exhibition.** Provide a room containing coops similar to those in which the birds are to be exhibited. There the birds may become coop-wise and may be further observed before being shipped to the show.

The most intelligent birds are likely to be the best ones for exhibition. Such birds will usually respond quickly to training. They should be taught to be friendly and not to be easily frightened, in order to show to best advantage their type, carriage, and action.

With the aid of a short rod, a bird can be trained to move about the coop without fright and to feel perfectly at home when viewed by the judge and spectators. If this preliminary training is not provided, very valuable birds frequently are so timid when on exhibition at the show that they do not appear to advantage. For example, they may carry the tail so erect or so far to one side as to be seriously handicapped in competition with birds that feel at home when on exhibition and therefore show their true quality to the best advantage.

B. **Shipping birds for exhibition.** (1) Provide shipping coops which will carry the birds to the show and back with the

\(^1\) The authors purposely omit any instructions for preparing birds for exhibition which involve operations for removing evidence of minor defects and disqualifications, on the ground that the publication of such knowledge of questionable practices will tend to encourage, rather than to discourage, faking in poultry shows. Faults in birds should be bred out, and not pulled out or artificially covered up or removed. Birds should be shown in their natural color and conditions, with the exception of the removal of dirt. The bleaching of plumage, the removal of off-color feathers, the mutilation of the comb, and other operations intended to deceive the public and the judge into believing that a bird is what it is not, have worked incalculable injury to the reputation of poultry shows and exhibitors in the minds of the public.
least possible danger of injury, due to fighting or rough handling in transit or exposure to variations in temperature.

(2) Place in the bottom of each shipping coop at least 2 inches of clean shavings or straw, as an absorbent, to assist in keeping the birds clean and comfortable.

(3) See that each coop has a non-breakable receptacle, to carry water in the case of long-distance shipments or soaked grain for near-by shipments. Also add green food, such as cabbage or beets.

(4) Provide shipping tags showing the name and address of the exhibitor, or the farm, or both, the leg-band numbers of the bird or birds in the coop, the shipping directions for the return of the birds, and the name and address of the show to which they are to be shipped.

The tag should be attached to the shipping coop, in duplicate, on each side of the coop, by wiring or tacking in such a manner as best to safeguard it against injury or loss in transit or from being destroyed by the birds in the coop.

(5) Place leg bands, preferably of the sealed type, on each
bird, in order that any bird may be identified in case of loss in transit, or transfer, by mistake or otherwise, at the show.

3. Judging poultry

The following articles are needed by the judge:

1. A suitable garment, such as a linen duster.
2. A short rod for moving the birds about in the coop.
3. A pencil and eraser.
4. A pad on which to record the characteristics of the birds.

<table>
<thead>
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<th>Judge's Descriptive Record of Defects</th>
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<tbody>
<tr>
<td>Exhibitor's number</td>
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</tbody>
</table>

1. Standard Disqualifications

2. Condition

3. Handling quality
4. Head
5. Body
6. Legs and Toes
7. Molt
8. Plumage
9. Pigmentation

The judge should be assisted by another person, whose duty it is to act as secretary in taking down the comments of the judge, to locate the birds in the class, and to make a record of the awards.

A. Method of judging. When exhibitors or visitors are particularly interested in the judging, the judge may make the occasion an educational demonstration.

To do this make all observations on the quality of the birds in an audible tone, so that all who are present will have the opportunity of seeing the birds handled and hearing the opinion.
of the judge as to the merits and demerits of each bird handled.

When birds showing outstanding quality or lack of quality are being judged, give the exhibitors and visitors present an opportunity to handle them, if time permits and the owner has no objections.

B. Steps in judging. (1) If exhibitors and visitors are present make a public announcement of the policy to be followed in judging birds, and request those present not to give information at any time which would enable the judge to know the owner of any of the birds.

(2) Make a rapid examination of all the birds in all the classes which you are to judge, in order to get a proper estimate of the size of the job and the general quality of the stock.

(3) Make a careful inspection of all the birds in the first class to be judged, without removing the birds from the coops. This examination ordinarily will enable the judge to eliminate a number of birds which show by their appearance that they are not worthy of individual handling. This saves time, and is fair to the exhibitor if it is understood that the judge will be glad to examine any particular bird, if requested to do so.

(4) In removing birds from the coop, endeavor to avoid frightening the bird. This can be best accomplished either by seizing the bird by the shoulder or running the hand under the body and drawing it forward through the door. Place the other hand on the back of the fowl if it should be necessary to do so. When judging, hold the bird in a comfortable position. (See Chapter I.)

(5) Commence at one end of the line and handle each bird, calling attention to its outstanding qualities, desirable and undesirable. Designate, by reversing the exhibitor's card, the coops containing birds that are not worthy of further consideration.

(6) Make a careful re-examination of each of the birds remaining in the class, reducing them "to lower terms" by turning over the exhibitor's card as before.
(7) In a close competition, it aids greatly in forming correct judgment to remove the remaining birds to adjoining vacant coops. This method of placing the final award has the greatest educational value to the exhibitors present and other observers, since it enables the judge to make fine distinctions between birds presumably of very similar quality. It furnishes the most intense interest in the judging process.

When the judge's decision is rendered in each class, his secretary should enter in the judge's book the proper award. The book should be inspected by the judge and signed by him when the judging has been completed.

(8) After all the classes have been judged, it is advisable for the judge to remain for informal discussion with exhibitors.

4. Conducting a poultry show

Secure, if possible, a room which is properly lighted and wide enough to permit the placing of at least four rows of coops, one row against each of the side walls, and two rows back to back in the center, leaving passageways for visitors on either side, with opportunity to pass around the center rows at either end. The room should provide a reasonably uniform tem-
perature of 60 to 70 degrees F. and should permit proper ventilation to make the place congenial and safe for the poultry and persons in attendance.

Suitable coops usually can be rented, provided the funds are not available for their purchase or manufacture. One of the most satisfactory types of coops is shown in Figs. 309, 310. This prevents fighting between birds in adjoining coops, gives

---Second New York State Production Poultry Show, 1923---

<table>
<thead>
<tr>
<th>Rank No.</th>
<th>Name</th>
<th>Variety</th>
<th>Class No.</th>
<th>Show No.</th>
<th>Awards</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>46</td>
<td>S. G. V.</td>
<td>1</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>47</td>
<td></td>
<td>1</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>48</td>
<td></td>
<td>1</td>
<td>31</td>
<td></td>
<td></td>
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<tr>
<td>20</td>
<td>49</td>
<td></td>
<td>1</td>
<td>32</td>
<td></td>
<td></td>
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<tr>
<td>20</td>
<td>50</td>
<td></td>
<td>1</td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>51</td>
<td></td>
<td>1</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>52</td>
<td></td>
<td>1</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>53</td>
<td></td>
<td>1</td>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>54</td>
<td></td>
<td>1</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>55</td>
<td></td>
<td>1</td>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>56</td>
<td></td>
<td>1</td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>57</td>
<td></td>
<td>1</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>58</td>
<td></td>
<td>1</td>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>59</td>
<td></td>
<td>1</td>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>60</td>
<td></td>
<td>1</td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>61</td>
<td>Buff L. U. S.</td>
<td>1</td>
<td>439</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 311—Sheet from judge's book.

an unobstructed view of the birds in all directions, can be knocked down for shipment, is strong and durable, is convenient for feeding, watering, and handling the birds, and is easily disinfected and durable. These principles should be incorporated, in so far as possible, in the making of coops for temporary use. A proper arrangement of boxes and poultry netting can be made to serve the purpose temporarily at comparatively low cost.
Collapsible wooden horses may be used to support the coops at the proper height to permit the easy observation of the birds. The bottom of the coop should be approximately 30 inches from the floor. Each coop should be provided with cups for feed and water and should be properly littered with dry, clean shavings or sawdust.

An entry book is necessary for recording each exhibitor's name, number, and address, and the leg-band number of the birds in each entry (Fig. 312).

---New York State Production Poultry Show, 1923---

Name

Address

Exhibitor No.

Temple~County

Date

Receipt No.

Fee Received

Total

There should be a judge's book showing the entry numbers and coop numbers in each class (Fig. 311).

Cards made out in duplicate should be provided, giving the entry and exhibition coop number, one to be attached to the shipping coop when the birds are removed, and the other to be attached to the exhibition coop when the birds are placed in it. This facilitates the accurate receiving, placing, and returning of the birds.
As far as possible, all birds competing in the same class should be staged together. This simplifies judging and increases interest in the show.

GENERAL INFORMATION

(1) The names of the exhibitors should not be allowed to appear on the exhibition coop until after the awards have been made and the prize cards placed.
(2) The decision of the judge should be final.
(3) Visitors should not be allowed to open coops or handle birds not their own, without the presence and consent of the judge or the exhibitor.
(4) A three- or four-day show usually is sufficient to meet ordinary requirements: the first day to stage the show, the second day to judge it and place the awards, the end of the third or the fourth to close up the show.
(5) The number of classes and the amount and nature of the premiums to be awarded will depend to a large extent on the locality in which the show is held and the number of birds that are to be entered. Generally, the following will apply:

RULES AND ENTRY LIST

The following rules and entry list have been successfully combined with the preceding suggestions in the holding of a production poultry show. The rules for a show should be made to fit the local conditions.

Additional classes may be added to care for entries from persons representing particular groups, i.e., Boys’ and Girls’ Club Work, birds in other recognized associations, etc.

RULES

(1) Competition will be limited to five varieties to one exhibitor or family.
(2) A cock or hen is a male or female bird, respectively, hatched prior to January 19—.
A cockerel or pullet is a male or female bird, respectively, hatched since January 19—.

(3) All entries are to be made to Secy. and will positively close Entrance fees must be paid in full at the time the entries are made. In the case of only one competitor, 10 per cent will be deducted from the premiums. When only one entry, first or second money will be awarded, if in the judge's opinion the quality warrants this premium.

(4) All poultry entered for premiums must have been owned by the exhibitor for at least 30 days before the fair.

(5) No premiums will be awarded on birds not true to the breed or which are sick or of low vitality, or which in any way are unworthy of a prize.

(6) The same bird cannot compete in two classes.

(7) All birds entered in trapnested classes must be accompanied by the individual daily trapnest records.

(8) Each coop should be labeled with the breed and variety of poultry it contains.

5. Conducting an egg show

The object should be educational and encourage the production of better-quality market eggs. The following rules have been successfully used for several years at the Egg Show of the Northeast:

RULES

1. Competition open to all egg interests in United States and Canada.
2. No Entry Fee Charged—All eggs to become property of NEPPCO Exposition to help defray expenses; no eggs sold for hatching.
3. Make entries on attached blank and forward at once to your State Chairman.
4. Judging done according to score card, explanation printed herewith. Score card will be delivered to exhibitor after show.
5. Packing—It is suggested that eggs be carried to the show if possible or shipped in a 30-doz. egg case regardless of the number sent. Do not send by parcel post. Do not wrap individual eggs in newspaper. They are liable to soil from printers' ink.
ENTRY FORM

THIRD ANNUAL NEW YORK STATE PRODUCTION POULTRY AND EGG SHOW

Place: ........................................
Date: ........................................
Name of Exhibitor: ......................... County: ............
Address: ........................................

<table>
<thead>
<tr>
<th>Classes of Poultry</th>
<th>Number of birds entered</th>
<th>Class (mark X below)</th>
<th>Name of variety</th>
<th>Legband number</th>
<th>Amount of fee per bird</th>
</tr>
</thead>
</table>

**SECTION A. Without Pedigree or Trapnest Records**

1. Cock
2. Hen
3. Cockerel
4. Breeding pen old (4 hens and 1 cock)
5. Pen old (5 hens)
6. Pair old (cock and hen)
8. Farm flock, old (9 hens and 1 cock)

**SECTION B. With Pedigree and Trapnest Records**

9. Cock
10. Hen
11. Cockerel
12. Breeding pen old (4 hens and 1 cock)
13. Pen old (5 hens)
14. Pair old (cock and hen)
15. Pair hen
16. Farm flock, old (9 hens and 1 cock)

**SECTION C. Pullet Classes**

17. Pullet
18. Pair pullets
19. Pullet and cockerel
20. Breeding pen young (4 pullets and 1 cockerel)
21. Pen young (5 pullets)
22. Farm flock (9 pullets and 1 cockerel)

**SECTION D. Special Classes**

**Hens with Trapnest Records of 200-250 Eggs in One Year**

23. Hen
24. Pair hens
25. Pen (5 hens)

**Hens with Trapnest Records of 250 or More Eggs in One Year**

26. Hen
27. Pair hens
28. Pen (5 hens)
Properly planned educational exhibits stimulate interest in the production and consumption of eggs according to quality or grades.
6. Delivering Eggs—Eggs must reach the show by noon, to compete for awards. State Chairmen should provide special means of assembling and transporting eggs to the show. However, your eggs may be sent prepaid express.

NEPPCO Exposition. Address

---

**Fig. 314—A market egg show.**

The spectators are able to see the entries easily. Eggs are weighed and judged for both interior and exterior quality before they are displayed on the tables as shown here.

7. **Premiums**—Gold, Silver, and Bronze NEPPCO medals for first three places in each division; ribbons for first to fifth place in each class or sub-class.

A large plaque suitably inscribed and bearing the NEPPCO insignia is given as Sweepstakes Prize for best entry in Show.

**Classes**—There are ten distinct divisions:

1. **Producers**—Open to all individual producers, 1 doz. large each. Brown and White Class. Entries unlimited.

2. **Breeder and Hatchery Class**—Open to all breeders and hatcheries producing or using hatching eggs; 6 dozen Brown and White Class. Entries unlimited.

3. **Cooperative Egg Organizations**—Open to all auctions, cooperatives and quality clubs; Brown and White Class. Entry—6 doz. large on top layer of 30 doz. case. Entries unlimited.

4. **Shippers, Packers, Dealers, and Receivers**—Brown and White Class; entry—30 doz. large eggs. Entries unlimited.

5. **States Division**—Open to any state and to any province in Canada. Entry 25 doz. White or Brown, large or medium or any combination of even dozens; each dozen uniform. Sum of scores for each dozen will be total competitive score, deciding state or dominion winner.

6. **Commercial Carton**—Open to any concern or wholesale division of any concern other than individual producer cartoning eggs under
536 FITTING, EXHIBITING, AND JUDGING POULTRY

private brand; 1 doz. large each. Brown and White Class. Entries unlimited.

7. **Producer Carton**—Open to all individual producers; 1 doz. large each. Brown and White Class. Entries unlimited.

8. **4-H**—Open to all 4-H Club members. Entry 1 doz. large each. Entries unlimited. Brown and White Class.

9. **Vocational Agriculture**—Open to all Vocational Agriculture students. Entry 1 doz. large each. Entries unlimited. Brown and White Class.

10. **Egg Laying Contest**—Open to contestants; 5 pedigreed eggs from an individual bird entered in any official egg laying contest.

**SCORE CARD USED**

<table>
<thead>
<tr>
<th>Exterior Quality:</th>
<th>Cuts</th>
<th>Total Cuts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Size (dozen)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut 6, if av. wt. is within one oz. above or below class wt.; cut 12, if more than one oz. See disqualification on total wt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Uniformity of Weight (per egg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2 for each egg varying over 1/2 to 1 oz. from predominating wt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 for each egg varying over 1 oz. from predominating wt. If two or more groups with the same number of eggs exist, calculate from group resulting in least cut.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Uniformity of Shape</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/4 for each egg differing from average.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Uniformity of color</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/4 for cream or tint in white eggs; or varying from average color in brown eggs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Shell Texture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/4 for rough shell, porous shell or blind check.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 for each leaker, smashed, or cracked egg.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Condition (Cleanliness, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/4–1/3 for dirty or stained eggs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Interior Quality:**

<table>
<thead>
<tr>
<th>Fancy grade</th>
<th>No cuts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade A</td>
<td>Cut 3/4 point for each A</td>
</tr>
<tr>
<td>Grade B</td>
<td>Cut 1 1/4 points for each B</td>
</tr>
<tr>
<td>Grade C</td>
<td>Cut 2 1/4 points for each C (incl. small blood and meat spots)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Totals Cuts</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>X</td>
</tr>
</tbody>
</table>

**Disqualifications:**

1. Total wt. of large eggs less than 22 oz. per doz.
2. Total wt. of medium eggs less than 20 oz. per doz.
3. Inedible eggs, including large blood and meat spots or germ development.
4. Signs of incubation.
APPLICATION FOR ENTRY

This form should be filled out at once and sent to your State Chairman as listed in this program.

I will make the following entries in NEPPCO's "EGG SHOW." I will have these eggs delivered before noon, October 13th. I wish to have these eggs entered in the division that I check below:

- Producer
- Breeder and Hatchery
- Cooperative
- Shippers, Packers, Etc.
- States Division

<table>
<thead>
<tr>
<th>Commercial Carton</th>
<th>Producer Carton</th>
<th>4-H Clubs</th>
<th>Vocational Agriculture</th>
<th>Egg Laying Contest</th>
</tr>
</thead>
</table>

Name ..........................................................
Address ...................................................... State ...........

6. Baby-chick shows

These shows are popular. They are an effective way of teaching the differences existing between various grades of chicks.

![LITTLE JOURNEYS OF TWO EGGS](image)

**Fig. 315.**
The cartoon type of exhibit attracts and teaches.

![Baby-chick show at Kingston, N. Y.](image)

**Fig. 316—A baby-chick show at Kingston, N. Y.**

Note arrangement of chick entries and position of judges.
### BABY-CHICK SCORE CARD

#### 25-Chick Entry

<table>
<thead>
<tr>
<th>Total cuts</th>
<th>Deduct 4 points for each dead chick arriving at the show</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead chicks</td>
<td>2 pounds 1 ounce is considered standard weight for an entry of 25 chicks. Deduct 6 points for every ounce below.</td>
</tr>
<tr>
<td>Weight</td>
<td>Deduct 1/2 point for each deformity, imperfectly healed navel, pasty vent, or sign of a sticky hatch.</td>
</tr>
<tr>
<td>Vigor</td>
<td>Deduct 1 point for each chick showing the following disqualifications: Type of comb foreign to the breed and variety. Side sprigs in single combs. In all breeds required to have unfeathered shanks, any down, feather or feathers, stub, stubs, or feather-like growth on shanks, feet, toes, or hocks; or unmistakable indications of down, feathers, stub, or stubs having been plucked from same. Color of shank foreign to the breed. Web feet in any breed of chickens, or abnormal number of toes for the breed and variety.</td>
</tr>
<tr>
<td>Condition</td>
<td>Deduct 1 point for each chick whose down or leg color varies from the average of the entry.</td>
</tr>
<tr>
<td>Uniformity of color</td>
<td>Deduct 1/2 point for each chick not showing the maximum of alert, snappy activity when judged. Consider eye and shank condition in determining vigor.</td>
</tr>
<tr>
<td>Uniformity of size</td>
<td>Deduct 1/2 point for each chick varying over 5 grams from the average chick weight of the entry.</td>
</tr>
<tr>
<td>Conformity to breed characteristics</td>
<td>Deduct 4 points for each chick showing the following disqualifications: Type of comb foreign to the breed and variety. Side sprigs in single combs. In all breeds required to have unfeathered shanks, any down, feather or feathers, stub, stubs, or feather-like growth on shanks, feet, toes, or hocks; or unmistakable indications of down, feathers, stub, or stubs having been plucked from same. Color of shank foreign to the breed. Web feet in any breed of chickens, or abnormal number of toes for the breed and variety.</td>
</tr>
</tbody>
</table>

#### Entry disqualified if positive evidence of disease is present.
COMMUNITY SURVEY

1. Is a winter poultry show held in the community?
2. Is a poultry show held at the local or county fair?
3. Are the birds judged for production value only or for breed characteristics only or both?
4. How many poultry keepers in your vicinity exhibit at the shows or fairs?
5. Inquire how they select birds for exhibition.
6. Is poultry shipped to shows outside the county?
7. If so, what shows are patronized?
8. Inquire what prizes have been received.
9. What differences in selection are made, if any, for birds exhibited at fairs, local shows, or shows out of the county?
10. What are the reasons for these differences?
11. What care and preparation are given to poultry sent out of the county to shows?
12. What care and preparation are given to poultry sent to local fairs and shows?
13. What reasons are given for this?

REFERENCE

CHAPTER XXVII

CLASSES, BREEDS, AND VARIETIES

The prospective poultry keeper has a larger number of varieties to select from than has any other breeder of livestock. These varieties differ widely in size, type, color, vitality and productivity. Therefore, it is essential that the different varieties, as well as the breed characteristics, be recognized.

It may be said that no matter whether a person is interested in meat or egg production or in the growing of poultry for ornamental purposes, he will be able to find a variety of poultry possessing both the size and shape of body and the plumage color pattern that will satisfy him, however exacting he may be.

When one considers the great number of varieties and the extreme differences in size, shape, and color that are found among chickens, and realizes that all presumably originated from one or two wild species which may even now be found in their native haunts, the results seem little less than marvelous.

The number of breeds and varieties of chickens now recognized is so large that the average person who has not made a study of the subject finds himself confused in attempting to identify breeds. At poultry shows, where birds are carefully cooped and each variety numbered, one can, by means of the printed catalogues, identify the particular bird in question. Certain varieties have outstanding points by which the amateur will remember them. All varieties differ one from another in

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1 Space prohibits any attempt to discuss the historical development of breeds. This may be studied in various poultry books and bulletins, some of which are listed at the end of this chapter.
some respect, but the difference in some cases is slight. The same color patterns of plumage may be found on several breeds.

Operations:

1. Studying the parts of a fowl.
2. Studying the shape and location of feathers.
4. Studying comb types.
5. Studying heads.
7. Studying body shape.
8. Identifying breeds and varieties.

General information:

1. The American Standard of Perfection.
2. Definition of terms.
3. Classification according to "The American Standard of Perfection."

1. Studying the parts of a fowl

Definitions and key to the diagrams of the body parts and feather sections. Refer to Figs. 317, 318, 319 and 320.

11. Front of hackle. See illustration of male.
12. Neck. The part of the fowl which unites the body with the head and allows the head to be turned freely in various directions.
14. Breast. The part of the fowl extending from the lower part of the neck to the keel.
15. Cape. The feather section at the junction of the neck and back just beneath the hackle of the male or neck feathers of the female.
16. Shoulder. The upper section of the wing.
17. Wing. The organ of flight.
18. Wing-bow. The shoulder feathers.
19. Wing-front. The front section of the shoulder.
20. Wing-coverts (wing-bar).
22. Primaries (flight feathers.)
23. Primary coverts.
24. Back. The part of the body between the neck and the saddle or cushion.
25. Saddle. The feather section of the male overlapping the base of the tail.
27. Cushion. The feather section of the female overlapping the base of the tail.

![Diagram of a chicken with labeled parts](image)

**Fig. 317—Parts of a male.**

Drawn from the American Standard of Perfection.

28. Tail. The rump and the feathers which are found on it.
29. Sickles.
30. Smaller sickles.
31. Tail coverts.
32. Main tail feathers.
33. Abdomen. The part of the body between the rump and the keel.
34. Body feathers.
35. Keel. The sternum. (Fig. 77.)
36. Fluff.
37. Leg. The organ of locomotion, including the feet, shank, hock, thigh, and second joint.
38. Thigh. That part of the leg above the hock. The “first joint” or drumstick formed by the fibula and tibia, and “second joint” formed by the femur. (Fig. 77.)

![Diagram of a chicken showing parts of a female]

**Fig. 318—Parts of a female.**
*Drawn from the American Standard of Perfection.*

39. Hock. The joint between the thigh and the shank.
40. Shank. The part of the leg between the foot and the hock. (The metatarsus, Fig. 77.)
41. Spur. The horny growth on the shank.
42. Feet. The lower parts of the legs, including the toes.
43. Toes. The appendages of the feet.
44. Toe-nails. The nails on the end of each toe.

2. **Studying the shape and location of feathers**

Figures 319 and 320 show drawings of feathers from different sections of the body. In studying feathers from birds of the
same variety, notice that there is always a similarity and that feathers of the same size and shape will always be found on

the same section of birds of the same sex and same variety. The feathers from each section differ in shape, size, and struc-
ture from feathers on other sections of the same fowl. This difference is always found in normally developed fowls.

The illustrations show the relative size, structure, and name of each type of feather.
Compare the feathers from the corresponding section of the male and female. Note that there is little or no difference, except perhaps in size, between the following: leg, thigh, fluff, flight covert, wing covert, secondary, primary, main tail, and breast.

The remaining feathers (with the exception of the sickle and smaller sickle, which do not appear on the female) are more pointed in the male. (This difference in structure and shape of the saddle hackle of the cockerel and the cushion of the pullet is often used in determining sex when separating cockerels and pullets during the brooding and rearing season.)

<table>
<thead>
<tr>
<th>Section</th>
<th>Name of feathers</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>Neck hackle</td>
<td>The long, narrow, pointed feathers found on the neck of the male and female.</td>
</tr>
<tr>
<td>Back</td>
<td>Back feathers</td>
<td>The short, broad feathers of the back.</td>
</tr>
<tr>
<td>Saddle</td>
<td>Saddle hackle</td>
<td>The narrow, pointed feathers overlapping the base of the tail of the male.</td>
</tr>
<tr>
<td>Cushion</td>
<td>Cushion feathers</td>
<td>The round-tipped feathers overlapping the base of the tail on the female.</td>
</tr>
<tr>
<td>Breast</td>
<td>Breast feathers</td>
<td>The short, broad feathers covering the breast.</td>
</tr>
<tr>
<td>Sickle</td>
<td>Sickle feathers</td>
<td>The longer flowing feathers of the tail of the male.</td>
</tr>
<tr>
<td>Smaller sickle</td>
<td></td>
<td>The shorter flowing feathers of the tail of the male.</td>
</tr>
<tr>
<td>Main tail feathers</td>
<td></td>
<td>The broad, flat, upright feathers of the tail.</td>
</tr>
<tr>
<td>Tail</td>
<td>Tail coverts</td>
<td>The smaller, flowing, pointed feathers in the male and the more blunt feathers in the female, extending partly over the main tail feathers.</td>
</tr>
<tr>
<td>Primary</td>
<td>Primaries</td>
<td>The 10 long, stiff feathers on the outer (metacarpus) section of the wing. (Fig. 77.)</td>
</tr>
<tr>
<td>Secondary</td>
<td>Secondary feathers</td>
<td>The large feathers which grow on the wing section formed by the ulna and radius. When the wing is folded they are seen at the lower end. The wing-bar.</td>
</tr>
<tr>
<td>Wing</td>
<td>Wing coverts</td>
<td>The feathers overlapping the base of the secondaries. In parti-colored varieties they frequently form a distinct bar across the wing. The wing-bar.</td>
</tr>
<tr>
<td>Shoulder feathers</td>
<td></td>
<td>The short feathers overlapping the wing coverts. The wing-bow.</td>
</tr>
<tr>
<td>Body</td>
<td>Body feathers</td>
<td>The medium-sized feathers covering the body where not otherwise protected.</td>
</tr>
<tr>
<td>Fluff</td>
<td>Fluff feathers</td>
<td>The soft feathers covering the abdomen back of the legs and below the tail.</td>
</tr>
<tr>
<td>Thigh</td>
<td>Thigh feathers</td>
<td>The short, fluffy feathers covering the thighs.</td>
</tr>
<tr>
<td>Shank</td>
<td>Leg feathers</td>
<td>The stiff feathers found on the shanks of feather-legged varieties.</td>
</tr>
</tbody>
</table>
Fig. 321—Feather color patterns.
3. Studying plumage color patterns (Fig. 321)

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Definition</th>
<th>Example Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barred</td>
<td>A feather having bars across the web at right angles to the shaft.</td>
<td>Barred Plymouth Rock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dominique</td>
</tr>
<tr>
<td>Horizontal pen-</td>
<td>A feather having narrow straight stripes across the vane at right angles</td>
<td>Silver or Golden Pencil</td>
</tr>
<tr>
<td>ciling</td>
<td>to the shaft.</td>
<td>Golden Hamburgs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partridge Wyandotte</td>
</tr>
<tr>
<td>Crescentic Pen-</td>
<td>A feather having narrow stripes on the vane which follow the outline of</td>
<td>Hackle of Brahmash or</td>
</tr>
<tr>
<td>ciling</td>
<td>the feather, forming a crescent.</td>
<td>Brown Leghorns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silver or Golden Hamburgs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silver or Golden Wyandotte</td>
</tr>
<tr>
<td>Striped</td>
<td>A feather having a stripe through the center on a web of another color</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spangled</td>
<td>A feather having a dark-colored, roundish marking on the vane near the tip.</td>
<td></td>
</tr>
<tr>
<td>Laced</td>
<td>A feather having an edge or border differing from the color of the central</td>
<td></td>
</tr>
<tr>
<td></td>
<td>part of the feather.</td>
<td></td>
</tr>
<tr>
<td>Stippled</td>
<td>A feather having fine dots sprinkled or stippled over a vane of a different</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mottled</td>
<td>A dark-colored feather tipped with white.</td>
<td></td>
</tr>
</tbody>
</table>

**Feather Coloration**

- **Solid White**: A feather without other color than pure white.
- **Solid Black**: A feather without other color than black.
- **Solid Buff**: A feather without other color than buff.
- **Red**: A feather without other color than red.

Many variations of these colors are found, as, for example, rich golden buff, pale or light buff, or medium buff.

It is only rarely that perfectly marked plumage will be found in all sections of a fowl. Frequently, birds of a known variety are so poorly marked, both in distribution of the feathers and in the color patterns, as to be worthless from the plumage standpoint. In identifying birds, therefore, according to plumage color, practice and experience are often great helps.

4. Studying comb types (Figs. 322-324)

The well-recognized types of combs to be found on our domestic fowls are:
Comb | Definition | Example Varieties
--- | --- | ---
Single | A single serrated (notched) fleshy growth on top of the head. It may be large, medium or small; thick or thin; deeply or lightly serrated; erect or lopped. | Rocks, Leghorns
Rose | A thick, solid comb, covered at the top with fine points and terminating in a spike at the rear. | Hamburgs, Wyandottes, Rose Comb Rhode Island Reds
Pea | A comb resembling three low, thick, slightly serrated, single combs, grown together, the center comb slightly higher than the other two. | Brahma, Sumatra
Strawberry | A fleshy growth so named because of its similarity in shape and color to a strawberry. | Malay
Cushion | A solid, low comb, set well forward, front and rear square, sides straight, and having a smooth surface. | Chanticleer
Buttercup | A deep cup-shaped comb formed by a circle of serrations, resting on a single base. | Buttercup

5. Studying heads (Fig. 322)

The main difference in the head points which differentiate between breeds and varieties of fowls, in addition to the comb, are as set forth in the following table:

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Example Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beard</td>
<td>A group of feathers hanging from the throat.</td>
<td>Sultan, certain varieties of Polish</td>
</tr>
<tr>
<td>Muff</td>
<td>A group of feathers on the sides of the face below the eyes, extending from the beard to the earlobes. Found only on bearded varieties.</td>
<td>Sultan, certain varieties of Polish</td>
</tr>
<tr>
<td>Crest</td>
<td>A group of feathers on top of the head.</td>
<td>Sultan, certain varieties of Polish</td>
</tr>
<tr>
<td>White Face</td>
<td>Enlarged earlobes meeting in front of and extending well backward and downward on each side of the neck, and covering the face.</td>
<td>Black Spanish</td>
</tr>
</tbody>
</table>

6. Studying shanks and toes

Most varieties of fowls have four toes on each foot. In a few cases, such as the Houdan, Faverolle, Sultan, and Dorking,
Fig. 322—Types of combs and heads.
there are five toes on each foot (Fig. 326). The fifth toe is located below the spur and above the rear or first toe (Fig. 77).

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Example Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feathered Shanks</td>
<td>Shanks feathered down the outside from thigh to toes. Feathering differs with the variety; for example, on Cochins and Brahmas the middle and outer toes are feathered, while on the Langshan the middle toe should be free from feathers.</td>
<td>Brahmas, Cochins, Langshans</td>
</tr>
<tr>
<td>Vulture Hocks</td>
<td>Stiff, quill feathers growing on the thighs, extending backward, straight beyond the knee joint, or hock.</td>
<td>Sultan, Mile Fleur, Booted Bantams</td>
</tr>
</tbody>
</table>

R. C. White Leghorn

Wyandotte

Hamburg

Fig. 323—Rose comb types.
Note position of the spike.

Fig. 324—Cushion comb.
Drawn from American Standard of Perfection.
7. Studying body shape

A study of Figs. 327 to 329 shows differences in body shape between certain breeds of fowls, as outlined in the American Standard of Perfection. Occasionally the shape or size of body will be the only difference between certain varieties of fowls. For example, the Rose Comb Rhode Island White is similar to the White Wyandotte except in shape of body. The Jersey Black Giant and the Black Java are similar as they appear side by side except that the Giant is supposedly larger. (Examination of the undercolor should show a difference, the Java being dull black and the Giant slate color shading to white at the skin.)

It is well, therefore, to become familiar with the shape of several outstanding breeds in, at least, the three classes, American, Mediterranean, and Asiatic.

8. Identifying breeds and varieties (Key on page 556)

The general plan to be followed when determining the variety, as here outlined, is:

1. Earlobe ........ Red or White
2. Shanks ........ Feathered or Non-feathered
3. Skin ............. Yellow or White
4. Toes ............. 4 or 5
5. Feathering ...... Loose or Close
6. Comb ............. Single, Rose, Pea, V, Strawberry,
                   Cushion, or Buttercup
7. Size ............. Large or Small
8. Crest ............. Present or Absent
9. Beard and Muff . Present or Absent

**STANDARD DIFFERENCES IN BODY SHAPE**

![Diagram of bird shapes]

**MEDITERRANEAN CLASS**

Leghorns ■ Anconas ■■ Minorcas ■

Fig. 327.

Three important standard varieties of the same class superimposed to show general uniformity of shape. Note difference in back lines.

*Example.* It is well to try the key with a bird of a known variety. When the method of using it is thoroughly in mind, it may be used with birds the variety of which is unknown to the person using the key.

Suppose, for example, we have a bird and wish to determine the variety. Examining the bird in accordance with the general plan given above and the key on page 556, we find the following:
Three important standard varieties of the same class superimposed to show the variation in shape.

Three important varieties of the Asiatic class superimposed. Note general similarity in type and differences in tail, fluff, and breast.
Example 1.—Bird No. 1

General Plan and Key

The Bird

Earlobes ......................... Red
Shanks .......................... Non-feathered

Since A is "Shanks feathered" (page 556) we must turn to B, which is on page 557. There we find "Shanks Non-feathered."

Now proceed with the next character, which is skin color.

Skin ................................ Yellow
Feathering .......................... Loose
Comb .............................. Rose
Size .................................. Large
Plumage ........................... White

The variety is White Wyandotte.
It will be seen that when a character is found on the key the next character to consider is the one directly following.

Example 2.—Bird No. 2

Key

The Bird

Earlobes .......................... White

Since classification I in the Key is "Earlobes red" it will be necessary to turn to page 562 under II "Earlobes white."

Shanks .......................... Non-feathered
Skin .............................. Yellow
Comb ............................. Single
Plumage ........................... White

Variety, White Leghorn.

KEY FOR BREED IDENTIFICATION

The following key has been revised to apply to all 1938 Standard Varieties of Fowls. The key may be used either for

1 First worked out in 1910 by Prof. C. A. Rogers, formerly of Cornell University.
identifying varieties or in noting how the varieties differ in the arrangement of external characters.

I. Earlobes red.
   A. Shanks feathered.
      1. Skin yellow.
         a. Comb pea.
            (1) Size large.
               Plumage:
               (a) Body white, hackle and tail black laced with white,
                   Light Brahma.
               (4) Male—breast black, back silvery white,
                   Female—gray with dark crescentic penciling,
                   Dark Brahma.
               (c) Buff,
               (2) Size small.
               Plumage:
               (a) Body white, hackle and tail black laced with white,
                   Light Brahma Bantam.
               (b) Male—breast black, back silvery white,
                   Female—gray with dark crescentic penciling,
                   Dark Brahma Bantam.

b. Comb single.
   (1) Size large.
   Plumage:
   (a) Black,
   (b) Buff, Black Cochin.
   (c) Male—breast black, back red,
       Female—brown with black crescentic penciling,
       Partridge Cochin.
   (d) White, White Cochin.
   (2) Size small.
   Plumage:
   (a) Black, Black Cochin Bantam.
   (b) Buff, Buff Cochin Bantam.
   (c) Male—breast black, back red,
       Female—brown with black crescentic penciling,
       Partridge Cochin Bantam.
   (d) White, White Cochin Bantam.
   (e) Male—breast feathers golden bay tipped with black bars and white spangles,
       Female—Golden buff each feather tipped with a black bar and a white spangle,
       Mille Fleur Booted Bantam.
2. Skin white.
      (1) Comb single.
         (a) Size large.
            Plumage:
            (1) Black,          Black Langshan.
            (2) White,         White Langshan.
      (b) Size small.
         Plumage:
            (1) White,          Booted White Bantam.

   b. Toes—5.
      (1) Comb single.
         (a) Beard and muff.
            Plumage:
            (1) Male—breast black, back reddish-brown,
                 Female—salmon brown,        Salmon Faverolle.
      (2) Comb V.
         (a) Crested and bearded.
            Plumage:
            (1) White,          Sultan.

B. Shanks non-feathered.

1. Skin yellow.
   a. Feathering loose.
      (1) Comb rose.
         (a) Size large.
            Plumage:
            (1) Barred,          Dominique.
            (2) Black,           Black Wyandotte.
            (3) Buff,            Buff Wyandotte.
            (4) Body white, hackle and tail black laced with
                white,           Columbian Wyandotte.
            (5) Golden, laced with black, Golden Wyandotte.
            (6) Male—breast black, back red,
                 Female—brown with black crescentic penciling,
                 Partridge Wyandotte.
            (7) Silver laced with black, Silver Wyandotte.
            (8) Male—breast black, back silver white,
                 Female—gray with dark crescentic penciling,
                 Silver Penciled Wyandotte.
            (9) White,          White Wyandotte.
            (10) White, back long, horizontal,   Rhode Island White.
            (11) Red,           Rhode Island Red.
(b) Size small.
The shape and color of the large Wyandottes conform to the corresponding varieties in Bantams for White, Black, Buff, Partridge, Silver-penciled, and Columbian.

(2) Comb single.

(a) Size large.

Plumage:

(1) Rich red,  
Rhode Island Red.

(2) Medium chestnut red,  
New Hampshire.

(3) Black, under color dull black,  
Black Java.

(4) Black, size larger than Java. Undercolor slate shading to white at skin,  
Jersey Black Giant.

(5) Black with white-tipped feathers,  
Mottled Java.

(6) Barred,  
Barred Plymouth Rock.

(7) Buff,  
Buff Plymouth Rock.

(8) Body white, hackle and tail black, laced with white,  
Columbian Plymouth Rock.

(9) Male—breast black, back red,  
Female—brown with black crescentic penciling,  
Partridge Plymouth Rock.

(10) Male—breast black, back silvery white,  
Female—gray with dark crescentic penciling,  
Silver Penciled Plymouth Rock.

(11) White,  
White Plymouth Rock.

(12) White, breast full, body low on hocks,  
Lamona.

(13) Blue,  
Blue Plymouth Rock.

(b) Size small.

Plumage:

(1) Body white, tail black,  
Black-tailed Japanese Bantam.

(2) Black,  
Black Japanese Bantam.

(3) White,  
White Japanese Bantam.

(4) Male—breast black laced with silvery gray, back silvery white,  
Female—breast black laced with white, back black,  
Gray Japanese Bantam.

b. Feathering close.

(1) Comb pea.

Plumage:

(a) Black,  
Black Sumatra.
(b) Male—breast black, back red, 
    Female—red with black crescentic penciling, 
    Dark Cornish.

(c) Red with white lacing, White laced Red Cornish.

(d) White, White Cornish.

(2) Comb single.

(a) Size large.

Plumage:
Tail rather short, compact, closely folded. Hackle short, close to body.

(1) Breast black, laced with white, Birchen Game.

(2) Black, Black Game.

(3) Male—breast black, back red, hackle golden,
    Female—back grayish brown stippled with golden brown, Black-breasted Red Game.

(4) Breast black, laced with lemon,
    Brown Red Game.

(5) Male—breast black, back and wing bows golden,
    Female—breast rich salmon, back gray stippled with darker gray, Golden Duckwing Game.

(6) Male—breast white, back red,
    Female—breast salmon, back white,
    Red Pyle Game

(7) Male—breast black, back and wing bows silver,
    Female—breast light salmon, back light gray stippled with darker gray,
    Silver Duckwing Game.

(8) White, White Game.

(b) Size small.

Plumage: Tail rather short, compact, closely folded. Hackle short, close to body.

(1) Breast black, laced with white, 
    Birchen Game Bantam.

(2) Black, Black Game Bantam.

(3) Male—breast black, back red, hackle golden,
    Female—back grayish brown stippled with golden brown,
    Black-breasted Red Game Bantam.

(4) Breast black laced with lemon, 
    Brown Red Game Bantam.

(5) Male—breast black, back and wing bows golden,
Female—breast rich salmon, back gray stippled with darker gray,

Golden Duckwing Game Bantam.

(6) Male—breast white, back red,
Female—breast salmon, back white,

Red Pyle Game Bantam.

(7) Male—breast black, back and wing bows silver,
Female—breast light salmon, back light gray stippled with darker gray,

Silver Duckwing Game Bantam.

(8) White,

White Game Bantam.

(3) Comb strawberry.

(a) Size large.

Plumage:

(1) Male—breast black, back red,
Female—cinnamon brown,

Black Breasted Red Malay.

(b) Size small.

Plumage:

(1) Male—breast black, back red,
Female—cinnamon brown,

Black Breasted Red Malay Bantam.

(4) Comb cushion.

Plumage:

(1) White,

White Chanticleer.

(2) Male—breast black, back red,
Female—brown with black crescentic penciling,

Partridge Chanticleer.

2. Skin white.

a. Feathering loose.


(a) Comb rose.

(1) Size large.

Plumage:

(a) Male—breast black, back red,
(b) Female—brown with black spangles,

Redcap.

(2) Size small.

Plumage:

(a) Golden laced with black,

Golden Sebright Bantam.

(b) Silver laced with black,

Silver Sebright Bantam.
(b) Comb single.
   Plumage:
   (1) Black,  Black Orpington.
   (2) Blue,  Blue Orpington.
   (3) Buff,  Buff Orpington.
   (4) White,  White Orpington.
   (5) Red,  Red Sussex.
   (6) Reddish brown, each feather tipped with a bar of
       black and a white spangle,  Speckled Sussex.
   (7) White, hackle and tail black edged with white,  Light Sussex.
   (8) Black, legs and toes dark slate,  Australorp.

(c) Comb V.
   Plumage:
   (1) Black, bearded and crested,  Crevecoeur.

2. Toes—5.
   (a) Comb rose.
   Plumage:  White Dorking.
   (b) Comb single.
   Plumage:
   (1) Male—breast black, hackle and saddle straw color,
       Female—breast dark salmon edged with black,
       back black with light bay shafting,  Colored Dorking.
   (2) Male—breast black, back and hackle silvery
       white, Female—back gray, stippled with darker
       gray,  Silver Gray Dorking.

b. Feathering close.
   Plumage: Tail well spread. Hackle, long, covering
   shoulders,  Old English Games.
   Old English Game Bantams.

   (The descriptions for Games and Game Bantams above
   apply to the Old English varieties with these exceptions:
   Brown Red and Red Pyle are not included in Old English
   Game Bantams. The Birchen appears in neither the Old
   English Games nor Game Bantams.)

   1. Size large.
      Plumage: Red, each feather tipped with white spangle,  Old English Spangled Game.

   2. Size small.
      Plumage, red, each feather tipped with white spangle,  Old English Spangled Game Bantams.
II. Earlobes white.
   A. Shanks non-feathered.
      1. Skin yellow.
         (a) Comb rose.
         Plumage:
         (1) Male—breast black, back red, neck and hackle red, 
             front of neck black,
             Female—back dark brown stippled with black,
             Dark Brown Leghorn.
         (2) Male—breast black, back red, neck and hackle orange, 
             front of neck black slightly mottled with salmon,
             Female—back light brown, stippled with darker brown,
             Light Brown Leghorn.
         (3) White, White Leghorn.
         (4) Black with white-tipped feathers, Mottled Ancona.
         (b) Comb single.
         Plumage:
         (1) Black, Black Leghorn.
         (2) Male—breast black, back red, neck and hackle red, 
             front of neck black,
             Female—back dark brown stippled with black,
             Dark Brown Leghorn.
         (3) Male—breast black, back red, neck and hackle orange, 
             front of neck black slightly mottled with salmon.
             Female—back light brown, finely stippled with darker brown,
             Light Brown Leghorn.
         (4) Buff, Buff Leghorn.
         (5) Male—breast black, back and hackle silvery white,
             Female—gray stippled with darker gray,
             Silver Leghorn.
         (6) Red, Red Leghorn.
         (7) Red with main tail feathers black,
             Black-tailed Red Leghorn.
         (8) White, White Leghorn.
         (9) Body white, hackle and tail black laced with white,
             Columbian Leghorn.
         (10) Black with white-tipped feathers, Mottled Ancona.

2. Skin white.
   A. Toes—4.
      1. Comb rose.
         a. Size large.
         Plumage:
         (1) Golden with black spangles,
             Golden Spangled Hamburg
(2) Silver with black spangles,  
   **Silver Spangled Hamburg.**

(3) Male—reddish bay, secondaries with black parallel penciling,  
   Female—bay with black parallel penciling,  
   **Golden Penciled Hamburg.**

(4) Male—body white, secondaries with dark parallel penciling,  
   Female—white with black parallel penciling,  
   **Silver Penciled Hamburg.**

(5) White,  
   **Shape:**  
   (a) Back short and curved, comb small,  
      **White Hamburg.**  
   (b) Back long and straight, comb large,  
      **White Minorca.**

(6) Black,  
   **Shape:**  
   (a) Back short and curved, comb small,  
      **Black Hamburg.**  
   (b) Back long and straight, comb large,  
      **Black Minorca.**

b. Size small.  
   **Plumage:**  
   (1) Black,  
      **Black Rose Comb Bantam.**  
   (2) White,  
      **White Rose Comb Bantam.**

2. Comb single.  
   **Plumage:**  
   (a) Blue,  
      **Blue Andalusian.**  
   (b) Golden with black parallel penciling,  
      **Golden Campine.**  
   (c) Silver with black parallel penciling,  
      **Silver Campine.**  
   (d) White,  
      **White Minorca.**  
   (e) Black.  
      (1) Red face,  
      **Black Minorca.**  
      (2) White face,  
      **White Faced Black Spanish.**  
   (f) Buff,  
      **Buff Minorca.**

3. Comb V.  
   (a) Non-crested or bearded.  
      **Plumage:**  
      (1) Black,  
      **La Flèche.**  
   (b) Crested but not bearded.  
      (1) Size large.
564 CLASSES, BREEDS, AND VARIETIES

Plumage:
(a) Golden, laced with black, 
   **Non-bearded Golden Polish.**
(b) Silver, laced with black, 
   **Non-bearded Silver Polish.**
(c) Body black, crest white, 
   **White Crested Black Polish.**
(d) White non-bearded, 
   **White Polish.**
(e) Buff laced with lighter buff, 
   **Non-bearded Buff Laced Polish.**

(2) Size small.
Plumage:
(a) Non-bearded. The above varieties of Polish 
   are duplicated in miniature in the Polish Bantams.

(c) Crested and bearded.
(1) Size large.
Plumage:
(a) Buff laced with lighter buff, 
   **Buff Laced Polish.**
(b) Golden laced with black, 
   **Bearded Golden Polish.**
(c) Silver laced with black, 
   **Bearded Silver Polish.**
(d) White, 
   **Bearded White Polish.**

(2) Size small.
Plumage:
(a) Bearded. The above varieties of Polish are 
   duplicated in miniature in the Polish Bantams.

4. Comb buttercup.
Plumage:
(a) Male—red, sickles black, 
   Female—back golden buff with black spangles, 
   **Buttercup.**

B. Toes—5.
1. Comb V.
(a) Crested and bearded.
Plumage:
(1) Black and white tipped feathers, 
   **Mottled Houdan.**
(2) White, 
   **White Houdan.**
GENERAL INFORMATION

Miscellaneous:
Shanks, skin, and earlobes purple. Feathers white and silky, Non-Bearded White Silky.

Same except bearded, Bearded White Silky.

• Feathers curled, comb single, plumage black, white, red, or bay, Frizzle.

GENERAL INFORMATION

1. "The American Standard of Perfection"

This is the title of a book published by the American Poultry Association and is the official guide for judging Exhibition Poultry. The first edition was published in February, 1874. The book is revised and brought down to date every five years. Practically all recognized breeds and varieties are listed in the "Standard," together with a description of the size and shape and color of each.

2. Definition of terms

The "Standard" classifies fowls under Class, Breed, and Variety.

Class is a subdivision of species or families and includes Breeds. It refers usually to the place of origin.

Breed consists of a group of fowls having distinct size and shape characteristics, and, to a large degree, habits.

Variety refers to fowls within the breed and differing in (1) Type of Comb, (2) Color of Plumage, (3) Presence or Absence of Crest, Beard or Muff, etc.

Strain is a family of any variety of fowls bred in line of descent by one person, or by one person and his successor, during a number of years, and that has acquired individual characteristics which distinguish it more or less from other strains or specimens of the same variety. There may be greater differences between strains of fowls than between varieties, or, in many cases, between the breeds within a class.

3. Classification according to "The American Standard of Perfection"

In the following, S. C. and R. C. stand for Single Comb and Rose Comb, respectively.
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Certain varieties within a breed may have slight differences in points affecting usefulness. They are so similar in all useful characteristics, however, that the class may be the major consideration when selecting fowls. The wide range of plumage color within a class makes it possible for any person to select the particular breed or variety to his liking, without sacrificing the important class characteristics. Where one variety of a class will thrive, any other variety in the same class may be expected to produce similar results. This fact makes it possible to study the characteristics of the domestic fowl by classes, leaving the student to realize that important differences do occur between the varieties of a breed and between breeds. Many of these differences, however, may be due to the strains within a variety.
THE AMERICAN CLASS

Adaptability to management. Stand confinement well, a 5-foot fence usually being high enough for yarding. A tendency to take on surplus fat.

Production. Generally good.

Marketing. Egg size, about 2 ounces. Color, a rich brown, except for Wyandottes, whose eggs run lighter and more uneven in color. Rather slow to mature and therefore better as large broilers, fryers, roasters, and capons. Skin, yellow and attractive. Fairly heavy in bone. Flesh of excellent quality.

Rate of maturity. Require six to eight months from hatching to laying condition.

Broodiness. Strong tendency. Excellent sitters and mothers.

Fertility and hatchability. Not as high as the Mediterranean class.


Foragers. Not easily frightened. Range over a fairly wide area.

Hardiness. Very hardy. Less affected by sudden variations in temperature than the Mediterranean class.

Popularity. Very popular for eggs, meat, or exhibition purposes.

THE ASIATIC CLASS

Adaptability to management. Easily confined, a 3- or 4-foot fence being sufficiently high for yarding. Require care in feeding to avoid overfatness.

Production. Generally lower than the American class, although Brahmas and Langshans have made satisfactory records in certain cases.

THE MEDITERRANEAN CLASS

Rate of maturity. Very slow, requiring eight or nine months to reach laying condition.

Broodiness. Strong tendency. Too heavy to be desirable sitters or mothers. Very faithful.

Fertility and hatchability. Lower than the American class.

Disposition. Quiet, easily tamed and seldom excited. Likely to be sluggish, slow in movement, lazy and inactive. Tendency to take on fat.

Foragers. Prefer to remain quiet rather than to forage for food.

Hardiness. Very hardy. Better able to withstand extreme cold than birds of most classes.

Popularity. Very popular where a large carcass is desired for the table or for market purposes.

THE MEDITERRANEAN CLASS

Adaptability to management. Stand confinement well. Require at least a 6-foot fence if the area is small or a 5-foot fence with ample range.

Production. Known as the egg breeds.

Marketing. Egg size standard, i.e., about 2 ounces each. Egg color, white. Produce the best squab broilers, weighing from \( \frac{7}{2} \) to 1 pound each. The Black Minorca is especially noted for laying a very large egg.

Rate of maturity. Rapid, reaching laying condition at five to seven months old and the squab broiler stage sooner than other classes.

Broodiness. Comparatively non-broody.

Fertility and hatchability. Unexcelled.

Disposition. Very active, nervous, quick, timid, easily frightened.

Foragers. Prefer to keep within easy distance of their house. When they have been carefully reared and seldom scared, and the range conditions are favorable, they will range
over a large area, especially in the early morning or late afternoon.

**Hardiness.** Very hardy. Affected by extreme cold, owing primarily to their larger comb and wattles. Quick to recuperate from severe weather conditions.

**Popularity.** Universally popular for commercial egg production.

**THE ENGLISH CLASS**

Very similar to the American. All, but Cornish have white skin. They are a little less active than the American class and are not as good foragers. Bred for both meat and egg production. Excellent mothers. Below the American Class in production. Not especially popular in America. The Cornish, formerly classed with the Orientals and now classed as English, are of game type, rather poor layers, but with an abundance of hard meat over the breast and on the legs.

**THE HAMBURGS**

Timid, active and small. Good producers of small white eggs which are difficult to market satisfactorily. Chicks reach maturity quickly. Fairly satisfactory squab broilers. Small for meat production. Fairly good foragers. Easily adapted to climatic conditions. Especially used for exhibition purposes. Formerly very popular in America, but have been succeeded largely by the Leghorns. The dark color of shank is against them for market.

**THE FRENCH CLASS**

Have been consistently developed for table purposes. Have a splendid quality of flesh. Satisfactory foragers. Very hardy. Medium in production, fertility, and hatching power. They have a white skin, which in the past has been a drawback on the American market.
THE POLISH CLASS

More popular years ago than now. Bred primarily because of their beauty of crest and plumage. Quiet and easily tamed. Plump and desirable for the table.

THE CONTINENTAL CLASS

The Campine is the only breed in this class. Lay a small white egg. Quite similar in characteristics to the Leghorn, but are, as a rule, much smaller.

THE GAMES

Fairly satisfactory as layers. Not a commercial egg- or meat-producing class. Unexcelled as sitters and mothers. Breast muscles well developed, but too compact for an ideal meat fowl.

THE ORIENTALS

Of Game type, but heavier-meated than the Games. Used only to limited extent for commercial production. The Malay is a close-feathered, compact-bodied bird with very long neck and legs.

The Sumatra is noted for its long, black tail.

NON-STANDARD VARIETIES

There are many other varieties in this country, which are not recognized by the "Standard of Perfection." Examples are Lackenvelder, La Bresse, and Maline.

MISCELLANEOUS CLASS

Frizzles and Silkies are purely of exhibition value and interest. Sultans, while of average size, are so profusely feathered, having a heavy crest, muff, and beard, and vulture hocks coupled with heavy shank and toe feathering, as to be of little value except for exhibition.
COMMUNITY SURVEY

1. How many varieties of poultry are kept in your locality?
2. Which variety is the most popular? Why?
3. Arrange the other varieties in the order of their apparent importance.
4. What reasons can you give for this arrangement?
5. How many varieties of chickens are exhibited at the local or county fair?
6. How does this fair-exhibit express the popularity of poultry in the county?

REFERENCES

CHAPTER XXVIII

SHALL I BE A POULTRYMAN?

The choice of an occupation is one of the most important decisions that we are ever called upon to make. In considering the poultry business, one should carefully weigh the main factors upon which success in this field depends.

General information:
1. The personal inventory.
2. The labor problem.
3. The necessary cash and credit.
4. Limitations of the business.
5. Special advantages of the business.

1. The personal inventory

In choosing an occupation one should first consider the personal characteristics necessary for success. Some persons might succeed very well in a city occupation and yet fail in a farming occupation like poultry raising. A successful poultryman must have two types of characteristics: (1) Natural and (2) acquired.

Chief among the natural characteristics are love of the business, initiative and ability to work, and good judgment. One must like poultry in order to succeed, for the birds are very susceptible to the feelings of the person caring for them. No longer may one handle poultry by rule-of-thumb methods. As in other productive occupations, one must be willing to work and have the physical ability to work skillfully. Initiative in the poultry business is especially important, since the poultryman must constantly observe the birds, watch his accounts, and
otherwise study his business, being ready at all times to plan new improvements. As poultry respond to the feelings of their keeper, so the person in charge must be quick to understand the birds. Such "chicken sense" constitutes good judgment in caring for and managing the flock.

The chief acquired characteristics are knowledge and skill in conducting the business. These abilities can be acquired only through training and experience. The young man who is anxious to enter the poultry business will find that time and effort spent in acquiring training in poultry farming constitute an excellent investment. To be able to perform the work skillfully, a man must have experience. If he can get this experience with the help of an instructor or a successful poultryman, he will be saved many expensive mistakes. Another very necessary qualification is a knowledge of the business methods commonly practiced. The poultryman must know how to deal with people, how to be courteous, prompt, tactful, and at all times he must be honest and ambitious to build a reputation for himself.

Poultry farming is not an easy business. It is, however, a worthwhile occupation. It requires an alert, keen mind and a willingness to work hard with mind and body.

2. The labor problem

Securing and keeping competent help are the most difficult problems for the poultryman to solve. On a small plant, the operator can do the feeding, selecting, and other work requiring judgment, carefulness, fidelity, and a love for the work, and may employ help for doing the rough work. On larger plants, the operator finds that he cannot do all the important work himself and that he must employ men competent to perform skilled work for him. Herein is a serious difficulty, because there are comparatively few persons who have received special training or who are experienced in handling birds. Persons so trained or experienced are able to command wages so high that it is difficult for the operator to meet them. Also, skilled
Laborers are constantly seeking an opportunity to go in business for themselves. Many persons who are financially "well to do" operate poultry plants as a "hobby" and offer attractive wages to poultrymen. This practice tends to keep the wages of skilled workers quite high.

### 3. The necessary cash and credit

As in most productive enterprises, the poultryman needs both cash and credit. The amount of each required will be determined by the method of starting in the business, the size of the enterprise, the efficiency of the plant, and the financial standing of the operator in the neighborhood.

If a place is rented, less ready cash will be needed than if a plant were purchased, unless many new buildings or much equipment is necessary. Credit for the poultry enterprise is often impaired by the lack of public confidence in the poultry business. This is a serious handicap. Without doubt, the lack of confidence is due to the large number of persons without experience who have entered the business and failed.

A sound method of starting a poultry business is to begin with a small plant and build up gradually. One should determine in advance the amount of cash and credit needed and the amount which he has available. For the beginner, it is well to reserve approximately one-half of the funds for working capital, leaving the remainder as fixed capital invested in land, buildings, and equipment. The business may be enlarged as the net earnings increase.

### 4. Limitations of the business

Many years of practice and observation have shown that there are several conditions which serve to limit or handicap the poultryman. One should be familiar with these in order to profit by the experience and study of others. These limiting factors are:

1. Small size of the individual fowl.
2. Short life of the individual fowl.
(3) Small value per individual unit.
(4) Problems in controlling egg production.
(5) Difficulty in controlling fertility and hatchability.
(6) Dangers from diseases and parasites.
(7) Dangers from stealing.
(8) Dangers from fire.
(9) Difficulties in marketing.

The small size of the fowl, together with the large number of birds in the flock, make it very easy to lose sight of the individual. Disease may progress unobserved more easily than with larger animals. Thus, risks and losses are greater. Individuals may disappear from a flock, especially in large flocks, and the loss may not be discovered until the fowls are counted. The feed requirements of individual birds vary, but it is impossible to feed every individual separately as is done with cattle. This problem of feeding requires special ability in the poultryman. (See Chapter V.)

Because of the short normal life of the fowl, there is rapid depreciation of stock, which requires frequent renewal. Poultrymen must, therefore, take the risk from year to year in hazards of incubation, brooding, and rearing.

Egg production cannot be absolutely controlled, since it is a reproductive process, but great strides have been made in this direction. Artificial illumination, flock segregation, and improvements in hatching, feeding, and housing are at present the best-known aids in the control of egg production. The proper use of these, coupled with correct breeding, secures good production and quite satisfactory hatches throughout the year.

The fertility and hatchability of eggs and the strength of the young stock depend on the vitality of the breeding flock and feeding and mating methods. Severe climatic conditions or wrong handling prior to or during the breeding season give unsatisfactory results.

Both young and old stock are susceptible to diseases and parasites because of their small size and the mass method of
management practiced. The young are naturally delicate and fall easy prey to predatory animals and diseases. Mature stock resist many diseases but are easily thrown out of condition by mismanagement, which renders them susceptible to various troubles. New forms of diseases are constantly preying upon the flock. Diseases and parasites are stimulated by man's mistakes in methods of care and management.

Many poultrymen are handicapped by thieves. There is a popular idea that the "chicken thief" is not a serious malefactor. When we consider that the loss of mature individuals represents an entire season's work and money, we begin to realize the seriousness of this crime. Poultrymen may also sustain large losses by fire. The use of incubators and brooders increases the fire hazard. The risk is small, but fire occasionally occurs.

The vast number of eggs which must be graded as to color, size, and shape, and the loss from breakage and inferior interior quality constitute vital problems in marketing. To succeed, the poultryman must understand both production and marketing problems. Unless one can market successfully, it is of little avail to produce.

5. Special advantages of the business

The following constitute the more important advantages of the poultry business:

(1) The money value of poultry and eggs as human food.
(2) The efficiency of poultry in multiplying and producing human food.
(3) The maintenance of soil fertility.
(4) Attractiveness as a business and homemaking occupation.
(5) Adaptability to many persons and types of farming.
(6) Superior marketing advantages.
(7) Available knowledge as a basis for successful methods.
The egg is the most universally used of any animal product except milk. It is a staple commodity for which there is no substitute. The egg is essentially liquid meat, being one of the most easily digested and assimilated forms of animal food; it also is one of the richest in growth-promoting vitamins (Fig. 330).

The quick growth of the fowl, its early laying maturity, heavy laying, and natural vitality to resist disease offset the handicaps of short life, small size, and the low money value per individual. The birds' self-reliance and flocking instincts make it possible for large flocks to be brooded, housed, and fed together, and also make possible large poultry enterprises. The fact that poultry are natural foragers enables farm flocks to get much of their living from food which otherwise would be wasted. Furthermore, the addition of poultry manure and litter to the soil constitutes an excellent method of improving fertility, since these materials contain considerable quantities of nitrogen, phosphorus, potash, lime, and humus.

From the standpoint of the attractiveness of the poultry business, it is to be noted that relatively small amounts of capital and land are required and that there is a quick turnover of capital. Also, with good care and management, the business may be made reasonably profitable. Like other farming occupations, it is a healthful vocation.

In considering adaptability to persons and types of farming, it is significant that poultry is found on 85 per cent of the farms of this country. Without doubt, poultry is kept in conjunction with other types of farming more than any other kind of livestock. This is because poultry provides the table with eggs and meat and furnishes an income throughout the year. Domestic fowls suffer less under close confinement than other kinds of animals, and therefore may be kept on small village lots. Because poultry keeping does not require as heavy manual labor as most other kinds of farming, this enterprise serves to interest many women and children on farms and in villages.
Eggs and Milk

% COMPOSITION:

AN EGG
Weight-2 Ounces (56 Grams)

Water ______________________ 73.7%
Fat _________________________ 10.5%
Protein _____________________ 14.8%
Mineral Matter ______________ 1.0%

A GLASS OF MILK
Weight-8.5 Ounces (240 Grams)

Water ______________________ 87.0%
Fat _________________________ 4.0%
Protein (Casein & Albumin) ______ 3.3%
Carbohydrates (Milk Sugar) ______ 5.0%
Mineral Matter ______________ 0.7%

AMOUNT PER UNIT
One Egg, One Glass of Milk—Grams

* 

Legend
* Egg
+ Milk

Fig. 330.

Eggs are one of our most valuable food products.
All kinds of poultry are efficient transformers of raw materials into high-priced finished products. The domestic fowl, for example, transforms about 90 to 100 pounds of grain and mash, 2 pound of oyster shell and grit, and 50 gallons of water into approximately 18 to 22 pounds of eggs, besides maintaining the body. It is a great advantage to many persons to be able to ship concentrated commodities to market. This the poultryman is able to do.

Because eggs may be held under favorable conditions without cold storage for several days, it is not usually necessary to ship to market more than once or twice a week. Also, poultry may be held, killed, and shipped as the market requires. This is an advantage as compared with the production of highly perishable products, which must be shipped daily.

The egg is sold in its original package, the flavor and odor being concealed. The shell container prevents the quality from being known to many consumers until the egg is used, thus placing a premium on superior-quality products. Producers who have established a reputation for high-quality eggs frequently receive several cents per dozen over the highest market quotations. The fact that eggs and poultry may be preserved in storage for many weeks exercises a stabilizing influence upon prices. While the storage eggs and poultry are not equal to the fresh product, as is true of practically all preserved or storage food products, consumers are provided a year-round supply at much lower prices than would be possible without storage. While the producer at the same time is accorded a higher seasonal price.

6. Methods of getting started in the business

"What is the best way for me to start?" is a most natural question for a person desiring to enter the poultry business. The answer depends upon the individual, and upon his available cash, experience, and special opportunities at the time. Education, experience, and capital usually present the most difficult problems for the beginner.
METHODS OF GETTING STARTED IN THE BUSINESS

The following are the six usual methods of entering the poultry business. The amount of cash and experience necessary increases in the order named: (1) working for salary for owner or operator; (2) working for salary with percentage of the profits; (3) share rent; (4) cash rent; (5) partnership; (6) buying outright.

![Fig. 331—Sources of Receipts of Shell Eggs at New York City in 1939. (Bureau of Agri. Econ. Market Reports, U.S.D.A.)](image)

| SOURCES OF RECEIPTS OF SHELL EGGS AT NEW YORK CITY FROM DIFFERENT GEOGRAPHIC AREAS |
|----------------------------------------|--------|--------|--------|--------|--------|
| Area                                    | 1923   | 1928   | 1933   | 1938   | 1939   |
| Total Receipts (mil.) cases             | 7.2    | 7.3    | 6.9    | 6.2    | 6.4    |
| North-East                              | 20     | 19     | 19     | 25     | 28     |
| East North-Central                      | 38     | 25     | 19     | 18     | 16     |
| West North-Central                      | 23     | 29     | 39     | 40     | 43     |
| Far-West                                | 10     | 22     | 21     | 16     | 12     |
| South                                   | 4      | 5      | 2      | 1      | 1      |
| 100                                     | 100    | 100    | 100    | 100    | 100    |

Over a period of years, receipts of eggs at New York City have varied with egg production in the country. Receipts for 1926-30 averaged 7.2 million cases per year as compared with 6.5 million cases for the 1934-38 period. In 1939, about 6.4 million cases of shell eggs were received at New York City. Of the total receipts, 71 per cent came from the North-East and West North-Central States.

During the past 16 years, receipts from the North-East and the West North-Central areas have been on the increase; whereas receipts from the South and East North-Central States have decreased. Shipments from the Far-West increased until about 1928 and since then they have declined.
Salary. This method is usually employed when one desires to accumulate money or experience to start for himself. If the plant is up to date, this constitutes an excellent opportunity for the employee to learn while the employer assumes the risks. One is likely to learn in direct proportion to the extent to which he does all kinds of work and studies the business. This method permits the beginner to gain in maturity and judgment before making a permanent investment for himself.

Salary with percentage of profits. This method is most advantageous when one is in charge of production and selling, since such an arrangement is satisfactory to both employer and workman. The salary acts as insurance for the laborer, and sharing in the percentage profits induces him to work for high yield and good prices, which, of course, the employer is anxious to have. A bonus on the number of chicks reared or of eggs produced frequently is a satisfactory plan.

Share rent. Share rent is higher than cash rent. The landlord assumes the risk of a poor tenant. If he owns a part of the stock, the risk is considerable. Share rent is common because it requires less capital on the part of the tenant. The landlord provides the land, buildings, equipment, and perhaps stock. Part of the running expenses, such as feed, are paid jointly. If both desire to participate jointly in expenses and receipts, a partnership is preferable.

Cash rent. This is desirable if the tenant knows his business, and can produce successfully and market efficiently. The tenant assumes the risk of failure. The better the prospect is for making profit, the greater is the advantage to the cash renter. The simplest procedure in determining a fair rent is to inventory the buildings, equipment, and stock that are provided by the landlord. The rent should be at least 5 per cent of this investment and should also cover taxes, insurance, and depreciation, which the landlord usually assumes. (For inventory values, see page 194.) It is better for the tenant to buy all stock. When the landlord provides part of the stock, the rent is higher because of the increased risk. A long
Fig. 332—A modern poultry farm layout.

Note: Feeding buildings across the road. This is typical of many modern egg-laying plants, where the birds are confined to the laying houses at the end of their rearing period and single-story houses are used.
lease of three to five years is better for both landlord and tenant.

**Partnership.** This is the fairest form of a share lease. Professor W. I. Myers, of Cornell University, suggests that "the general plan of such a lease might be that all going expenses of the poultry enterprise and of maintaining the buildings should be paid out of receipts. After this a stipulated salary should be paid the tenant for his work, and then interest should be paid the landlord on his investment. Anything remaining above these items should be divided equally. Such an agreement has the advantage of taking the guesswork out of the lease, since all receipts and costs would be shared equally by both parties.

Many dangerous complications may develop in poultry-farming partnerships, owing primarily to the fact that home as well as business relations are involved. All partnership agreements should be in writing.

**Buying outright.** This is the ideal method for those who have sufficient education, experience, and capital to justify it. Risk is assumed entirely by the owner, and changes in the plant and management may be made at his discretion. The beneficial effect of the pride of ownership is one of the most important elements in this method. One usually takes most interest and pride in the effects of his own handiwork.

**COMMUNITY SURVEY**

1. Ask one or more poultrymen in your neighborhood, who started with a small business, to give you the following details:
   
   (a) When they started with poultry.
   (b) What problems appear to give the greatest difficulty in establishing and building up a poultry plant and business.
   (c) How the labor problem has been handled.
   (d) Whether or not it has been difficult to secure and keep competent labor.
   (e) Which one of the several ways of starting in poultry work these poultrymen would recommend.
   (f) What troubles they have experienced with the stock, and how they have learned to combat and prevent these troubles.
DIRECTIONS FOR A STUDY OF THE LOCATION AND LAYOUT OF A POULTRY PLANT

Farmers who make poultry raising their major enterprise find that special buildings, equipment, and layout are needed in order to make the business profitable. For students or farmers who contemplate taking up a specialized type of poultry farming, there is no better means of preparation than to study the practices of successful men in the region. Several hours spent in studying their plants and interviewing them will yield valuable returns to the student. He may profit by their successes and failures. In most communities, there are one or more farmers who are practicing poultry farming on an extensive scale. Visit several of these farms and ask for an interview with the operator. Equip yourself with notebook and pencil, observe the following points, and secure the suggested information from the farmers.

Observations on the plant.

1. Sketch the layout of the plant.
2. Note the location of the following buildings:
   Laying and breeding houses.
   Brooder houses.
   Range shelters.
   Bachelor’s hall.
   Hospital and crematory.
   Flock segregation shelter.
   Service building.
   Incubator building.
   Root cellar.
   Manure shed.
   Storage building.
   Fattening and conditioning house.
3. Are the buildings conveniently located?
4. Are the buildings located so as to conserve the time and effort of the operator?
5. What system of housing is used?
   (a) Colony system?
   (b) Continuous house system?
   (c) Multiple-story.
6. Is ample range provided?
7. What is the character of the range?
8. How much range is allowed for old stock? For young stock?
9. What system of fencing is used?
10. Is the range cultivated?
11. In what directions do the buildings face?
12. Are the buildings protected by natural windbreaks?
13. Is the air drainage good?
14. What natural advantages are there which favor the location of the building?

![Diagram of laying houses and their footprints](image)

**Fig. 333.**

Location of laying houses vs. amount of walking.
In each sketch 2000 birds may be housed and the amount of range is the same. Compare the different arrangements with respect to time consumed in making several trips each day for a year.

**Data to be secured from farmers or other sources:**

1. Secure the following information. These data will be serviceable in determining the regions adapted for poultry farming.
   (a) Seasonal temperature, maximum, minimum.
   (b) Seasonal rainfall, maximum, minimum.
   (c) Sunshine, maximum and minimum.
   (d) Direction and force of prevailing winds.
   (e) Principal markets.
   (f) Distance from market.
   (g) Population of the near-by markets.
   (h) Distance from the local station.
(i) Express rate on eggs ....... Dressed poultry ....... Live
poultry ............... 
(j) Freight rate (per ton feed).
(k) Passenger rate to the market.
(l) Frequency of train service to the market.
(m) Hours for express shipments to reach the market.
(n) Condition of the roads in the neighborhood during bad
weather.
(o) How are the roads kept in repair?
(p) What are the educational advantages in the community?
(q) What are the religious advantages in the community?
(r) What are the social advantages in the community?
(s) What can be said of the character, progressiveness, and pros-
perity of the people of the community?
(t) What organizations are in operation—Grange, clubs, asso-
ciations, etc.?
(u) Is trolley or bus service available?
(v) What is the cost per year for telephones?

2. What do you consider the advantages of a colony system of hous-
ing mature stock?

(a) Does it give the fowls greater liberty and wider range?
(b) Is there less danger from fire?
(c) Is there less trouble from disease carried from flock to flock?
(d) Is the original cost greater?
(e) Is the labor cost higher?
(f) Are the houses cold?
(g) Are the colony houses more convenient?

3. What do you consider the advantages of a continuous system of
housing mature stock? Of the multiple-story house?

(a) Is it cheaper per bird to construct?
(b) Is the operation cost less for labor?
(c) Are the houses warmer?

4. What influences do the following have on the location of the lay-
ing and breeding house?

(a) Range.
(b) Accessibility.
(c) Exposure.
(d) Protection.
(e) Air drainage.
(f) Safety.
590 SHALL I BE A POULTRY MAN?

5. Does the range provide shade and green growth? What is the soil on the range? Are specially prepared pastures provided?
   (a) What seed mixtures are used?
   (b) What care is given the pasture during the growing season?

6. How often is the range cultivated?

7. In the following list, check the uses made of the service building:
   (a) Feed storage and mixing.
   (b) Work shop.
   (c) Egg room for candling and packing.
   (d) Killing and picking.
   (e) Incubation room.
   (f) Office.
   (g) Storage for crates, supplies, and equipment.

8. Why did you select this location for a poultry farm?
9. In what order were the buildings constructed or remodeled?
   What buildings were on the place when you acquired it?

10. What do you regard as the advertising value of this location?

11. Do you contemplate enlarging the plant and layout? If so, how and why?

12. From the standpoint of the community, what schools are available? What churches?

13. What are the nationality and attitude of the neighbors?

14. Have you installed soil drainage?

15. What crops do you grow? Area of each?

16. Would it be advantageous to have more land and grow more crops?

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