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Profitable Culling and Selective Flock Breeding

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1920

PROFITABLE CULLING
and
SELECTIVE FLOCK BREEDING

Complete Details Regarding the Latest Approved Methods for Culling, or the Selection of Layers--Simple and Practical Instructions for Securing Permanent Improvement in Egg Production in Any Flock

Compiled by
HOMER W. JACKSON
and
GRANT M. CURTIS

"In my opinion this matter of careful, systematic culling is the biggest dividend earner that now confronts the practical poultry keepers of this country."---Prof. H. R. Lewis.

FULLY ILLUSTRATED

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INTRODUCTION

ONE of the most important advance steps in commercial poultry keeping in recent years, and one that promises to exercise a truly great influence upon the development and permanent upbuilding of the industry, is the more exact knowledge poultry keepers now have of the characters of individual fowls; also the extent to which these characters, whether good or bad, are directly transmissible to offspring. The disposition to look upon the individual bird as too small and unimportant a "unit" to receive separate attention is giving way to a demand that each individual of the flock shall measure up to definite standards in practical qualities. Progressive poultry keepers realize that they can well afford to take the necessary time to apply these standards to each fowl, no matter how many there may be, thus to know, instead of guess, what return each is capable of rendering for the feed and care bestowed upon it.

This effort naturally centers chiefly upon the layers, among which there exist the widest differences in relative productiveness. It has been demonstrated beyond question that practically every flock contains some hens that are either entirely nonproductive, or that will lay only a comparatively small number of eggs even under the most favorable conditions; also that there almost certainly are in the same flock some hens whose egg production is quite high. The proportions in which good and poor producers will be found in a given flock are determined by various factors, such as breeding, feeding, general care, etc., but in the great majority of instances the percentage of inferior producers is so high that, leaving all other measures out of the question, it has been found possible greatly to increase average production in any flock, simply by eliminating the "slacker hens". The possibilities of securing better average production from laying flocks in this way are fairly well understood by poultry keepers generally, though comparatively few realize how readily this may be achieved, or appreciate the vital importance of doing so at times like the present, when prices of feed are abnormally high.

During 1917 and 1918 an extraordinary situation developed. On the one hand, thousands of poultry specialists sold off their flocks and retired permanently or temporarily from the business because they found it impossible to continue except at a loss; and on the other hand, practical poultry keepers in the same localities reported as great or greater net profits than those realized in former years. Careful study of this anomalous condition has shown that, while other influences may have been involved, the chief factor in determining in which class the individual poultry keeper found himself was THE AVERAGE PRODUCTION OF HIS FOWLS. In other words, those who through modern methods of breeding and selection were able to realize a fairly high average of production per fowl, made money; those whose average was low, lost heavily.

There are numerous methods known to practical poultry keepers by means of which average production may be increased. But in ease of application, and in promptness and importance of results secured, CULLING, or the selection of laying fowls on the basis of external characters, has no equal. That this can be done—is being done by thousands of persons in all parts of the country—and with a high degree of accuracy, does not admit of any question. The evidence as given in the pages of this book should convince anyone who may yet be in doubt as to the utility of the method.

Of even greater practical importance than the immediate increase in average production in the flock and reduction in feed cost through the elimination of poor producers, is the opportunity which culling affords every poultry keeper for breeding to secure increased egg production by the simple and easily practiced method known as SELECTIVE FLOCK BREEDING. It has been demonstrated beyond question that heavy-laying ability is an inherited character and thus is capable of being transmitted to the hen's offspring. Unfortunately, systematic breeding for improvement along this line has only been possible in the past to those who were in position to adopt the use of trap nests—a certain but highly expensive practice that the average breeder cannot afford to adopt.

Now that the method of estimating the hen's laying ability by observing her external characters has been developed to so high a degree of accuracy however, permanent improvement in production through systematic breeding has been brought within the reach of every earnest poultry keeper. It is only necessary for him to go over his hens in the manner hereinafter to be described, readily to identify his best producers and set them aside for use as breeders the following year, thus limiting reproduction in the flock to the best layers in it, accomplishing by this simple and easily applied method much that the user of trap nests achieves only at vastly greater expense. Selective flock breeding DOES NOT take the place of pedigree breeding; let there be no misunderstanding on this point. But its superiority to the usual method of selecting breeding fowls where trap-nest records are not available is so great as to warrant the belief that its general adoption would practically revolutionize the poultry industry in this country.

The selection of laying hens on the basis of external characters being so vitally important, and also being now a well-defined and fairly exact science, it obviously is highly desirable that all trustworthy information on the subject should be assembled in a permanent and readily available form, not only giving poultry keepers and students a reliable guide to the accurate and rapid culling of fowls, but also enabling them to secure a well-balanced knowledge of the subject in all its phases. That, in brief, is the object of this book. The material used in compiling it has been collected from a variety of sources, full credit being given for same wherever possible. Only methods recommended and used by the best authorities are given, and these are presented in so complete detail that anyone should be able to apply them with entire success, without any other instructions.

While it appears that some practical poultry keepers have known for years that there are certain characters distinguishing hens with reference to their productive ability (see Chapter I), it is chiefly through the painstaking work of the poultry departments of various state agricultural colleges and experiment stations that attention generally has been focused upon this important detail of practical poultry management, and that methods of selection have been classified and their value thoroughly proved. Not only have these college poultry departments taken the lead in the development of practical culling methods, but a number of them, such as Connecticut, Missouri, New Jersey, and New York (to mention only a few), by means

(Continued on page 9.)

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PLATE I—A HEAVY-LAYING WHITE LEGHORN

The hen shown in above color plate illustrates the general appearance of a typical heavy layer in the fall. As a result of long continued production, the yellow pigment in ear lobes, face, beak, and shanks has been completely lost, and the fowl still retains her old plumage. Her comb is large and bright red in color indicating an active ovary. Compare her carriage with that of hen in plate II. Photo from Cornell University.

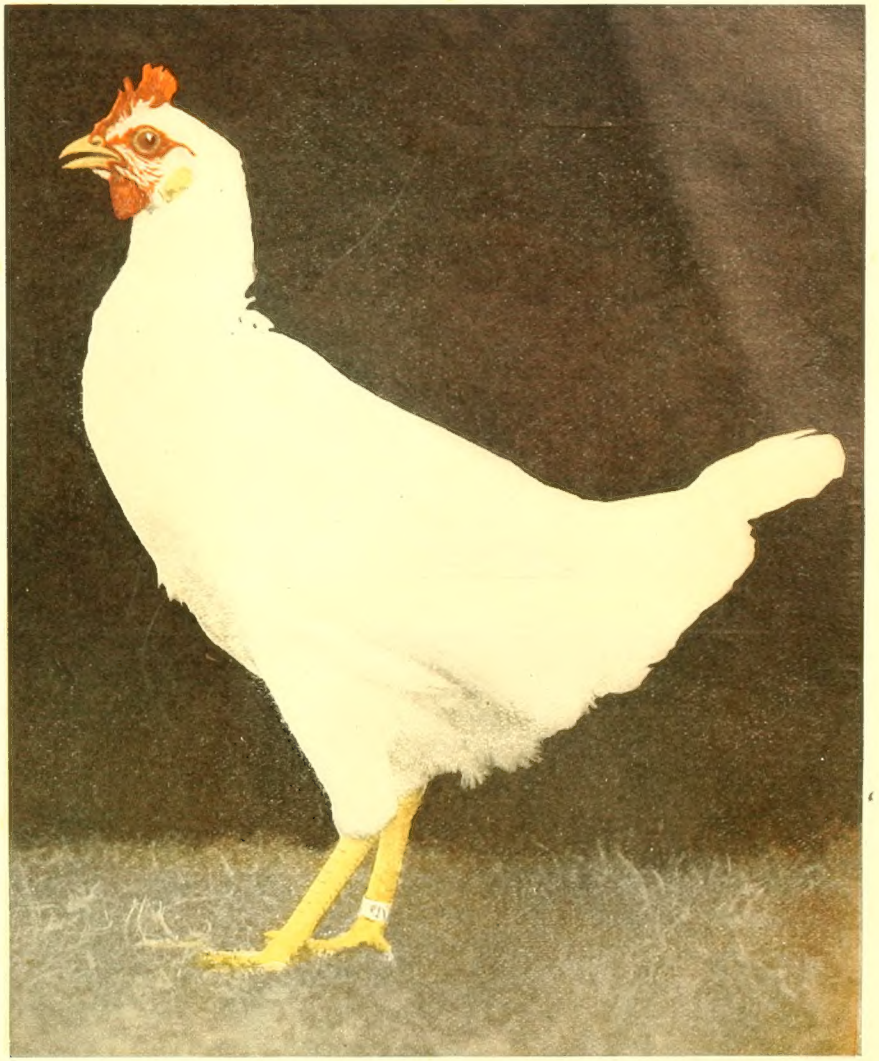


PLATE II—A NONLAYING WHITE LEGHORN

This hen also was photographed in the fall, as was the one shown in Plate I. She had been idle for so long a time however, that the yellow pigment had entirely returned to ear lobe, eye ring, beak, and shanks, and her new coat of feathers was practically full grown. Her shrunken, whitish comb is another unmistakable indication of a long continued period of nonproduction. Photo from Cornell University.

PLATE III—HEAD OF NONPRODUCER—HIGHLY PIGMENTED

PLATE VI—GOOD LAYER—ALL PIGMENT BLEACHED OUT

PLATE IV—PIGMENTATION INDICATING 2-4 WKS. OF LAYING

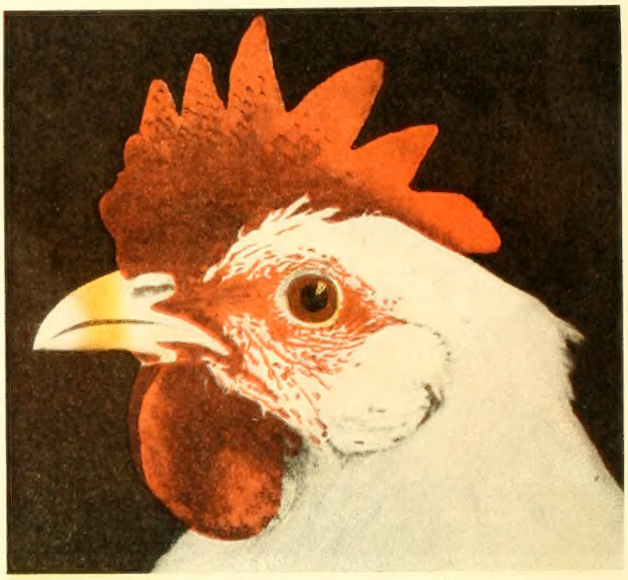


PLATE VII—PIGMENTED BAND INDICATING A LONG REST

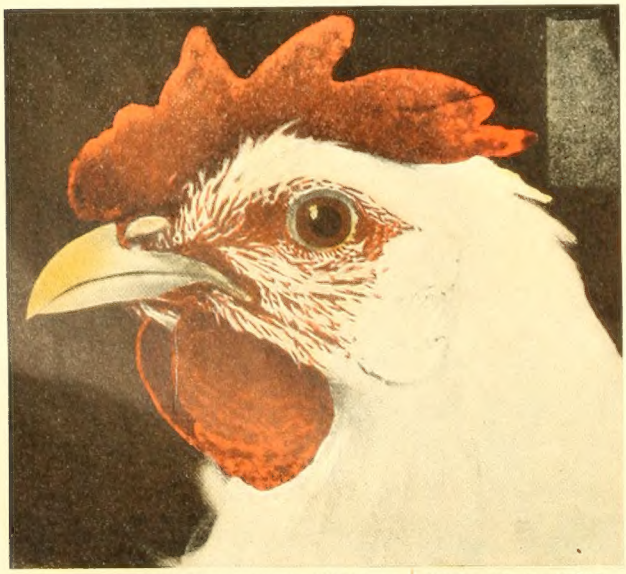


PLATE V—PIGMENT INDICATING 4-6 WKS. OF LAYING

PLATE VIII—PIGMENT COMING IN AFTER LAYING CEASES

Reproduced from Photos furnished by Cornell University.

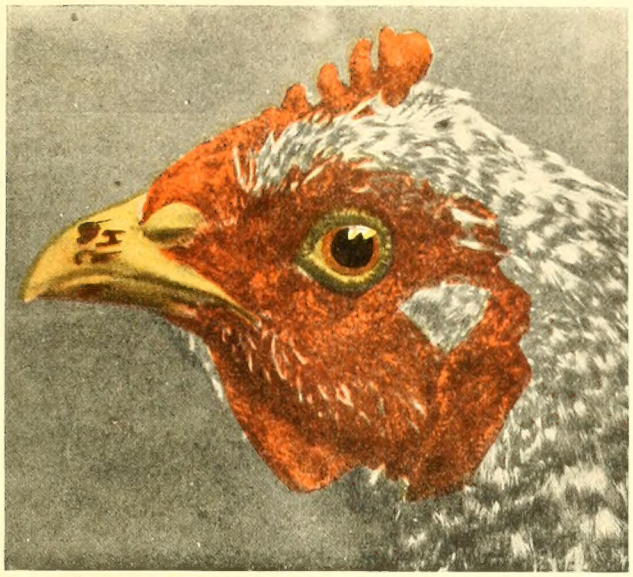


PLATE IX—HEAD OF NONLAYING BARRED PLYMOUTH ROCK

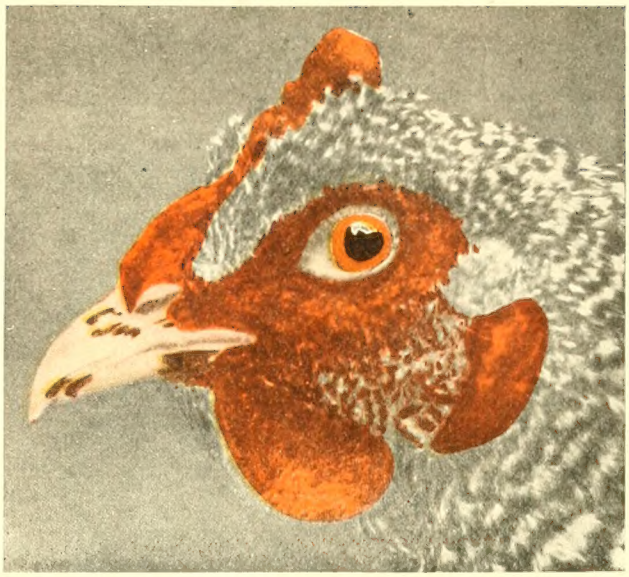


PLATE X—HEAD OF LAYING BARRED PLYMOUTH ROCK

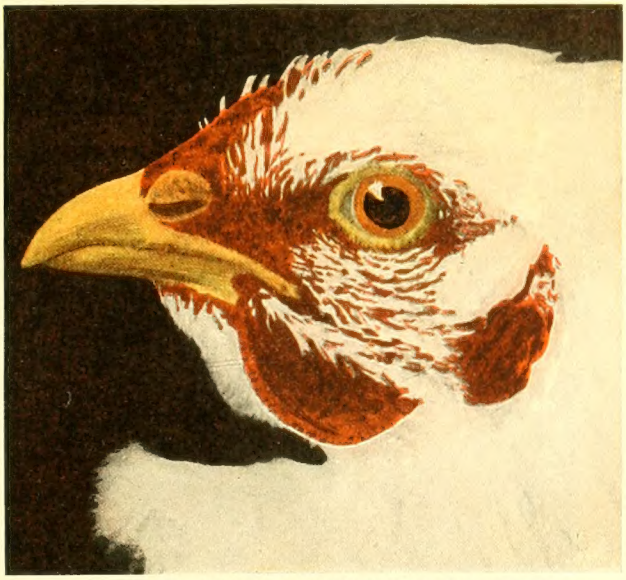


PLATE XI—HEAD OF NONLAYING WYANDOTTE

PLATE XII—HEAD OF LAYING WYANDOTTE

PLATE XIII—HEAD OF NONLAYING RHODE ISLAND RED

PLATE XIV—HEAD OF LAYING RHODE ISLAND RED

Reproduced from Photos furnished by Cornell University.

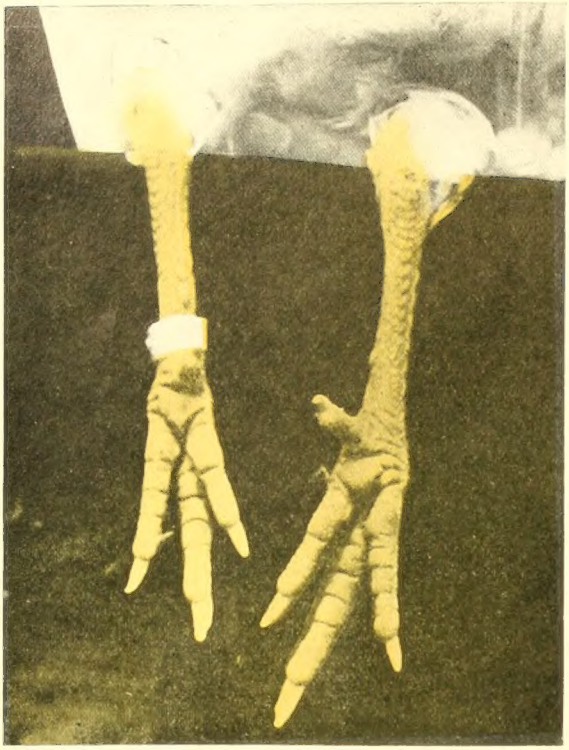


PLATE XV—FEET AND SHANKS OF NONLAYING HEN

The shanks are pigmented like the beak of the nonlayer shown in Plate III and they are plump and full, showing the presence of considerable fat under the skin. A hen whose shanks are round and yellow like these, has certainly been idle for many weeks, and if in this condition during the laying season or near the end of it, she probably has never been profitably productive. Photo from Cornell University.

PLATE XVI—FEET AND SHANKS OF A GOOD LAYER

The shanks are the last of the pigmented sections to lose their color as a result of production, requiring not less than eight weeks or more. The pigment goes out of the front of the shanks first, the back part next the hock joint, being the last to fade. In this heavy layer they were not only bleached out, leaving them white or pinkish, but they also are thin and flat. Photo from Cornell University.

PLATE XVII—REAR VIEW OF BODY OF NONLAYING HEN

Comparing this plate with Plate XVIII, the difference in abdominal capacity, in condition of skin, and in size and condition of vent, is clearly brought out. Photo from Cornell Univerasity.

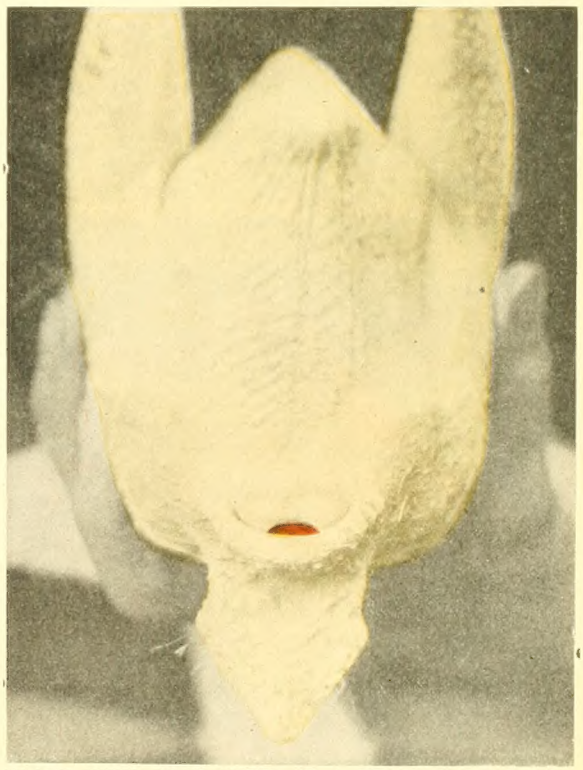


PLATE XVIII—REAR VIEW OF A HEAVY-LAYING HEN

Good spread of pelvic arch and wide span between arch and keel are indicated, also loose, pliable skin and large vent. Compare with the "slacker" hen shown in Plate XVII. Photo from Cornell University.

INTRODUCTION (Concluded)

(Continued from page 4.)

of annual state-wide "culling campaigns" have spread the information and demonstrated its practical value in a manner that has proved of almost incalculable benefit to poultry keepers.

The compilers of this book have sought to avail themselves of every practical opportunity for getting the latest and most complete information on the subject. Both spent the better part of two weeks at Cornell University (July, 1919), in attendance at the Second Annual Judging School, and in personal interviews with Professor Rice and his able assistants—recognized leaders in this field. Prior to this, the senior author spent several weeks at the New Jersey Experiment Station, where, through the cooperation of Professor Lewis and his assistants, Dr. Thompson and V. G. Aubry, he was able thoroughly to investigate numerous special phases of the subject. During this visit to New Jersey he also was fortunte in securing the helpful interviews with Professor Lewis which are given in Chapters III and X; also the splendid set of photos showing different stages in the culling of fowls which are reproduced in Chapter III.

The reader will note that expense has not been spared in illustrating this book. In addition to the series of photos received at New Jersey (mentioned in preceding paragraph) there are four pages of color plates (pages 5 to 8) secured through the helpful cooperation of Dr. O. B. Kent, of Cornell University; also, from the same source, the series of photos illustrating steps in culling high and low-producing Barred Plymouth Rocks, and a number of miscellaneous photos. The excellent photos reproduced in Chapter IV, showing the application of tests to high and low-producing R. I. Red hens, were furnished by the Storrs (Conn.) Experiment Station which has, from the start, taken a leading part in the development of practical culling methods.

The material in Chapter XVIII, on Culling Demonstrations, was largely supplied by W. G. Krum, Extension Poultryman at Cornell University. Special articles have been contributed by Dr. C. T. Patterson, ex-Director of the Missouri State Poultry Experiment Station, Professors L. S. Palmer and H. L. Kempster of the University of Missouri, and others. Numerous other station workers and expert poultrymen have contributed directly or indirectly to the contents of this book, or have assisted in its compilation, and to all of these the authors wish to express grateful appreciation and thanks.

Description of Color Plates

The color plates on pages 5 to 8 inclusive, are presented to show the striking changes in pigmentation, color and condition of comb, etc., which are brought about by continued egg production. The way in which these changes are produced is fully explained in the various chapters of this book dealing with these particular subjects. The following brief description of the different plates however, is here given for convenient reference:

PLATE I—The photograph from which this plate was reproduced, was taken in September, at which time this hen was still laying heavily and her comb was full and bright red in color. While this hen naturally had a yellow beak and shanks, the pigment in these sections had entirely disappeared (as here shown) due to long continued production of eggs. She had not yet begun to molt. With proper management such hens should continue laying for nearly two months before molting.

PLATE II—This nonlayer was photographed at about the same date as the one shown in Plate I, at which time she had already gone through the molt and her new coat of feathers was practically complete. Further proof that she had not been laying for a long time is found in the fact that her eye ring, ear lobe, beak, and shanks are all highly pigmented, and there also was some pigment in her feathers.

PLATE III—This plate shows the head of a nonlaying White Leghorn, and illustrates quite clearly the yellow eye ring, ear lobe, and beak that are characteristic of the nonlayer.

PLATE IV—This plate shows the gradual fading out of beak pigment as laying progresses. This hen had been laying long enough so that all pigment had disappeared from eye ring, ear lobe, and from the base of the beak, though the pigmented tip shows that she probably has been laying for only three or four weeks.

PLATE V—The head of this hen shows a more advanced stage of laying than the one shown in Plate IV. The pigment has entirely faded from the lower mandible and there is only a little at the tip of upper one. This also will soon lose its yellow color if the hen continues to lay.

PLATE VI—This hen has been laying for a longer period than any of the fowls whose heads are represented in preceding plates—probably eight weeks or more—and as a result of this long period of production the pigment has entirely faded out of the beak.

PLATE VII—The banded beak shown in this plate indicates that the hen, after laying heavily for a time during which her eye ring, ear lobe, and beak entirely faded out, stopped laying for a considerable period, during which the pigment came back into the ear lobes and most of the beak. Later she began laying again and the pigment a second time faded out of eye ring, ear lobe, and from the base of the beak. If she continues to lay a little longer this band will entirely disappear.

PLATE VIII—This hen laid until the color entirely faded out of her beak. At some time after that she stopped for a rest, and the pigment came back into the eye ring, ear lobe, and the base of the beak, showing that she has taken a rest of probably a month.

PLATE IX—This plate and the others on this page show heads of good and poor-laying Barred Plymouth Rocks, Wyandottes, and Rhode Island Reds. The Plymouth Rock here represented has a completely pigmented beak as well as eye ring, showing that she has been idle for a long time.

PLATE X—The Plymouth Rock hen in this picture has been laying long enough completely to fade out the pigment from the beak. The red of her face and comb also has a different shade.

PLATE XI—This highly pigmented Wyandotte hen had not been laying for a considerable period prior to the time when the photo from which this reproduction is made, was taken. Note the yellowish red of comb and face also, as compared with Plate XII.

PLATE XII—There is a complete absence of pigmentation in the head of this laying White Wyandotte.

PLATE XIII—This nonlaying Rhode Island Red shows high pigmentation of beak though it is not so readily observed as in the case of the Wyandotte and Plymouth Rock heads shown in above plates, on account of the horn color in the upper mandible.

PLATE XIV—The complete absence of pigmentation in the beak of this R. I. Red clearly shows her superiority to the one shown in Plate XIII, as an egg layer. After a long rest her beak will be just as yellow as that of the other.

PLATE XV—All comments on preceding plates with reference to pigmentation in beak due to poor laying, apply with equal force to the shanks, though the pigment fades out in this section more slowly. A hen with yellow shanks like these is either a nonlayer or as been productive for a few weeks only.

PLATE XVI—The shanks of the bird here illustrated are not only lacking in pigmentation but appear more shrunken than those in Plate XV, which is also characteristic of good layers. It takes two months or more of laying to take all the yellow out of the shanks.

PLATE XVII—This plate illustrates strikingly the difference in color of skin and in general condition of a nonlaying fowl as compared with a good layer such as the one shown in Plate XVIII. The skin carries a great deal more pigment, is comparatively hard and tight, and the abdomen generally is firmer and the space between the pelvic bones is more contracted.

PLATE XVIII—In width and depth of abdomen (the latter being indicated by the high keel bone), in looseness of skin and flabbiness of abdomen, and in size and coloring of vent, this fowl meets all the requirements of a good layer as these are commonly understood, and presents a distinct contrast in all these characters to the nonlayer in Plate XVII.

CHAPTER I

Development of Modern Culling Methods

How the Science of Culling was Discovered and Developed—A Brief History of the Discovery of the Different Methods Employed in Selecting Hens of High or Low Productiveness—Educational Value of Egg Laying Contests and their Influence upon the Development of the Poultry Industry

CULLING, as the term is commonly used, refers to the examination of fowls and their classification as layers and nonlayers on the basis of external characters. The ability to do this with a good degree of accuracy has been developed as the result of the observations of several independent operators who, in comparatively recent years, have discovered a number of such characters that bear unmistakable evidence as to productivity, or the lack of it.

Experienced observers however, are able to go much further than merely to learn whether the fowls are laying or not at the time they are examined. They also can determine, in the case of nonlayers, just how long they have been nonproductive, or whether they have ever laid at all; also whether they were good or poor producers during the laying period, whenever that may have been. Toward the end of the laying season they can estimate with surprising accuracy the exact number of eggs produced, whether few or many, and can discriminate between the hens that laid well in winter and those that were only productive during the low-price season of the year. Furthermore, they can take the pullets before they have begun laying, or hens at the beginning of the laying period, and estimate with a good degree of accuracy how many eggs they will lay during the coming season.

It would be difficult to overestimate the practical importance of this knowledge to the individual poultry keeper. While it is not claimed that estimates of production based on external characters are exact, the adoption of culling methods enables the poultry keeper, to a greater extent than ever before, to determine what production may be expected from his fowls during the ensuing season, to eliminate nonproducers at practically any time, and toward the end of the season to pick out the hens that have made the best records, and that, therefore, are the ones he will want to keep for use in the breeding pen the next year. He thus is able gradually to eliminate the blood of poor producers from his flock, replacing these with fowls descended only from high producers, and therefore capable of greatly increased production and, in turn, of transmitting this character to their offspring.

While the development of culling methods and their popular adoption has been the work of recent years, it is known that long before the present interest in culling methods had developed, observant poultry keepers in different parts of the country had found that some external characters were associated with heavy production. For example, Dr. O. B. Kent of Cornell University writes as follows in an article in the Journal of the American Association of Instructors and Investigators in Poultry Husbandry under date of May, 1916:

"A study of some of the various periodicals shows that at least as early as 1876, a woman contributor to the Cultivator and Country Gentleman recognized that late layers are late molters, and that late molters molt rapidly. This fact seems to have been rediscovered several times before Cornell Bulletin 258, 'The Molting of Fowls', was published. Until that bulletin was published, however, it seems to have been the general practice strongly to advise against using the late molters as breeders, even if they were late layers.

"It has been known for some time that during production the yellow pigment goes out of the shanks, beak, ear lobes, plumage, and skin. The woman contributor before mentioned, in an article on page 615 of the Cultivator and Country Gentleman for 1879, writes as follows: 'Towards fall there comes a change over the birds. Their plumage grows rusty, and the bright orange legs fade out as the season advances for the second molt. Especially is this true of persistent layers. Often and again have I been disappointed in my fine yellow-legged birds of early spring for, as the season advances, and they pile the eggs

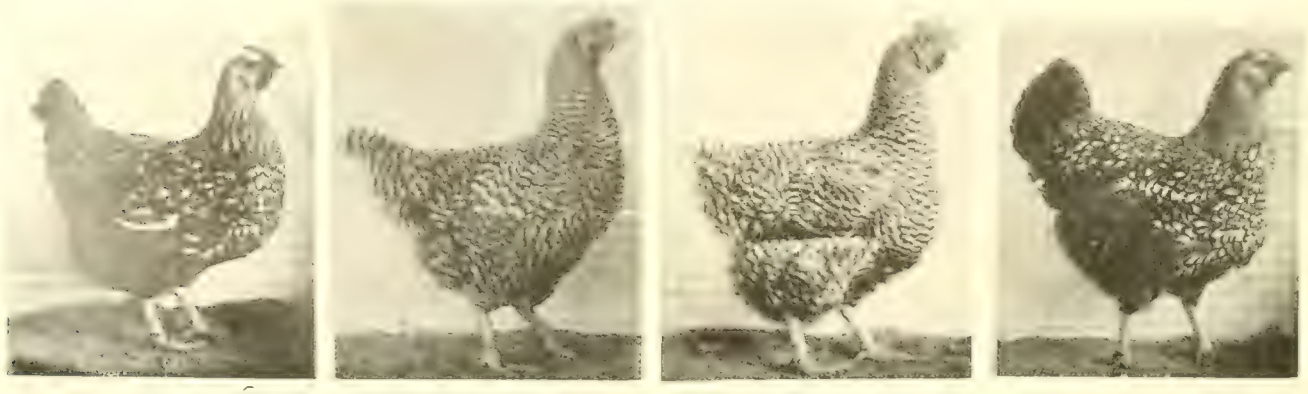


FIG. 1—CAN YOU TELL WHICH ARE THE GOOD LAYERS AND WHICH ARE THE SLACKER HENS?

Two of the hens shown above were heavy layers producing over 200 eggs in their pullet year, and two did not lay enough eggs to pay for their feed. Detecting the nonlayers and removing them from the flock may mean all the difference between profit and loss on the year's operations.

up, the legs gradually bleach out until they become, by August, a pale flesh or as generally termed, white. The bloom is washed off, and in a Leghorn is almost a certain indication of a good layer. In Leghorns, either Brown or White, the whitest ear-lobed bird is apt to possess the palest colored legs—often a pale lemon that fades to flesh color. The deep orange tint will fade with egg production.'

"The same idea has come out several times since, and probably it came out much earlier."

About 1905, Walter Hogan first published his system of estimating probable production by means of measurements of the pelvic arch and the span of pubic bones and keel, and Potter's "Don't Kill the Laying Hen" (relating to the same method) was issued.

Among college and station workers, the first reference to external characters useful in estimating the value of fowls as layers, so far as we have been able to learn, was by Professor James E. Rice of Cornell, who contributed an article to the Farmers' Institute Report published by the New York Department of Agriculture in 1909, in which the following statement is made:

"It was found in our molting experiments that the best laying hens as a rule were the ones to molt late. Hen No. 61 laid 213 eggs in ten months, and did not molt until the middle of November when she was nearly featherless."

Circular No. 11 (1910) of the New York Department of Agriculture, written by Professor Rice, contains the following reference to faded shank color as an evidence of productiveness: "It is a well-known fact that the breeds having yellow shanks will have laid the color out of their shanks toward the close of the laying season."

In Bulletin 37 of the N. Y. Dept. of Agriculture, published in 1912, as a result of further investigations, Professor Rice listed three factors in the selection of high-producing hens:

"Highest Producers Molt Late. The first physical character and the most valuable of all in selecting hens for breeders that are high producers is lateness in molting. The hen that is born to lay a large number of eggs and is well fed and handled will generally follow the line of least resistance and continue to lay and thus fail to perform the natural process of molting. This is because she has so much reserve power that she continues to lay, and as a result her feathers do not die and loosen.

"High Producers Have Pale Shanks. Another important factor in selecting high producers is the color of the shanks of the yellow-skinned breeds. If you were to examine the high-producing hens in the early fall, you would see that their shanks are 'laid out', that is, pale in color. The hens that have had little to do during the summer except to loaf around and eat, usually have the finest kind of colored shanks and skin, whereas, the high-producing hens have laid out most of the color. After they have rested a month or two, the color will come back.

"High Producers are Heavy Eaters. Watch the hens and see them eat and observe how they act; it will help you to pick out the laying hens in the fall and winter. The hen that is the largest layer is generally the one that is eating the most food. She goes to roost late and gets up early."

In Bulletin 65 of the same Department, published in 1914, Professor Rice adds two more characters:

"The Width of the Pelvic Arch. Fowls in a laying condition may be said to be in a condition of pregnancy. This physical condition causes in most animals a softening of certain ligaments and muscles which in a measure modifies their physical conformation. In the case of the fowl the arch of cartilagenous bones through which the egg is expelled, enlarges and softens during conditions of heavy laying, and hardens and contracts during periods of dormancy. This condition enables a person to determine at any given time, with considerable accuracy, the hens that are laying at that particular time from those that are not. In the case of large fowls the space between the pelvic bones will be sufficient to place three fingers of average size. In the same fowl, in the dormant condition, the pelvic arch probably would not be more than one to two fingers wide.

FIG. 2—PEN OF HIGH EGG-PRODUCING R. I. REDS

This pen of ten S. C. R. I. Reds laid 1966 eggs in their pullet year. Individual records were 148, 202, 243, 207, 183, 150, 170, 177, 216, 241. This was the highest R. I. Red pen in the Vineland Egg Laying and Breeding Contest in 1917-1918. Courtesy of the New Jersey Experiment Station

"Size of Abdomen and Crop. The size of the abdomen and crop, and the size, texture, and color of the comb indicate the condition of health and productivity of the fowl with fair degrees of accuracy. It may be said that, in general, a hen in a condition of high production may be expected to have a deep abdomen, a full crop, and a large, soft, velvety, bright red comb for that particular variety. The size, texture, and color of the comb are an indication of physical vigor. Physical vigor generally is correlated with the active reproductive system of the fowl.

"A pullet that is laying has a good appetite and therefore, usually a full crop. The laying fowl has an oviduct that is many times larger than the same fowl will have during a period of dormancy—at least twenty times as large. The size of the oviduct and the fuller condition of the intestines in the case of the productive fowl enlarges the abdomen to such an extent that frequently one would find difficulty in recognizing pictures of the same fowl taken at different times of the year during different conditions of productivity and dormancy."

The first station publication on the subject, of which we have knowledge, is a Press Bulletin issued by the Maine Experiment Station as a synopsis of Bulletin 232,

on the "Histological Basis of the Different Shank Colors in the Domestic Fowl", and in which shank color is described as a reliable means of determining the productiveness in fowls. This Maine Bulletin received a good deal of attention in the poultry press, and was the first step in arousing popular interest in the subject. The following paragraphs are from this bulletin:

FIG. 3—PARTIAL VIEW OF POULTRY BUILDINGS AT CORNELL UNIVERSITY
The Poultry Department at Cornell has taken a leading part in the development of culling methods and their practical demonstration. The large brick building contains offices, class rooms, laboratory, etc. The smaller buildings are devoted chiefly to fowls used in instructional work. The experimental pens and range for young stock are on a separate farm a mile or so distant.

"It is a well-known fact to every poultryman and every visitor to a poultry show, that different breeds of fowls have characteristically different colors of the skin. In the United States generally yellow-skinned birds are preferred over white-skinned ones for market purposes. As a consequence of this preference nearly all of the so-called American breeds such as, for example, Plymouth Rocks, Wyandottes, Rhode Island Reds, etc., have a distinct yellow color to the skin. Correlated with this general yellow skin color these same breeds of poultry have characteristic yellow shanks. This color of the shank is one to which a good deal of attention is given both by the judges in the show room and by the expert poultryman in picking out stock for his pens. A clear, bright yellow leg is always preferred in these breeds by the show room judge.

"The cause of the yellow skin color of birds is really a layer of colored fat which lies in and below the skin. This fat in the American and other yellow-skinned breeds is colored by a particular kind of yellow fatty pigment known as lipochrome pigment. Also probably this same coloring matter gives the yellow color to the yolk of the normally pigmented egg.

"This last consideration is one which calls attention to the practical bearing of these results on shank color. It is a well-established fact, both in cattle and in poultry, that when the food does not supply a sufficient amount of yellow coloring matter for the product, whether milk or eggs, the animal then draws on its own body fat for the further supply of this coloring matter. This results in a bleaching of the body fat of its yellow color while keeping up the color of the milk or the eggs. From this fact it results that the general skin color, and particularly the shank color of a hen having naturally yellow shanks, is much bleached out after the hen has been laying heavily, and furthermore, the heavier the laying has been the greater will be the amount of bleaching observed. In consequence of this it is possible to go through a flock at the end of a laying year and pick out at once by the color of the shanks those birds which have been extremely heavy layers from those which have been drones. The drones will be the birds which at the end of the season have bright yellow legs, such as one is accustomed to see in pullets which have not yet begun to lay. On the other hand, birds which have done a hard year's work and produced many eggs will have shanks completely white or nearly so. Examination at this station of many hundreds of birds whose trap-nest records are known, makes it possible to say positively that no bird which has been a high producer will have bright yellow legs at the end of the laying season. 'Two hundred egg' hens always have white legs at the end of their pullet year.

"This point is one which may be of a great deal of value to the poultryman when he is culling his flock in the fall and deciding which of his pullets he will keep over to use as breeders the next year. If he has no trap-nest records the color of the shanks furnishes him one of the best indications he can have as to the way in which these pullets have laid during their first year of life."

Development of Pigmentation Tests at Storrs

At the Storrs (Conn.) Experiment Station the question of pigmentation and its connection with egg production has received special attention, and in 1915 Messrs. Blakeslee and Warner published an article in Science, entitled "Correlation Between Egg-Laying Activity and Yellow Pigment in the Domestic Fowl", in which the first experimental data in this connection appear to have been presented. It is there stated that:

"In the Leghorns and the so-called American breeds, such as the Plymouth Rocks, yellow in the form of yellow fat is present in varying amounts in the legs and beak. In these breeds individual birds may undergo considerable change in the amount of the yellow pigment visible. The paling or yellowing of the legs has been attributed by poultrymen to various environmental factors. Of recent years some individual poultrymen however, have claimed that paling of the legs is due to heavy laying.

"So far as the writers are aware, no published data are available which show in how far the leg color may be of value in selecting the laying hen, and such suggestions as have been made in this connection have confined themselves almost entirely to a consideration of the legs alone. The results tabulated in the present paper show conclusively, it is believed, that a close connection does in fact exist between the yellow pigmentation in a hen and her previous egg-laying activity, and that in Leghorns the color of the ear lobes is perhaps a better criterion of laying activity than either legs or beak, and is more

readily recorded." (For the data mentioned in preceding quotation, see Chapter V.)

An interesting incident in connection with the discovery of the influence of egg production upon pigmentation, at least so far as it relates to the development of the method at the Storrs Agricultural College, is the following:

Some years ago, Professor A. F. Blakeslee, a member of the Horticultural Department of that institution, inspected the laying contest pens in company with Professor Kirkpatrick, the latter pointing out the good producers in the various pens, also the poor ones, using the actual records of production which he held in his hands. After having gone through a number of pens, Professor Blakeslee said: "Now let us go over these same pens and see if I cannot tell you which are the good producers and which are the poor ones without the use of your records." They proceeded to do this and to Professor Kirkpatrick's surprise, Professor Blakeslee was able to pick out the good and poor layers with great accuracy. To the inquiry as to how he was able to do it, he replied: "As you pointed out the different fowls I noticed that the poor layers had yellow shanks and in some cases yellow beaks, whereas the heaviest producers had bleached-out legs and beaks." Professor Blakeslee's attention was naturally drawn to this detail as he had for years been engaged in a line of research work that involved close observation and comparison of colors and shades of color. Application of Professor Blakeslee's method by members of the Station Poultry Department gave similar results and showed quite clearly that pigmentation tests were capable of general application.

Influence of Egg Laying Contests

In Chapter II special attention is called to the possibilities in the way of increasing the average production of fowls and the great practical importance of so doing. It is probable that one of the most important agencies in showing what can be done along this line and of awakening interest in advance methods of poultry keeping, has been the egg laying contests that have been conducted in different parts of the country.

The first laying contest to be held in this country was in 1894-5, and was conducted by the National Stockman and Farmer. In this contest 224 pens were entered. Weekly reports were required from each contestant, and the value of the eggs laid was determined according to the current price of eggs in the Pittsburg market.

The six highest pens were reported as follows:

First pen—eight W. P. Rocks; average, 289 eggs. Value of eggs, $5.02 per hen.

Second pen—eight cross-bred Leghorns; average, 283 eggs. Value of eggs, $4.82 per hen.

Third pen—eight W. P. Rocks; average, 280 eggs. Value of eggs, $4.00 per hen.

Fourth pen—eight S. C. B. Leghorns; average, 277 eggs each. Value of eggs, $4.64 per hen.

Fifth pen—twenty-four S. C. B. Leghorns; average, 277 eggs each. Value of eggs, $4.89 per hen.

Sixth pen—twelve B. P. Rocks; average, 262 eggs each. Value of eggs, $4.24 per hen.

The first of the annual contests held in this country was the "International", inaugurated in 1911. It was conducted jointly by the Philadelphia North American and the Storrs (Conn.) Station, and later by Storrs alone. The number has gradually increased since that date, until eight or more now are regularly conducted under state control in various sections of the country.

Egg laying contests held under the management and control of state institutions have a special value, since they largely eliminate skepticism regarding the accuracy of the results claimed, which is apt to be aroused by private records. Knowing the character of the men in charge of these contests, no one seriously questions the general accuracy of their reports.

Summary

Experienced observers are able to learn numerous facts in regard to production of hens by a careful study of their external characters.

Estimates of production based on culling methods properly applied, are accurate to a remarkable degree.

A correlation between the molt and productiveness was observed as early as 1876.

The loss of pigmentation, as a result of continued egg production, was noted in a newspaper article in 1879.

Among government workers the first reference to the fact that late molters are the best layers, was in 1909; to loss of pigmentation, in 1910; to pelvic arch test, in 1912.

The first experiment station bulletin relating to loss of pigmentation as a result of egg production, was issued by the Maine Station in 1914.

The first experimental data on pigmentation as a guide to culling were published by Storrs Exp. Station in 1915.

The various egg laying contests conducted under state supervision have been of the greatest value in awakening interest in poultry keeping and in demonstrating what it is practicable to accomplish along this line.

FIG. 4—BUILDINGS USED IN THE NATIONAL EGG LAYING CONTEST AT CONNECTICUT AGRICULTURAL COLLEGE

CHAPTER II

Importance of High Average Egg Production and How Secured

Capacity for High Egg Production a Common Inheritance in Fowls—Possibilities in the Way of Increased Average Production and How It May Be Brought About—Per cent of Egg Yield Required to Insure Profitable Production—Average Number of Eggs That Should Be Laid by Fowls of Different Breeds—Why Standard-bred Fowls Should Always be Kept

FROM a physiological point of view there appears to be scarcely any limit to the number of eggs that a hen can produce, aside from such as may be imposed by individual capacity for rapid assimilation of food and its transformation into the various compounds employed in the composition of the egg. The ovary of every maturing pullet contains several times as many ova as she will ever be able to elaborate into fully formed eggs (see Chapter XVI) and the total number actually produced will be determined by the skill of the caretaker and the fowl's individual laying ability in each case.

There is indisputable evidence in the reports from State Experiment Stations and laying contests conducted under government control in this and other countries, showing that the production of 200 eggs in the twelve months of the pullet-hen year is a comparatively common performance in well-selected flocks; that many hens can and do lay well over 250 eggs in one year; and that some have even exceeded the 300-egg mark.

While the chances for securing such "record" layers are greatly increased by breeding with that object in view, since high producers most frequently are descended from lines of heavy layers, they are by no means always of such known ancestry. On the contrary, a study of the winning pens at laying contests clearly establishes the fact that in many instances they owe their rank more to skillful selection than to systematic breeding—thus proving that capacity for high egg production is a more or less common inheritance in fowls—at least among those belonging to what are commonly called the "utility breeds." It also is true, however, that in every flock, no matter how carefully bred, there is a larger or smaller proportion of hens that by no practical method of feeding or handling can be induced to produce eggs in profitable numbers.

FIG. 5—A NEW JERSEY "MULTIPLE UNIT" LAYING HOUSE
Type of laying house popular throughout the state of New Jersey and well adapted to use of family and commercial poultry keepers generally.

The practical significance of this is that every poultry keeper, regardless of breed kept (within the limits of the "utility" breeds), has two definite means of improving the production of his flock:

(a) He can secure increased egg production by systematically breeding to that end. Breeding gradually improves the general level of flock production by raising the maximum reached by "record" layers, by increasing the proportions of high and medium producers, and by reducing the percentage of inferior layers.

(b) In every flock the average of production can be raised at any time, simply by removing inferior layers. This is culling—the quick and simple way to keep production up to a reasonable percentage. Culling improves average production by removing the inferior producers as they develop, cuts down feeding expense, and increases profits.

While the average annual production per hen in this country is not definitely known, the figures given in the United States census of 1910 indicate that it probably is in the neighborhood of 80 eggs. As will be shown later on in this chapter, that average is altogether unnecessarily low. Probably there is not a flock in this country in which the average per hen cannot be raised to a marked extent by proper culling. And speaking generally it MUST be raised if the production of table eggs is to remain a practical and efficient industry. Whatever may have been the case in the past, under present conditions a nation-wide average of 80 eggs per hen should not be tolerated.

Causes of Low Average Production

Leaving the matter of breeding out of consideration for the time being, there are a number of practical explanations for low production in the average flock.

Lack of Interest. It ought to require no argument to convince every poultry keeper of the importance of securing increased egg production so far as it is practicable for him to do so. The commercial poultry keeper, especially, with his heavy feed bill and his relatively large investment, and with his livelihood depending in whole or in part upon the net returns from his flock, should be quick to learn and apply every practical method for securing increased egg yields. And yet, one of the chief reasons why average production falls so low, is lack of interest.

Keeping Old Fowls. Keeping fowls that have outlived their ability to produce eggs in profitable numbers is a common cause of low flock averages. Included under this head are practically all hens over three years old. Where the plan of leg-banding each year's pullets is adopted, placing the bands on left and right legs on alternate years or using a different colored band each year, there is no danger of confusion on this point, and the old hens are readily identified and culled out at will. An exception must be noted here in the case of heavy layers, which should be retained for use in breeding pens as long as they keep in good condition and are reasonably productive, regardless of age.

Malformed and Diseased Fowls. Almost every unculled flock contains some hens that are obviously incapable of laying eggs and may even be a source of danger to the rest, the owner keeping them, as a rule, simply because he dislikes the disagreeable job of disposing of them. Under this head come fowls that have crooked backs or are seriously lame; chronic sufferers from any disease; hens that are extremely poor, showing that they have some hidden disorder, or that are broken down behind (often an indication of an abdominal tumor),—in short that have any obvious defect. Hens so affected, even when apparently in good health, rarely are profitable layers. If they are fit for use on the table they should at once be disposed of for this purpose, and if not, they should be killed and burned or buried without delay, thus stopping what in many flocks amounts to an important financial loss, caused by wasted feed and labor.

Late-Hatched Pullets. The laying year ends with the molting season, or along in September or October as a rule, regardless of when the pullets were hatched. A good first-year record is out of the question unless the pullets get an early start. Those hatched so late that they do not reach full development and laying maturity until well along in winter do not have sufficient time in which to make a good record, no matter what their inherent productive capacity may be.

Feeding and Care. Improper rations, insufficient feeding, uncomfortable or unsanitary houses all operate directly against securing good egg yields. The person who sets out to make the production of eggs a paying occupation should appreciate the importance of giving the fowls a chance. The conditions essential to good production are neither numerous nor hard to meet. Any one who is willing to be guided by the experience of others will find it a simple matter to get results, and of the most profitable sort.

Relation of Average Production to Profits

The direct relation of average production to net profits and the imperative necessity for a higher average egg yield for poultry flocks generally, is strikingly illustrated in Bulletin No. 329 of the New Jersey Experiment Station which gives the result of a survey of 150 egg farms in that state during 1915-1916. In this bulletin it is clearly shown that during those years "poultrymen did not begin to make money until their hens produced 90 or more eggs per year." Above this point they began to make good profits. Those who were able to reach an average of 148 eggs per year received a labor income of $1,823. The highest producing flock included in the survey made an average of 186½ eggs per hen. There were 350 hens in this flock, of which 300 were pullets, and the receipts for eggs sold averaged $5.83 per hen. The owner also sold baby chicks to the value of $168.00, 150 yearling hens for $90.00, and 600 cockerels for $200. With due allowance for increase in the flock, the total returns for the year amounted to $3,121, and deducting the cost of feed ($1,160), the income was $1,603.

Compare these results with the meager returns realized by those who accepted the low average of around 60 eggs per hen (see following table) for the true explanation of the wide differences of opinion that exist in certain quarters in regard to the practical possibilities for profit in commercial poultry keeping. It is true that it is not proper to consider the difference between feed cost and egg receipts as net profit. Labor, interest on investment, depreciation in value of birds, and other items enter into the cost of production. To get a clear idea of the relation that different averages of production bear to net profits, the following table is given, condensed from the bulletin just referred to:

Relation of Production to Receipts on 150 Poultry Farms in New Jersey

Eggs Per Hen	Total Receipts		Receipts Above Expenses	
	Per Farm	Per Bird	Per Farm	Per Bird
60 or less	$1,144	$2.20	$95	$0.17
61 to 80	1,733	2.50	286	.42
81 to 100	2,050	3.10	629	.94
101 to 120	3,009	3.70	1,127	1.43
121 to 140	3,415	4.60	1,578	2.15
141 and over	4,540	5.50	2,232	2.70
	$2,818	$3.82	$1,092	$1.48

The above table shows in the clearest manner the

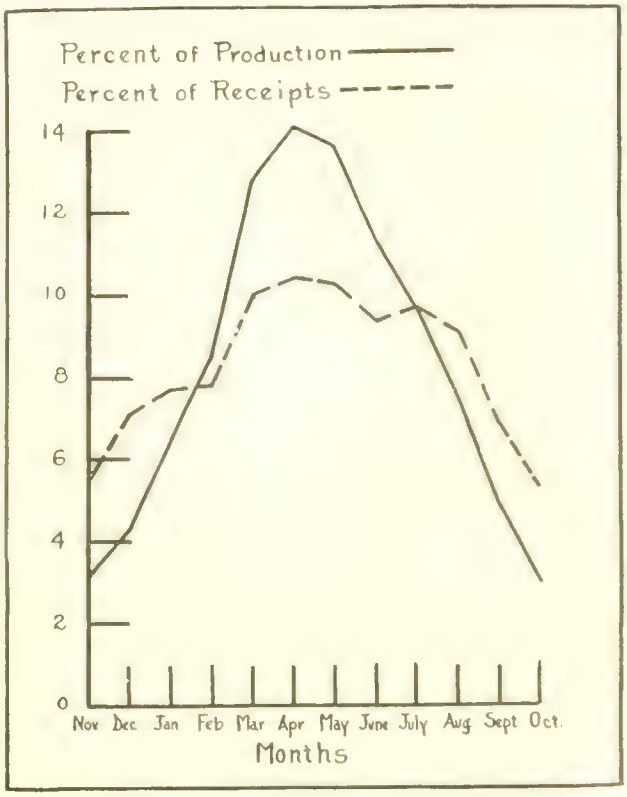


FIG. 6—AVERAGE MONTHLY PRODUCTION AND RECEIPTS ON 150 N. J. POULTRY FARMS

This illustration shows in graphic manner the unequal distribution of production and receipts through the year, on the average poultry farm. More attention paid to culling would bring fall and winter production and receipts more nearly on a level with those of summer. Reproduced from Bul. 329, of the N. J. Exp. Station.

practical importance of securing high egg yields. Not until an average production of over 100 eggs per hen was secured did the receipts represent a fair return on labor.

What Egg Yield Can Reasonably Be Expected

Accepting as reliable the results secured at various egg laying contests, it would seem that so far as general averages are concerned a practical, though no doubt only a temporary limit, has been reached with reference to average production. That is, while there is more or less fluctuation in the high records made by individuals and flocks every year, average production for all the fowls in the contests is not increasing, at least to a noticeable extent. This is illustrated by the following data from the records of the past five years at the International (Storrs) Laying Contest.

Annual Production Per Hen for Five Years at Storrs Laying Contest

	P. Rock	W'nd's	R. I. Red	L'horns	Ave.
3rd Contest	140	153	136	155½	145
4th Contest	146	165	155	158	152
5th Contest	160	169.6	158.7	165	162
6th Contest	161	165	158	167	163
7th contest	159	162	148	162	154

We do not have before us the records for the first and second years of the contest, but in connection with the third contest the statement is made that the average for that year is "somewhat lower than in preceding contests", which is believed to be due to the fact that the pens for the first two years were limited to only five fowls each, while in subsequent years the number was ten. The winter during the third contest was exceptionally severe, as was also the case in the seventh.

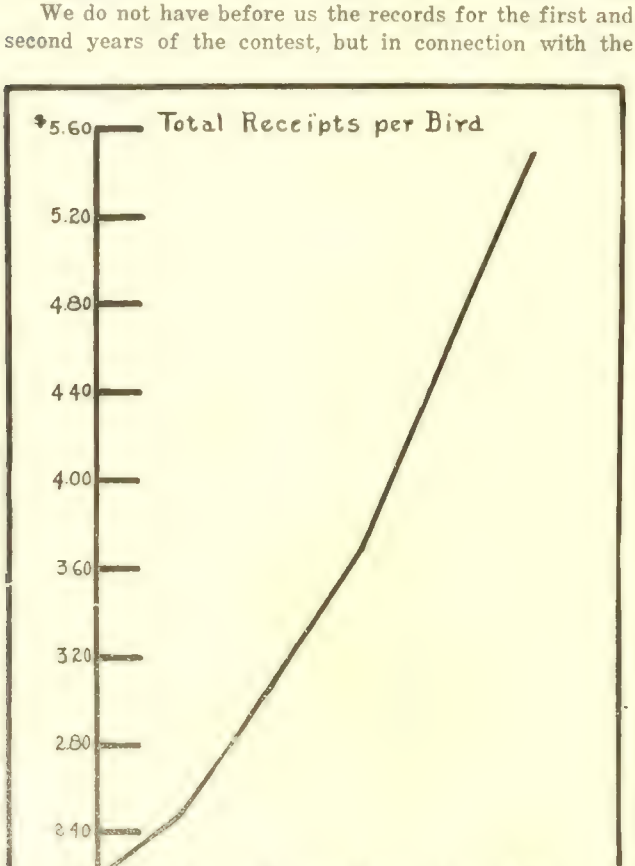


FIG. 7—GRAPH SHOWING RELATION OF EGG YIELD PER HEN TO TOTAL RECEIPTS

Note what an average increase of 20 eggs or more per hen means in increasing receipts. Systematic culling will make this difference in averages in almost any flock. Reproduced from Bul. 329, of the N. J. Exp. Station.

Production Standards for Poultry

The Monthly and Yearly Rate of Egg Production that Should be Realized in Well-Bred Plymouth Rock, Wyandotte, Rhode Island Red, and Leghorn Flocks

By MARCUS A. CANFIELD, Jr.

EDITORIAL NOTE—If records secured at the various egg laying contests are taken as establishing the limits of "reasonable expectation" in regard to the productiveness of fowls of the different popular breeds when kept under favorable conditions, these may be made to serve as standards of production by which poultry keepers generally can measure the results secured in their own flocks, and thus determine whether their fowls are fairly measuring up to what may be expected of them. An effort to establish production standards for several popular breeds is described in the following article which is condensed from an unpublished thesis entitled "The Elaboration of Production Standards for Poultry", by Marcus A. Canfield, Jr., New Jersey College of Agriculture. It is not to be supposed that fowls kept in the large flocks common on farms and commercial poultry plants generally, will reach the high average of production attained by the five or ten hens that constitute the average contest pen, though the advantage possessed by extremely small flocks is not as great as is generally believed. In point of fact, contest averages are regularly being equaled and even exceeded by numerous commercial poultry keepers having well-bred, carefully selected flocks.

THE years 1917 and 1918 proved an extremely difficult period for New Jersey poultry keepers, and many found that at the profit per hen which they were realizing, they were not making even a living wage. In contrast with these however, there were others whose returns were almost or quite equal to those of more favorable years.

To one studying the situation the question arises:—Why are not all producers in the same losing rut? Why are some men still highly optimistic and realizing a good profit? The answer is:—Efficiency. The latter have cut out the wastage in the cost of production. They have made an intensive study of cost-accounting factors. Furthermore they know their stock, and it is good. They have by various means eliminated the greatest source of loss to the average poultry raiser—the nonlaying hen—or, in other words, the loafer. There are many such hens in all ungraded flocks, and not only do they bring no revenue whatsoever, but they counterbalance the profits gained from high-producing hens. Hundreds of thousands of "boarder" hens are being fed today in this country. The simple elimination of such would be the means of keeping hundreds of discouraged men in the business,—of enabling them to realize a profit instead of a loss. A survey of 150 White Leghorn farms in this state last summer indicates that an average production of 100 eggs per hen must be accepted as the minimum (under New Jersey conditions) of profitable egg production.

The next question that arises is what is it possible or practical to do to increase the average so as to secure a

reasonable profit: In other words, what should well-bred and properly fed hens normally accomplish in the way of average egg production? That is the purpose of this investigation,—to determine standards of production to which the farmer can compare the accomplishments of his flock as individuals, with a view to eliminating all those below the standard, and striving to attain a production as much above it as possible, for this standard is to be an average of production which poultry keepers should be able to attain under favorable conditions, not a maximum.

For many years the Experiment Stations have realized the importance of standardizing egg laying, and a number have been slowly working toward that end through the medium of egg laying contests. Some of the best known and most representative of these contests are the Connecticut Contest at Storrs; the Philadelphia North American Contest at Newark, Delaware; the Missouri Contest, and the Vineland (New Jersey) Contest. The records of these different contests, it would seem, should afford sufficient data on which to base a careful analysis of the average per cent of egg production of each of the popular breeds on both a weekly and a monthly basis, and to standardize the latter. Such a standardization should enable one to see just what a flock of a certain size and breeding should normally be putting into the egg crate during any month in the year.

In this determination the following egg laying contests were considered:—Weekly reports of the Philadelphia North American, Sixth Storrs, and Vineland; monthly reports of Third and Fourth Storrs, Missouri, and Vineland. In obtaining the percentages of production, the following method was pursued. The number of pens of each breed was found in each contest; then the possible production within a certain period was determined. The total actual production, as found by adding together the productions of all the pens, divided by the possible production gives the per cent production for the breed. For example, in the Vineland Contest, there are 54 pens of S. C. White Leghorns, or 540 birds. In the month of March, 1917, each hen had a possibility of laying 31 eggs or 16,740 eggs for the breed. The actual production was found to be 10,830, or 64.7 per cent.

A similar operation was carried out with each breed in each contest, on both a weekly and a monthly basis, and results tabulated. These tables are here omitted for lack of space, but a study of them is found to reveal three important facts:

1st:—The Leghorns for five months are far higher in per cent of production than any of the other breeds; during the rest of the year they are considerably lower.

2nd:—Quick and complete molting is characteristic of the Leghorns.

3rd:—There is little to choose among any of these breeds, as regards percentages of total production.

From the monthly production records a graph was prepared (see Fig 12) showing the average monthly production of each breed in all the contests. The graph, shown in Fig 49, illustrates the average monthly production of Wyandottes compared with that of the Leghorns. From this can be seen the slight superiority of the Leghorn over the heavy breeds in the amount of production. However, as is clearly indicated by this graph, the variation between high and low points of production is only 44 per cent in the heavy breeds while in the Leghorns the corresponding difference is 57 per cent, thus showing that Rocks, Wyandottes, and Reds are, on the whole, steadier producers throughout the year than are Leghorns. Collecting the data herein referred to and putting it in tabulated form we arrive at the following as our Standards of Production for the breeds considered:

Standards of Monthly Production For Different Breeds

	Rock	Wyan.	Red	L'g'h'n
November	12.6	28.4	16.2	24.8
December	21.8	35.1	26.1	24.2
January	30.5	38.6	34.4	25.1
February	47.1	49.2	47.7	41.0
March	63.5	60.2	61.8	61.7
April	64.2	60.4	64.8	68.7
May	62.1	59.2	56.5	69.3
June	55.4	52.9	50.7	67.4
July	48.7	46.4	45.7	60.6
August	43.7	45.5	43.2	54.2
September	37.0	39.9	39.7	33.1
October	25.0	30.2	30.8	12.8

FIG. 8—A COMMERCIAL POULTRY PLANT IN CALIFORNIA.

Commercial poultry keeping now is on a safer and more profitable basis than ever before, because of the more exact knowledge of the subject and the better methods generally practiced.

Setting this in terms of yearly production, the mark which the poultryman should endeavor to have his hens reach is:—

Plymouth Rock	155 eggs
Wyandotte	163 eggs
Rhode Island Red	157 eggs
White Leghorn	165 eggs

Now by way of illustration we wish to bring in some results secured in an intensely practical investigation conducted in the summer of 1917, under the New Jersey Experiment Station. This work was thoroughly to survey 150 typical White Leghorn farms of the State. From some of the figures obtained in that survey, a table (presented herewith) was compiled, showing the average monthly production on thirty-six of these farms as compared with the production of the White Leghorns obtained in the Vineland contest.

	Avg. Per Cent Production, 36 N. J. Leghorn Farms	Avg. Per Cent Production Leghorns at Vineland Contest
November	10.0	24.8
December	13.0	24.2
January	19.7	25.1
February	28.2	41.0
March	38.9	61.7
April	44.2	68.7
May	41.5	69.3
June	35.3	67.4
July	29.4	60.6
August	22.9	54.2
September	15.4	33.1
October	9.6	12.8

Fig. 130 is a graphic representation of this table. Together they point out clearly and forcefully the discrepancy between the production actually obtained in this state on commercial egg farms, and the production which can and should be secured.

Practical Value of Culling

More than one factor is involved in securing maximum production in the laying flock, as has already been shown. It would be difficult however, to exaggerate the practical importance of culling as one means to this end. Methods of breeding and feeding for increased egg production will be considered in their proper place, but it is of the first importance that every person engaged in the production of table eggs shall realize the advantage which is placed in his hands by the discovery of simple, easily understood and applied methods of selection, by means of which he may AT ONCE change his flock from a low or no-profit basis to a truly paying one. The practical advantages of culling are set forth in a most impressive manner in the following article.

Importance of Culling

The Practical Advantages of Culling as a Means of Securing Increased Profit from the Laying Flock

By PROF. JAMES E. RICE

Our slogan should be to produce more eggs from the same number of hens, or as many eggs from less hens, with profit. This can be accomplished by introducing more efficient methods of production, buying, and marketing. Much can be done in each of these directions to enable the poultry producer to meet present critical conditions, without financial loss, while doing his part in furnishing the world's supply of food.

The one single factor of greatest importance in reducing the cost of production is to improve the productive quality of stock. This may be accomplished in two ways —first, by eliminating the unprofitable individuals, and second, by using the best fowls for breeding. Each is essential if we are to make the greatest improvement.

Fowls differ in the widest extremes in their laying capacity. Until recently it has not been possible accurately and cheaply to distinguish the more productive from the less productive fowls. With our present knowledge of how to pick out the laying from the non-laying hens, and the highest from the lowest producers, it is no longer necessary for poultrymen to breed without regard to laying quality, or to keep unprofitable fowls from year to year.

It is not only poor business, but is an economic and national crime to use valuable feed to support, at a loss, unproductive fowls. Our present knowledge of the ways in which climatic conditions, time of hatching, and habits of laying influence production, enables us to estimate with considerable accuracy the proportion of fowls that under normal conditions of care will cease and commence to lay at different times of the year. It is certain that in every flock many unproductive fowls are carried for many months as unprofitable boarders. By culling these out and selling them when they cease to lay for the year, we accomplish a number of profit-making things.

First, we release a large amount of valuable feed for productive purposes.

Second, we place upon the market immediately an important supply of poultry meat.

Third, we keep only the profit makers, thus increasing the average production and profit per fowl retained.

Fourth, we decrease the amount of labor required by reducing the size of the flock earlier in the year, instead of waiting until late in the fall.

Fifth, we secure a higher price for the culled stock by avoiding the overstocked late-fall markets.

Sixth, we secure more efficient production, because of less crowded conditions and better care given to the stock that is retained.

Seventh, we get more satisfaction because of the intellectual incentive which always comes with larger profits and greater knowledge.

The only solution to the poultryman's problem of meeting the present situation is to secure a satisfactory egg yield, in order to reap the advantage of high egg prices. To the one who can secure a reasonable egg yield the spectre of high feed prices vanishes. The most important factor in securing high egg yield is good hens. Without efficient hens, the best of rations, buildings, methods of incubation, breeding and marketing, are lost. At a time when maintenance costs are high, it is even more necessary to get production results than when production costs are low.

For the season of 1919 we are planning on a much more extended campaign than ever before in the matter of culling and selection. THIS WORK IS BOUND TO REVOLUTIONIZE THE BREEDING OF POULTRY WHEN THE STATES WAKE UP TO ITS IMPORTANCE.

Results Of a Culling Campaign in Connecticut

How Culling Increased the Daily Average Egg Yield on Seventy-five Poultry Farms from Twenty-eight Per cent to Forty-five and one-half, and Reduced the Grain Bill Forty Per cent

By PROF. W. F. KIRKPATRICK

EDITORIAL NOTE—Probably there is no better way to illustrate the practical value of culling to poultry keepers than to show what has been accomplished when the method has been practiced. The Extension Departments of a number of State Agricultural Colleges and State Departments of Agriculture have been quick to realize the importance of state-wide culling and have conducted intensive educational campaigns to that end, and with most encouraging results. In Connecticut interest has been especially keen and results highly satisfactory, as shown by the following extracts from a communication by Professor W. F. Kirkpatrick which appeared originally in the Reliable Poultry Journal.

THE whole culling campaign has been based on the fact that some hens quit laying in July, that a lot of them quit in August and September, and that these birds that quit too early are not of course the best producers. We have gone on the theory that a hen that quit the job for a three or four months' vacation was not entitled to serious consideration; in other words, we have considered such hens "slackers" as compared with those that lay on up to the middle of October and even into November.

We have of course employed the usual extension organizations to reach the people; that is, the county agents, poultry associations, and other organizations interested in the work. I want to add, too, that we have enjoyed the finest sort of cooperation and support from the Committee of Food Supply of the State Council of Defense. To assist in advertising the work we issued a large poster which was extensively circulated throughout the state.

Theoretically this is of course all very nice, but it is wasted energy unless one can get results. We have tried to keep careful records because the campaign was new to us, a project we had never before considered. Indeed it has never before seemed so necessary as now when New England poultrymen are paying such high prices for feed, while at the same time many believe that poultry products have not made relatively the same advance.

All demonstrations were of course properly announced and advertised beforehand. In addition to this, we asked the breeders whose birds were to be examined to keep a daily egg record of their flocks for one week preceding the date of the demonstration. We asked them likewise to keep a daily egg record of their flocks for one week following the demonstration. We wanted to have an absolute check on our work and to know for a certainty whether or not we were doing any good.

I think the following figures tell a good story. Up to the first of October the poultry department here had conducted 75 selection demonstrations on 75 different poultry farms, covering every county in the state. The average attendance at each of these was nearly 19, and these people who came to see the demonstrations passed in signed cards, pledging that they would go home and cull their own flocks, totaling nearly 55,000 hens. The figures below show the results in the 75 flocks that the demonstrator visited:—

FIG. 9—A FARM CULLING DEMONSTRATION IN NEW ENGLAND

Total number birds handled	7556
Average daily egg yield	2130 Eggs
Or 28 per cent.	
Total number of birds kept	4419
Average daily egg yield	2018 Eggs
Or 45½ per cent.	
Rejected as slackers	3137

It can be seen from the above figures that these 75 breeders, after removing over 3,000 hens from their flocks, suffered a loss of only 112 eggs a day; or in other words,

they decreased their flocks 41½ per cent, but lost only a little over 5 per cent of the eggs they had been getting; or to put the case in still another way, they were able to reduce their grain bills about 40 per cent, while losing only about 5 per cent of their income from eggs.

In closing, I want to say that this campaign has seemed to us to effect an immediate and direct saving to poultry breeders; and not only this, but in most cases it has automatically selected the best birds to keep over for

FIG. 11—A POOR LAYER
Photo from New Jersey Experiment Station.

next year's breeding work; and lastly it reduces substantially the consumption of grain fed to nonproductive animals.

A Culling Campaign in New Jersey and Its Results

The importance of eliminating nonproducing or low-producing hens, and in that way increasing the average egg yield of the flock, is duly appreciated by the Poultry Department of the New Jersey Experiment Station. Special efforts have been made to interest New Jersey poultry keepers generally in culling methods, with what success is shown by the following description of a culling campaign, supplied by Professor H. R. Lewis, Head of the Poultry Department:

"Our culling campaigns show that culling materially reduces the number of birds in the flock without reducing in any material degree the actual number of eggs received. In other words, it greatly reduces the feed bill without reducing the income from eggs. The following figures from New Jersey's campaign bear this out.

"During this state culling campaign twenty counties were covered and eighty-one demonstrations were held. The following tabulated results of this series of culling lessons show how profitable a practice is really represented. These demonstrations were held in August and September, 1917.

Total number of demonstrations	81
Number of persons present to see work done	1,762
Number of birds handled	22,542
Number of birds culled out	10,668
Number of culls to be kept for a short while, as they were laying some at the time of demonstration	3,256
Average number of birds actually handled at each demonstration	128
Per cent of profitable birds held	52 per cent
Per cent of birds culled	48 per cent

In the above campaign a record was kept on 7,532 of the birds handled, for a period of seven days before culling and for seven days after culling, with the following result: For 7 days before culling the birds laid a total of 17,565 eggs, or practically 33 per cent, while for the 7 days following the remaining birds laid 17,205 eggs, or a production of 32 per cent on the basis of the original number of birds. This is a drop of less than 1 per cent, while the number of birds culled was 47 per cent, which meant a reduction in feed costs of practically 50 per cent, with no appreciable loss of income."

Standard-Bred Fowls Should Be Kept

The superiority of standard-bred fowls has been demonstrated beyond question, time after time, and there is no excuse for or advantage in using those of mixed or mongrel breeding. Even though the poultry keeper may have no desire to breed for show qualities and may have no intention of attempting to realize the largely increased prices that are always obtainable for breeding fowls, or eggs for hatching produced by them, and may intend to devote his attention entirely to commercial production, he still cannot afford to breed or keep nonstandard fowls, Whether comparison is made on the basis of egg production, cost of maintenance, or salability of product, the advantage invariably is with standard-bred stock and in no small degree.

It is not denied that among fowls of inferior breeding there may be some that will possess desirable characters, even heavy laying ability. The proportion of such is always small however, and their inability to transmit such characters to their offspring with any degree of certainty makes their use in the breeding pen disappointing. It is only by mating fowls whose ancestors have been bred for generations towards a definite ideal, that there can be reasonable certainty of improvement or uniformity in any desired character. Even if it is granted that many breeders have been more interested in developing special markings of feathers or other superficial

FIG. 10—A GOOD LAYER
Photo from New Jersey Experiment Station.

characters than in developing size or productiveness, the fact remains that the so-called "practical" poultryman who makes his start with fowls of mixed or mongrel breeding invariably finds that he has handicapped himself, cut his possible financial returns in two or worse, and has definitely set himself back one, two, or more years as a truly successful poultry keeper.

Superiority of Standard Fowls

Some of the advantages of using standard-bred fowls in commercial flocks are stated with special clearness in the following extracts from a circular entitled "The Mating of Standard Poultry for Practical Results", prepared in the Poultry Division of the United States Department of Agriculture:

"The term 'practical' is used here in the broad sense in which it applies as truly to all things that help to create and maintain interest in poultry production as to the things which relate particularly and directly to the production of eggs and meat.

"There is nothing in the nature of poultry that would prevent supplying the world with all the poultry products it could use from races of poultry not attractive to the eye and not uniform in appearance. But there is that in the nature of man which makes poultry keepers give more careful attention to flocks in which they take pride, and makes the sight of a uniform, handsome flock effective beyond all other things in extending interest in poultry culture.

"It is a general fact in the history of modern poultry culture that interest in poultry having distinctive appearance is essential to any marked increase in poultry products. It is also a matter of common observation that poultry keepers who are indifferent about the looks of their stock rarely make notable success. Good work with stock that does not look good is not impossible, but what there is of it is occasional, irregular, and spasmodic. As a rule, the owner of a flock of mongrel-looking poultry that does uncommonly well soon begins systematic efforts to improve its appearance.

"A good looking flock is a standing advertisement of a certain measure of efficiency in poultry culture. It is plain evidence open to all, of skill in breeding and growing poultry; while performance—especially in egg production—is celebrated only as far as detailed accounts of it are published. Appearance speaks for itself; performance in this line must have some one speak for it. Sufficient attention to appearance to secure a pleasing uniformity in a flock is in the highest degree practical. Experience has shown over and over that where this is lacking, interest is apt to flag and production is not maintained.

"American standards for poultry express the characteristic American attitude in regard to combining beauty with utility in the individual bird and in the breed. While a few breed types show the development of superficial characters carried to extremes which unfit the breed for common use, these extreme developments are all of foreign origin, the popularity here of the breeds possessing them is very limited, and the influence of the common American demand for use with beauty tends constantly to modify extreme types.

"The American idea of utility and beauty in combination in domestic animals and birds is that those forms and elements of beauty which are expressions of actual worth, and those which are attractive and in no way inimical to utility qualities, should be cultivated, but that those which are in any measure incompatible with usefulness ought to be eliminated."

What Breeds to Keep

As has already been stated, it does not matter greatly what breed of fowls the poultryman keeps, so far as egg-producing ability is concerned. The records of laying contests have shown that there are highly productive strains in nearly all of the popular breeds. In these contests Leghorns, Rhode Island Reds, Wyandottes, Plymouth Rocks, Orpingtons, Minorcas, Anconas, Langshans, —all have shared in the honors. What is of vastly more practical importance than breed is to have a heavy-laying strain within the breed selected, since it has clearly been demonstrated that different strains in each breed vary widely with respect to their average productiveness.

The poultry keeper who is interested chiefly or solely in egg production will naturally favor Leghorns, particularly if his market prefers white-shelled eggs, or at least does not discriminate against them. The chief advantage which Leghorns have for commercial egg farmers is not that they are necessarily better layers than fowls of other breeds, but that they are more economical producers, because they are smaller in size and so require less feed per hen.

The feed cost of producing eggs with Leghorns will average around 10 per cent less than with fowls of the

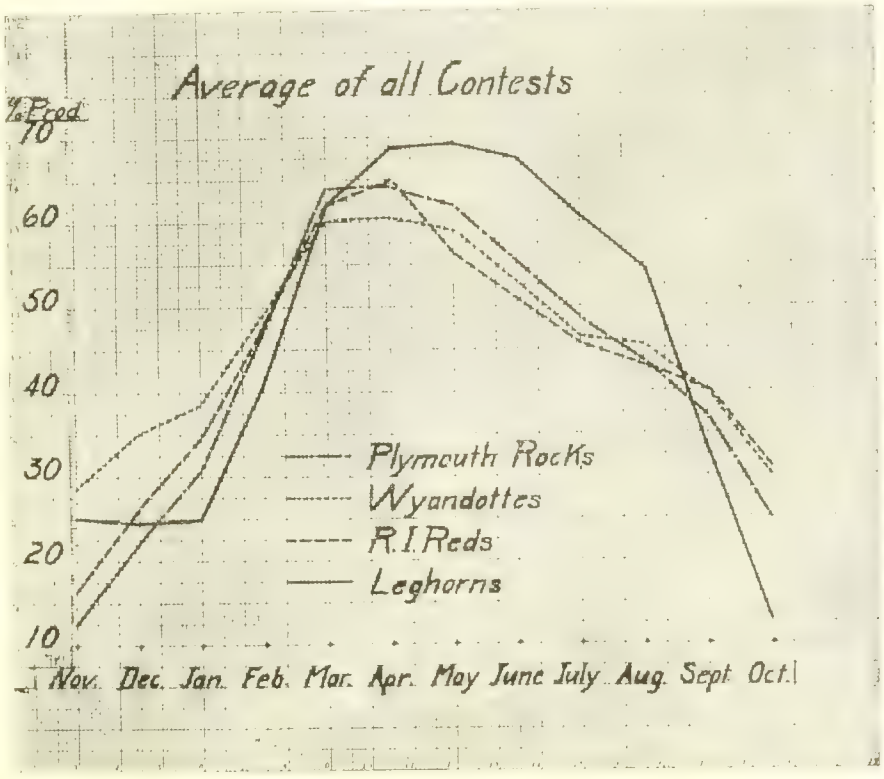


FIG. 12—RATE OF EGG PRODUCTION OF HEAVY BREEDS COMPARED WITH LEGHORNS

The lines in above illustration show how the different breeds compare in average production. In plotting these curves the records made by the different breeds at Storrs, Vineland, Mountain Grove (Mo.), and North American contests were used. Courtesy of the N. J. Exp. Station.

larger breeds—an important saving where great numbers are kept. Leghorns may be housed in larger flocks, thus reducing labor; they require less floor space per hen, which means a smaller investment in buildings; they respond better to wholesale methods of handling in housing and feeding; they waste less time in broodiness; as a rule, their eggs hatch better and the chicks are more easily raised by artificial methods. For such reasons as these Leghorns are used almost exclusively in great egg-producing centers such as Petaluma, Vineland, etc.

On farms however, Leghorns meet with less favor. What usually is wanted there is a large fowl that will also supply good-quality table meat, and that will have a substantial market value when sold. For this use the different varieties of Plymouth Rocks, Wyandottes, and Rhode Island Reds are much in favor, choice between them being largely a matter of personal preference or fancy. As the demand for prime table fowls develops, it is to be expected that the popularity of the larger breeds will increase, and there is reason to believe that, under many conditions, the production of poultry meat may be made a feature of added profit even now, which profit may more than offset the lower cost of egg production in Leghorn flocks.

Especial attention however, should be called to the fact that climate is, to some extent, a factor in choice of breed. In the comparatively mild winters of Southern New Jersey where the Vineland Laying Contest is conducted, Leghorns easily lead all others not only in numbers of eggs per hen, but in net profit. At the Storrs (Connecticut) Contest however, where the climate is more severe, Wyandottes exceed all other breeds in productiveness, though even there, when returns per 100 pounds of feed are considered rather than returns from individual fowls, Leghorns are found to be most efficient.

Summary

Heavy-laying ability is more or less common in all flocks, but is most highly developed and most general where fowls are systematically bred for this most important quality.

The number of eggs laid by any given fowl is determined by her individual laying ability and the skill of the caretaker.

The present general low average of production must be raised in order to insure permanence of the poultry industry as a profitable branch of farming.

There are numerous causes of low production, all readily avoidable.

The average production of any flock may be largely increased simply by culling out the inferior layers.

Under average conditions specialist poultry keepers must secure a yearly average of at least 100 eggs per hen to realize a fair profit on their labor and invested capital.

An average of from 150 to 165 eggs per hen has been secured with different breeds at egg laying contests, and can be approximated by commercial poultry keepers generally.

The best way to overcome the present handicap of high prices for feed is to secure larger average egg yields.

State-wide culling campaigns have resulted in remarkable savings in feed consumption without any appreciable reduction in total number of eggs produced.

The most profitable commercial flocks are of standard breeding. Where uniformity in the flock is lacking, interest lags and not even production is maintained.

A combination of standard and utility qualities in the same flock is possible and practicable.

There is little difference in the actual egg-laying ability of fowls of the popular breeds, but there are wide differences in the productive capacity of various strains in the same breed.

Leghorns are most popular on commercial poultry plants because more cheaply housed, fed, and cared for, than large fowls.

Fowls of the larger breeds are mostly preferred on farms, and can be made an important source of added profit through the production of superior-quality table poultry.

Climate should be considered in selection of breeds to be kept for egg production.

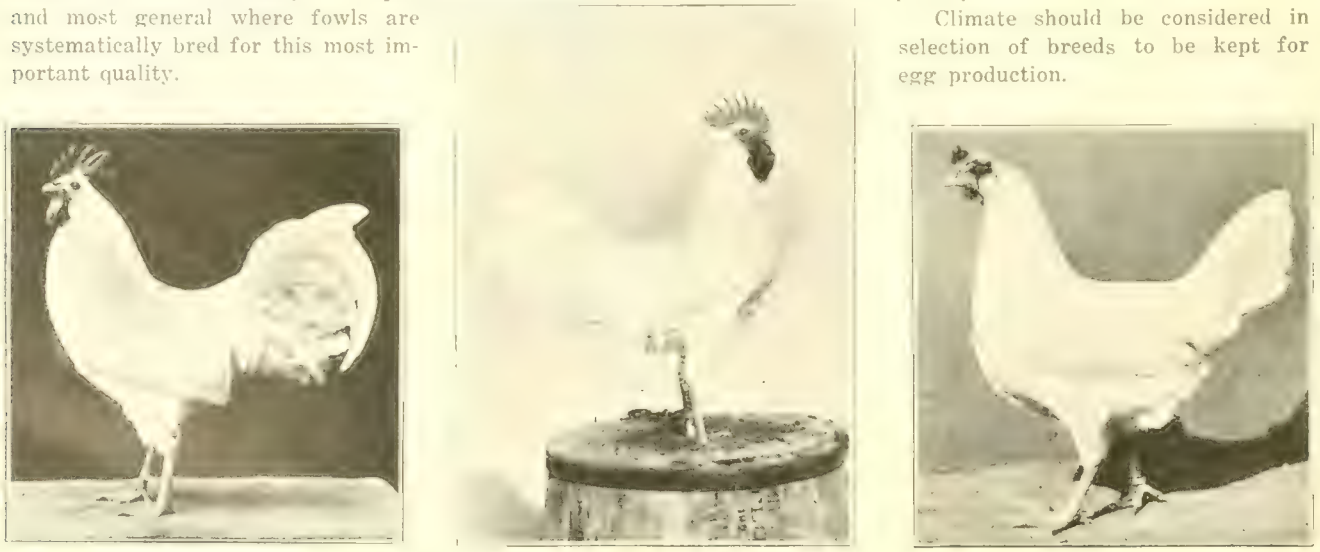


FIG. 13—PROOF THAT STANDARD QUALITY NEED NOT BE SACRIFICED IN BREEDING FOR HEAVY EGG PRODUCTION.

All of the above fowls are of the bred-to-lay strain of White Leghorns on the U. S. Government Poultry Farm at Beltsville, Md., where standard quality and high egg production have been successfully combined. The White Leghorn cockerel on the left is out of a hen that laid 230 eggs in her pullet year. Eight of her sisters and halfsisters produced as follows in their pullet year:—180, 187, 195, 196, 198, 208, 235, and 240 eggs. The sire of this cockerel is the son of a hen that laid 213 eggs in her pullet year and 536 eggs in three years. The grandsire on the sire's side is a son of hen on the right. This hen laid 214 eggs in her pullet year and 654 eggs in four years. She is the great-grandmother of the cockerel shown on left. The cockerel in center was one of the foundation birds used in this strain.

CHAPTER III

Culling Methods Outlined And Illustrated

This Chapter Gives in Brief Form the Important Details of Various Culling Methods In Common Use, Including the Official Outline for Culling as Adopted and Standardized by the American Association of Instructors and Investigators in Poultry Husbandry—A Truly Helpful Interview with Professor H. R. Lewis is Presented, Clearly Explaining Difficult Points and Giving Much Additional Practical Information

THE purpose of this chapter is to present, in condensed form, all the essentials of approved culling methods, thus grouping the important details together for convenient reference and for readily making a complete application of them. In succeeding chapters these methods are described more in detail, for the information of those who wish not only to know how to apply, in their complete form, the various tests recommended, but also to have a thorough knowledge of the whole subject.

Culling methods can be applied to some extent at any time of the year when the hens are laying. For several reasons the tests may be made more accurately in summer and early fall, when production falls off at the beginning of the molting season. It then is a comparatively simple matter to select not only nonproducers, but also those that may have laid well for a short period during the most favorable part of the year but that never reach a profitable total and that, after the first or pullet year, are apt to prove a source of serious loss, and are particularly undesirable in the breeding pen.

Many commercial poultry keepers find it to their distinct advantage to begin culling much earlier than the date just suggested, making the first test as early as June, or whenever the egg yield falls much below 50 per cent. By doing this and by repeating the operation at suitable intervals, they are able to keep the egg yield around 50 per cent all summer through, thereby reducing the feed bill and adding materially to the net profit annually realized from the flock. Where this practice is followed, the flock is gradually culled down to half its original size by fall, or possibly one-third if it contains an unusual percentage of inferior producers.

The first section of this chapter is devoted to the "Official Culling Outline" as approved and adopted by the American Association of Instructors and Investigators in Poultry Husbandry at the 1918 meeting, together with amendments adopted at the Second Annual Judging School at Cornell University, in 1919. This outline is a summary of the methods employed with great success by College and Station Extension workers generally, under whose care the various state culling demonstrations and organized campaigns are conducted in late summer and early fall.

While this outline is simple and readily understood in the main, there are some points mentioned in it which persons unfamiliar with the subject will want to have explained more in detail. The senior author of this book had the privilege of paying a visit to the New Jersey Experiment Station recently and, among other things, took advantage of the opportunity to discuss this outline in detail with Professor H. R. Lewis, Poultryman at the New Jersey Experiment Station, and Secretary-Treasurer of the American Association of Instructors and Investigators in Poultry Husbandry, who has given a great deal of attention to this subject and is, therefore, particularly well qualified to explain and enlarge on the outline. He consented to do this in a comprehensive interview which forms one section of this chapter.

In addition to explaining such points in the Official Outline as seemed to require explanation, Professor Lewis kindly arranged to furnish for our use a valuable series of photos, by means of which the whole culling operation is comprehensively illustrated. These highly instructive photos reproduced in halftone (see Figs. 17 to 34) and accompanied by the illuminating comments of Prof. Lewis, will also be found in this chapter.

The concluding article in this chapter, "Judging Fowls for Egg Production," also is by Professor Lewis. It describes a simple and practical method of applying the instructions given in the "Official Outline." The beginner should not fail to provide himself with some means of keeping a permanent record of the "score" of his hens, using either this score card or the culling chart shown in Figs. 35 and 36. Either of these can readily be prepared by any job printer, or written on a typewriter. When filled out, such cards are valuable permanent records of the laying condition of individual hens. They will prove especially interesting and helpful if the fowls are handled more than once in a season, as should be done if true efficiency is sought in the laying flock.

IT PAYS TO CULL

TO ELIMINATE INFERIOR BIRDS

TO SELECT BEST FOR BREEDING

HOW TO TELL THE

GOOD	from the	BAD
White, Large, Moist	Vent	Yellow, Small, Dry
White	Eye ring	Yellow
White	Ear lobe	Yellow
White	Beak	Yellow
White	Shanks	Yellow
Wide, Thin	Span	Narrow, Thick
Large, Plump, Bright	Comb	Small, Shrunk, Dull
Bright, Bulging	Eye	Dull, Flat
Lean	Head	Flat

FIG. 14—CULLING IN A NUTSHELL

This effective chart was prepared by the New Jersey Experiment Station and puts the principal external characters of good and poor layers in sharp contrast.

OFFICIAL OUTLINE OF CULLING METHODS*

IN ORDER to lay well, a bird must have a sound body. As a first consideration, the bird must be vigorous and healthy if it is to be able to lay well. Vigor and health are shown by a bright, clear eye, a well-set body, a comparatively active disposition, and an indication of good blood circulation. Further, the bird must be free from physical defects, such as crooked beak, excessively long toenails; eyelids that overhang so that the bird cannot see well; excessively scaly legs, or anything else that would keep the bird from seeing or getting an abundance of feed.

Loss of Fat and Loss of Color of Fat Due to Laying Pigmentation Changes

A laying fowl uses up the surplus fat in the body. Especially, it removes the fat from the skin. In yellow-skinned breeds, this loss of fat can readily be seen by the loss of the yellow color. The different parts of the body tend to become white, according to the amount of fat which is being taken from these parts, depending, of course, on the amount of fat which has been stored up in these various parts, and the circulation of blood through them. It should be recognized that all yellow-color changes are dependent on the feed, the coarseness of skin, and the size of the bird. A large bird fed on an abundance of green feed, or other material that will color the fat deep yellow, will not bleach out in color in these various parts as quickly as will a smaller bird, or one which naturally has pale yellow coloring. The changes occur in the following order:

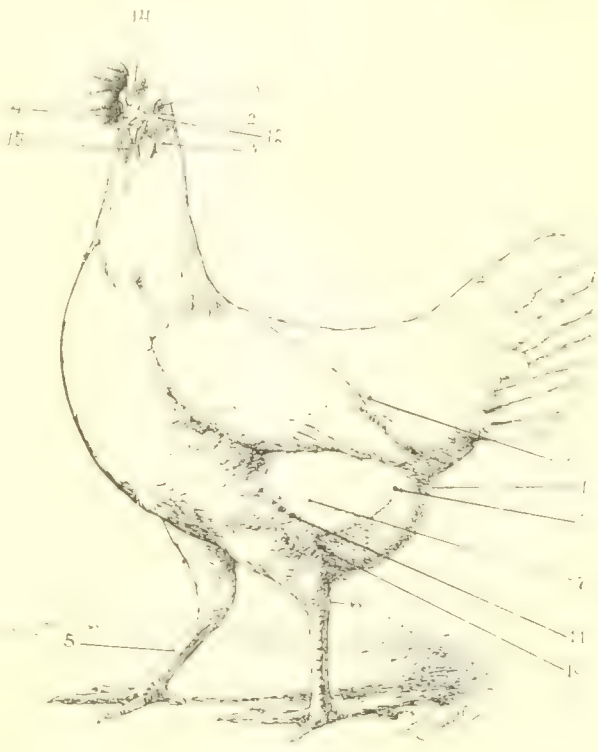


FIG. 15—CULLING NOMENCLATURE

1—Vent. 2—Eye ring. 3—Ear lobe. 4—Beak. 5—Shank. 6—Hock joint. 7—Abdomen. 8—Pubic bone (rear part of pelvic arch). 9—Pelvic arch. 10—Rear of keel or breastbone. 11—Location of lateral process. 12—Face. 13—Eye. 14—Comb. 15—Wattle.

Vent. The vent changes very quickly with egg production, so that a white or pink vent on a yellow-skinned bird generally means that the bird is laying, while a yellow vent means that the bird is not laying.

Eye Ring and Ear Lobe. The eye ring, that is, the inner edge of the eyelid, bleaches out a trifle more slowly than the vent. The ear lobes of Leghorns and other white-lobed varieties bleach out a little more slowly than the eye ring, so that a bleached ear lobe means a longer or greater production than a bleached vent or eye ring.

Beak. The color leaves the beak beginning at the base and gradually disappearing until it leaves the front part of the upper beak. The very tip of the beak is usually white before the bird is making eggs, and should not be confused with the loss of pigment due to production. A very small ring just on the crest of the curve of the beak often is the last part of the beak to lose its color. The lower beak bleaches faster than the upper, but may be used where the upper is obscured by a horn, or black color as in Rhode Island Reds and Plymouth Rocks. On the average-colored yellow-skinned birds, and on the average-sized bird, a bleached beak means fairly heavy production for at least the past four to six weeks.

Shanks. The shanks are the slowest to bleach out, and hence indicate a much longer period of production than the other parts. The yellow color leaves the outer ring of the scales, then leaves the entire scale, on the front of the shanks first, and finally, after a longer and greater production leaves the scales on the rear of the shanks. The scales on the heel of the shank—that part of the shank just below the back of the hock joint—are the last to bleach out, and for this reason may generally be used as an index as to the natural depth of the original yellow color of the various parts of the bird. A bleached-out shank on an averaged-sized bird with an average yellow color, indicates that the bird has been laying fairly heavy for at least from 15 to 20 weeks.

Reappearance of Pigment. When the bird stops laying, the yellow color comes back into the vent, eye ring, ear lobes, beak, and shanks in the same sequence as it left, but the color returns much more quickly than it went out. A vacation or rest period can sometimes be determined by the end of the beak being bleached and the base being yellow, or a longer vacation or rest can be determined by the shanks being pale or somewhat bleached and the beak showing a fair amount of yellow pigment. In other words, if the degree of yellow color in a bird gradually increases in density, from the vent to the eye ring, to the lobe, to the base of the beak, to the point of the beak, and to the shanks, it shows that the bird has laid continually without rest for a period indicated by the amount of yellow present; whereas, if the bird shows more yellow in any preceding part of the sequence as outlined, it indicates a rest period depending on the difference of the yellow color found in these parts.

Body Changes Due to Laying

Vent. A laying hen has a large, moist vent showing a dilated condition and looseness, as compared with the hard, puckered vent of nonlaying hens.

*Reproduced from Hints to Poultrymen Vol. 6, No. 10, issued by New Jersey Experiment Station.

FIG. 16—A CRATE FOR USE IN CULLING

Various methods of handling fowls are used by different culling operators. Where the birds are to be handled individually, probably the best method is to use a crate such as the one shown above. This crate is placed on the outside of the building on a level with the exit door, being provided with legs of the right height for this purpose. When ready to begin operations, the exit door is opened and the fowls—a dozen or so, are allowed to go out into the crate. The door then is closed and the birds are removed from the crate, one at a time, and examined.

Abdomen. The abdomen is dilated as well as the vent, so that the pelvic arches are wide-spread, and the keel is forced downward away from the pelvic arches, so as to give large capacity. The more eggs the bird is going to lay in the following week, the greater will be the size of the abdomen in proportion to the size of the bird. The actual size of the abdomen is, of course, greatly influenced by the size of the bird and to a certain extent, by the size of the eggs laid.

Quality of Skin. Heavy production is shown by the quality of the skin. Fat goes out from the skin and body with production, so that the heavy producers have a soft, velvety skin that is not underlaid by heavy layers of hard fat. The abdomen in particular, is soft and pliable.

Pelvic Arches. Heavy production is shown by the quality and the thickness and stiffness of the pelvic arches. In heavy producers these are apt to show high qualities by being thin and pliable rather than stiff and thick; hence the thicker and blunter the pelvic arches and the greater the amount of fat and meat covering them, the less the production, or the longer the time since production ceased.

Sternal Processes. These, like the pelvic arches, should, in a bird of good production or in a bird which is producing heavily, show good quality by being soft and pliable, prominent, and generally bent outward.

Head. One of the finer indications, yet one of the most valuable in picking the high layers, is the fineness of the head. The head of a good layer is fine; that is, the wattles and ear lobes fit close to the beak and are loose and flat, the face is clean cut, and the eyes are full, round, clear, and prominent, especially as seen from the front.

Feathering. The high layer is trimmer and always apt to be somewhat more angular, that is, the feathers lie closer to the body than on the poor layers, and after heavy production the oil from the base of the feathers does not keep the plumage relatively so sleek and glossy as on a poorer layer. On the other hand, the plumage of the heavy layer is apt to become worn and threadbare.

Comb, Wattles, and Ear Lobes. The comb, wattles, and ear lobes enlarge or contract, depending upon the activity of the ovary. If these parts are large, full, and smooth, or hard and waxy, the bird is in full lay. If the comb is limp, the bird is only laying slightly, but is not laying at all when the comb is dried down, especially at molting time. If the comb is warm, it is an indication that the bird is coming back into production.

Molting. When a bird stops laying in the summer, she usually starts molting. The later a hen lays in the summer, or the longer the period in which she lays, the greater will be her production; hence the high producer is the late layer and the late molter. The length of time that a hen has been molting, or has stopped laying, can be determined by the molting of the ten large feathers at the end of the wing,—the primary feathers. It takes about six weeks to renew completely the primary feather next to the middle feather of the wing, and an additional two weeks for each subsequent or outer primary to be renewed.

Temperament and Activity. A good layer is more active and yet more easily handled than a poor layer; she shows more friendliness and yet elusiveness than a poor layer. A poor layer or a bird which is loafing is apt to be shy, staying on the edge of the flock, and will generally squawk when caught.

1919 Amendments on Type

The following additions to the foregoing outline were

FIG. 17—EXAMINING A FOWL FOR EXTERNAL CHARACTERS INDICATING PRODUCTIVENESS

In this illustration Prof. Lewis of the New Jersey Agricultural Experiment Station is shown examining a hen, noting pigment in ear lobes, eye ring, face, beak, and shanks, also noting condition of plumage and comb, and general indications of health and vigor. Photo from New Jersey Experiment Station.

adopted at the Second Annual Judging School at Cornell University, July 7-12, 1919:—

In order to make a record a hen must not only lay long but heavily. In order to lay heavily she must have sufficient body capacity to digest large amounts of food rapidly. Large capacity in a laying hen is shown by a body that is deeper at the rear end of the keel than at the front end. The under line should be fairly straight as shown in the illustration and the back should be comparatively horizontal.

A small capacity hen stands erectly. The body is either very shallow or, in the case of beefy individuals, the abdomen shows a pronounced sagging at rear of keel. A small-capacity hen generally possesses a hump on the back. The comb generally has sharp, narrow points, with the blade pointing up.

The general body conformation of a heavy producer conforms very closely to a rectangle with pronounced angles rather than smooth curves.

A male shows the same general characteristics except that the abdomen is not so deep.

The keel bone should be long and the body relatively deep in proportion to weight or length.

FIG. 18—HIGH-PRODUCING PULLET NO. 3411

The above is a good illustration of the general appearance of the typical heavy layer. This pullet's production, estimated on the basis of the tests described in this chapter, was 120 eggs on the date when photograph was taken—April 23. Compare with low-producing pullet in Fig. 19. Photo from New Jersey Experiment Station.

FIG. 19—LOW-PRODUCING PULLET NO. 2411

The estimated production of this pullet on date when photo was taken (April 23rd) was only 40 eggs. She was hatched on the same day as high-producing pullet No. 3411. To see how the culling score of this pullet compares with that of No. 3411 see culling charts, Figs. 35 and 36. Photo from New Jersey Experiment Station.

Details of Official Culling Outline Explained

An Interview with Prof. H. R. Lewis of New Jersey Experiment Station in which He Explains Various Points in the Official Outline and Gives Additional Valuable Information on This Subject

AS previously stated, Professor H. R. Lewis, head of the Poultry Department of New Jersey Experiment Station, kindly consented to an interview designed to make plain, for inexperienced readers, various points in the foregoing outline that might cause some confusion; also to bring out additional details in regard to the practical application of culling methods which Professor Lewis has developed in his extensive experience in this line of work. In response to inquiries in regard to culling methods and the way in which they have been developed, Professor Lewis made, in substance, this general statement:

The methods of culling in use, particularly as developed by college and station workers, consist in examining fowls during the summer and early fall, doing this on a basis of their external characters, the purpose being to pick out birds that have ceased to lay, with a view to marketing or otherwise disposing of them; also for the purpose of picking out those birds that have laid well, with the intention to retain them during the following year, using them either as breeders or layers. By the statement "external characters" is meant comb, beak, ear lobes, and other head points, shanks, vent, skin, plumage, etc. These characters have been found to vary in hens, particularly in good layers as compared with poor layers. This variation may be, in some instances, with respect to size, and in other cases to color, softness of abdomen, pliability of skin, etc.

Culling methods are of comparatively recent origin, having come into popular use during the last three years. This method of culling was in a measure standardized at the conclusion of a one-week culling school at Cornell University in 1918. As a result of this week of study and of conferences between experts in culling methods,

certain official rules, regulations, and descriptive material were adopted. At the 1918 Annual Meeting of the American Association of Instructors and Investigators in Poultry Husbandry, which immediately followed the judging school at Cornell, these standardized descriptions were officially recognized and approved, thus giving culling methods an official status, and at the same time standardizing the practice to a great extent. As will readily be seen by a study of the outline, the various tests applied in culling may be classified under the general heads of pigment changes, body changes due to laying, and general temperament and activity.

Question—What is meant by "pigmentation" or "yellow pigment" as described in the official outline?

Pigmentation as here used refers to the yellow coloring matter found in the fatty tissues of certain sections of the fowl's body. This yellow pigment is an essential part of the ordinary poultry ration and manifests itself most clearly in the skin, shanks, beak, ear lobes, and vent. The pigment which gives these parts their characteristic yellow color in such fowls as Leghorns, Plymouth Rocks, etc., is the same pigment which makes the yolks yellow and, as stated in the outline, is associated with the fat in the fowl's body.

Question—When a pullet or hen begins to lay, in what succession do the yellow-pigment sections bleach out?

When a fowl begins to lay, her requirements for fat and yellow material for the yolk become exceptionally great, so that the ordinary ration does not supply the amount needed for both yolks and body fat. As a result the fowl draws upon the reserves of these materials in her body to build the yolks, or she possibly uses her entire supply of yellow pigment in the feed to manufacture yolks and has none to deposit in her body parts, consequently, as laying progresses, we find the yellow color disappearing successively from different sections of the body. It disappears first from those sections nearest to the ovaries, and in sections having the most rapid blood circulation. The fat, bearing with it its natural yellow pigment, is transported to the ovaries by the blood, and there elaborated into egg yolks. Careful observation has shown that the yellow color disappears from certain sections of the body in the following order: First from the section around about the vent, next from the eye ring and face, then from the ear lobe, beak, and shank.

Question—In the case of each section, about how long does the bleaching process require, as measured by eggs laid and by time?

My observation is that it requires the laying of approximately six eggs, or from ten to twelve days, for the vent to become entirely free from yellow. It requires the laying of from ten to fifteen eggs, or from fifteen to twenty days, for the ear lobe to become entirely bleached out. After laying from thirty to forty eggs, or from sixty to seventy-five days, the beak also will become entirely free from pigment, while in case of the shanks it will require from seventy-five to eighty eggs, or from one hundred to one hundred and twenty days, for them to become practically free from yellow. Since the shanks are the last to lose their color, the last-named period is the one required to make all sections practically free from yellow. These time periods apply primarily to Leghorns. Plymouth Rocks, Rhode Island Reds, and Wyandottes, being heavier fowls, have a larger reserve supply of pigment and body fat to draw from, hence require a greater egg production, and consequently a longer time is required in which to accomplish the same degree of bleaching. The extra time required by larger fowls depends in large part upon their weight, which is a measure of the reserve fat supplied. In general it will require from three to six weeks longer for the American breeds to bleach out than for the Leghorns, depending however, upon how fat they were when they began laying, and upon their amount of production. It must be remembered in this connection that much depends upon the rations fed and the condition under which the fowls are kept. Theoretically the pigment begins to fade from vent and eye ring as soon as

FIG. 20—MEASURING SPREAD OF PUBIC BONES

The distance between the pubic bones (the so-called "lay bones") varies more or less, and is greatest in high producers. The spread of the pubic bones is generally stated as being so many "fingers". The fowl here shown is No. 3411 (see Fig. 18) and is a "three-finger" fowl. Photo from New Jersey Experiment Station.

FIG. 21—A "TWO-FINGER" LAYER

Low-producing pullet No. 2411 (see Fig. 19) is here shown undergoing a test for spread of pubic bones. Only two fingers can be placed between them—a clear indication of inferior production. Photo from the New Jersey Experiment Station.

FIG. 22—MEASURING CAPACITY OF ABDOMEN

Heavy-laying ability depends quite largely upon abdominal capacity. This is conveniently measured by the distance between the rear end of the keel and the pubic bones. When these are far enough apart to admit four fingers, as in the case of the above pullet, high production is to be expected. Photo from New Jersey Exp. Station

yolk development begins, and since it requires approximately 14 days for the complete formation of a yolk to the point where it is ready to burst from its follicle and begin its passage through the oviduct, it frequently happens that the vent and eye ring become practically pigment-free by the time the first egg is laid, especially in the case of Leghorns fed on a grain ration which supplies little pigment and where only a limited amount of green feed is provided.

Question—When the fowl stops laying, what occurs, as regards pigmentation?

When a fowl stops laying, the requirements for pigment and fat for yolk formation promptly cease. The fowl then ordinarily begins at once to redeposit fat in its body, and quickly takes on pigmentation again. Fortunately for the poultryman, the yellow color reappears in the same order or sequence in which it disappears; that is, it comes back in the vent first, followed in succession by the eye ring, ear lobe, beak, and shank. It reappears, however, decidedly more rapidly than it was withdrawn. It follows from what has just been said that the first indication that the fowl has ceased laying is the return of yellow color to the vent and, as a rule, one week of idleness is long enough to permit a sufficient accumulation of yellow color to show clearly that the fowl has stopped. It is not practical however, to depend entirely upon the appearance of yellow pigment in the vent for proof that the fowl has permanently stopped laying, particularly in the case of fowls of the larger breeds. Before concluding that such hens have stopped for the season, it is necessary to determine whether the check in production which brought about increased pigmentation may not possibly have been due to broodiness, or to a brief rest resulting from faulty feeding or some other unfavorable condition in connection with her management. It would not be safe to say that such a fowl has stopped laying for the season even though the vent may be strongly pigmented, unless the color also is seen to be coming back in her ear lobes, also that her comb shows signs of drying up. If the condition of her plumage indicates that she is beginning the molt that, of course, would be good evidence, taken in connection with the reappearance of pigmentation, that she has stopped laying for the season. In attempting to apply the foregoing suggestions in regard to the time required for the return of pigment, the ration must be taken into account. Fowls that are fed on liberal allowances of yellow corn, or that are kept on alfalfa or clover sod will show a much more rapid reappearance of pigment than those kept whose ration carries a much more limited supply of pigment.

Question—Is the presence or absence of yellow pigmentation looked upon as a safe guide in culling?

Yes, I regard the presence or absence of pigmentation as one of our safest guides to use as a basis of determining the present and past performances of fowls, especially when the test is applied in late summer and early fall. In making close estimates the operator must know the conditions under which the hens have been kept.

Question—In treating on the reappearance of pigment after fowls have ceased laying, the outline refers to the fact that yellow color gradually "increases in density." Are these increases of sufficient distinctness to enable the poultry keeper to estimate with any degree of accuracy the length of the rest period?

Increase in density certainly is easily distinguished by the poultry keeper who makes a study of pigmentation in connection with culling. The practical value of noting the increase in density is to enable the observer to determine whether the bird has been a persistent layer, or whether she is taking a long rest. For example, frequently in the early spring we find a bird the tip of whose beak is white, also the base, while the center of the beak is yellow (see color plate No. 7). The vent also may be bleached out, and the ear lobes in the case of Leghorns. This variation in density tells us this interest-

FIG. 23—A HEN WITH LIMITED EGG LAYING CAPACITY

The distance between the rear end of the keel and the pubic bones in this fowl can readily be spanned by two fingers, thus showing restricted size of abdomen and, as a result, low production is to be expected. Photo from New Jersey Experiment Station.

FIG. 24—ILLUSTRATION OF DIFFERENCE IN ABDOMINAL CAPACITY

Note the large, soft, pliable abdomen of the high producer on the left, as compared with the small, hard abdomen of the low producer on the right. This illustration also shows clearly the difference in size of vent in a good layer as compared with a poor layer. Photo from New Jersey Experiment Station.

ing story: This bird laid persistently for two months or more, or until the color was faded out of the beak, then she took a rest and the color returned, first to the vent then to the ear lobe, then as far as the middle of the beak. But before the beak had become completely pigmented, she again started producing, so when we handle her later on this statement of her performance is found plainly recorded.

Question—What is meant by the following words quoted from the official outline, "a bird that naturally has pale yellow coloring?"

This statement applies to fowls which naturally do not have as yellow skin and shanks—that is, are not so heavily endowed with yellow pigment—as others. Yellow-skinned fowls vary more or less in the degree of pigment shown in skin, beaks, shanks, etc., and the observer must take this fact into account in "scoring" his fowls, in order to avoid the danger of giving the naturally pale-colored fowl a higher score than she really is entitled to. There are comparatively few birds however, that are lacking in pigment to an extent that will interfere seriously with the application of pigment tests.

Question—How can danger of errors be avoided in fowls having pale (but not white) shanks?

The number of fowls with bleached or pale shanks, among our yellow-legged varieties, is so limited that I doubt very much whether we can anticipate any practical error from this cause. It should further be appreciated that anyone who culls purely on the basis of pigmentation is making an error. Culling to be accurate and practical, should be based on a number of characteristics, and the relative appearance of all of these characteristics should be considered in making up one's mind as to the disposal of each individual bird. It should be understood further that culling, especially in so far as pigmentation is concerned, is not an effort to determine the exact number of eggs laid by a bird, but rather we are working with and considering the two extremes in a large population; namely, those birds which have been relatively poor producers, which have quit laying and should be disposed of, and on the other extreme, we are after those birds which have laid remarkably well and which it is desired to keep for breeding. The middle group, while they may be in large measure fairly accurately graded, do not interest us so much. In all the 2000 pullets which have passed through our Vineland Contest in the last three years, we have found less than one per cent that possessed natural pale or whitish shanks to such an extent that it will make us question our ability to cull them by the use of the pigmentation test together with other characteristics which we regularly consider.

Question—Does the condition of shanks as to fullness or hardness have any bearing on culling?

Undoubtedly the conditions of the shanks as regards fullness and plumpness has a good deal to do with indicating the value of a bird as a layer. Fowls that have laid heavily will have laid out the fat in all sections of their body, including the shanks which will show a thin, lean appearance, the scales on the back especially being quite pliable. Those that have not laid heavily show a hard, full shank due to the accumulation of fat under the scales. This is simply a parallel to the condition of the face; that is, those fowls which have laid heavily show a lean face free from excessive fat, along with lean, thin shanks, while the nonproducer has a full face with the fat showing through the red, and this almost invariably is accompanied by hard, round shanks.

Question—How can the poultryman successfully apply pigmentation tests at night, bearing in mind the fact that

FIG. 25—ABDOMINAL CAPACITY AND SIZE OF VENT COMPARED

Heavy layer is on the left. Note the larger vent, greater distance from vent to end of keel (at top), and the greater width at keel, showing spread of lateral processes, as compared with the poor layer at right.

FIG. 26—LOOSENESS AND PLIABILITY OF SKIN, CHARACTERISTIC OF GOOD LAYER
This illustration shows quite clearly the difference in the flexibility or softness of the skin of the abdomen of the good layer on the right, as compared with the poor layer on the left. Photo from New Jersey Experiment Station.

it is particularly difficult to detect yellow color by artificial light?

Where it is desirable to make pigmentation tests by artificial light, we always use what is known as a "daylight" flashlight. These are provided with globes in which the glass is tinted blue to destroy the natural yellow rays of the ordinary electric light. On commercial plants a strong flashlight often is used with the glass coated with light blue paint. An ordinary lantern globe may be treated in the same way. This makes examining the fowls on the perches easy, quick, and accurate, and involves disturbing them much less than the individual handling required in the daylight examinations.

Question—What is the most convenient method of handling the fowls in daylight culling?

In daylight culling we use a large crate like a turkey crate for catching the fowls, doing the work first thing in the morning. Keep the birds confined until ready, then place the large crate on the outside of the house with the opening opposite the exit, and open the door. When enough fowls have gone out to fill the crate, close the door and examine these birds and proceed in this regard with the entire flock. This is a more laborious way than night testing, though perhaps better suited to the requirements of the beginner. The professional method however, is to examine the fowls on the perches at night using the flashlight with blue globe, as already described.

Question—What importance is attached to the condition of the vent?

The appearance and condition of the vent is a most valuable clue to the present productiveness of the fowl. In the heavy-laying hen the vent is large, soft, pliable, and moist. It may be bluish or almost blue in color. In case of the heaviest layers the folds of skin on either side of the vent may be so blue as to present the appearance of being bruised. In a nonproducing bird the vent is comparatively small and rather dry; and where the hen is laying no eggs, is yellow in color.

FIG. 28—THE POOR LAYER HAS A NARROW SPAN
The two-finger span of No. 2411 here indicated is characteristic of limited egg laying capacity. Photo from New Jersey Experiment Station.

FIG. 27—WIDE SPAN INDICATING A HEAVY LAYER
This is pullet No. 3411 with a span of four fingers between pubic bones and keel, showing large abdominal capacity. Photo from New Jersey Experiment Station.

Question—What conditions of the abdomen and skin are associated with high egg production, and why?

The abdomen of a heavy-laying hen is always soft and flabby in condition, and the skin is loose and pliable. This is an important indication of productiveness in all instances. The nonlayer on the other hand is apt to have a hard, firm abdomen, while the skin will be tight and thick, and frequently will be coarse in texture. The skin of fowls varies more or less in the last named respect, in different individuals, and in general it will be found that the loss of pigment proceeds much more rapidly in fowls having fine-grained skin, though this is not a difference that will readily be noted by the average observer, nor does it need to enter extensively into a practical application of culling methods.

Question—How does heavy egg production or the lack of it affect body conformation?

The abdomen of the fowl is directly affected by production, and in the heavy layer is always well developed and deep. The space required for the accommodation of active egg organs and their contents, and the relatively

large quantities of feed required in heavy egg production call for large abdominal capacity, and this is in itself an excellent indication of the productiveness of the fowl.

Question—What is the pelvic arch and what relation does it bear to egg production?

The pelvic arch is the bony framework at the rear part of the fowl's body. It consists of three pairs of bones on either side of the backbone, forming an incomplete circle through which the egg passes. In the fowl about to begin laying it will be found that the bones of the pelvic arch show a more or less increased spread, the practical effect of which is to give greater room for the egg organs and thus to permit the more ready passage of the egg through the oviduct and, of course, to provide generally the additional abdominal capacity already mentioned as being highly important in heavy laying. The principal part of the pelvic arch in which the poultry keeper is interested, and which is utilized to a considerable extent as a guide in selecting layers, is the pair of pubic bones, sometimes called "lay bones", which form the lower end of the pelvic arch, and are readily felt in the live hen, being the two bony points on either side of the vent. The position of the pubic bones is regarded as of decided importance in selecting layers. In nonlayers we find these pubic bones drawn close together, while their apparent thickness also is much greater than in hens that are laying heavily. This thickness is brought about partly by an accumulation of fat under the skin which overlies the pubic bones, and which is always characteristic of nonlayers in good health, and partly by the bones folding over on themselves. As ordinarily tested, by folding the skin over them, the thickness of the pubic bones may vary anywhere from one-eighth to nearly one inch, thin bones always being a characteristic of the best layers. In addition to the thinness, pubic bones in good

FIG. 29—SPREAD OF PUBIC BONES IN A GOOD LAYER
Photo from New Jersey Experiment Station.

FIG. 30—THE POOR LAYER HAS LITTLE ROOM BETWEEN PUBIC BONES
Photo from New Jersey Experiment Station

layers appear much more soft and pliable. In nonproducers we find the ends of the pubic bones drawn close together chiefly as a result of increased curvature.

Question—What are the sternal or lateral processes, and what bearing do they have on egg production?

The sternal processes are the thin bony structures which extend out from either side of the upper part of the front of the sternum or keel bone. These processes extend backward diagonally from the keel and serve partially to enclose and protect the lower part of the abdomen. When the body cavity becomes filled and distended with a mass of egg and digestive organs, as they will during heavy production, these sternal processes are pushed outward, and due to this position and to the pliable skin and its freedom from fat they then are prominent and easily felt with the fingers. Prominence of sternal processes, therefore, is simply another evidence of enlarged abdominal capacity. In nonproductive fowls these bones are not readily detected from the outside.

Question—Given a normal healthy fowl that has ample body capacity, what should we look for in head points, with a view to estimating egg production?

Head points generally are important in that they denote vigor and stamina, while the comb is an extra good index to the condition of the egg-laying organs. The laying hen has a prominent, bulging eye, wide open and bright, and her head is free from an excess amount of fat. The face is pink rather than yellowish in color, and it has a dished, rather lean appearance. The comb should be of moderate size, and both comb and wattles should be of fine texture. In a heavy producer the comb is always well developed and bright in color, full, plump, and has a warm oily or waxy feeling, and when a portion of it is pinched to remove the blood it will look whitish rather than yellow. So far as the appearance of the head is concerned it is readily distinguishable when the observer has before him two birds showing the extremes in this connection. In heavy layers the wattles fit close to the head and hang rather near together, while in a poor layer the head parts are fleshy and filled with fat, causing the wattles to appear distended and to stand out more from the body. The changes in the appearance of the comb are much more gradual than the return of pigment to the vent. The experienced culler can determine

FIG. 31—FINDING THE LATERAL PROCESSES

The lateral or sternal processes are bones extending backward from the upper part of the front of the keel. They are widespread and prominent in good layers. Photo from New Jersey Experiment Station.

by the comb whether or not the hen is laying and can do so as readily and as accurately as by noting the color of the vent, but the comb condition requires longer to make the change from the bright, pliable red condition, characteristic of the good layer's comb, to the dry, shrunken condition of the non-producer.

Question—What effect does broodiness have upon the appearance of fowls, and is there any danger of confusing good layers when broody, with inferior producers?

The effect of broodiness upon the size or appearance of comb and wattles is not especially apparent if not too long continued. The physiological changes which take place in fowls at this time require high body temperatures and rapid blood circulation. The broody fowl therefore, presents in most sections the same appearance as when producing. While the brooding of the hen causes a rest period which may halt the bleaching process, this does not necessarily put her in the same class, as regards appearance, with those that have quit laying for the season and will go through a molt. During the period of broodiness the requirements of the body heat no doubt draw upon the fowl's food supply and upon her body fat, as we know from records of the weight of fowls during natural incubation. Her comb and wattles remain bright however, and do not show drying and shrinking as the hen that is taking a permanent summer rest. I doubt very much whether the average person would confuse a bird of this type with one that was ready for the discard as a result of having gone into the summer and fall rest period.

Question—What connection does early and late molting have with egg production?

The time of molting is an excellent indication of egg producing ability in hens. Early molters, that is, hens that molt in midsummer, generally take a long time to molt which means a long rest period. Observation has shown that the late molters, as a rule, are the ones that have been so diligently at work laying eggs that they have not had time to change their plumage. Natural or normal molting occurs in the late summer and early fall of the year following the spring in which they were hatched. Individuals vary somewhat in their molting periods however, depending primarily on the amount of their egg production. As a rule, fowls of the same strain or family, hatched about the same time and producing about the same number of eggs, will molt in about the same length of time. Anything which checks egg production is apt to throw the hen into a molt, hence the practical problem is to care for them so well that they will keep on laying eggs well into the fall, in which case the molt will take care of itself.

Question—What is the average length of time required for molting?

The time required for molting varies so greatly with individual hens that it is difficult to express an average. Heavy producers usually molt much more quickly than poor producers. We have records of hens taking three months or more to change their entire coat of body feathers and to grow a new coat. We also have records of hens making the complete change in six weeks.

Question—What do you consider the relative value of the different methods of culling as here described?

Placing them in the order of their relative value, I would suggest first considering the condition of comb and plumage (whether molting or not); next I would place pigmentation tests which are capable of being applied with a good degree of accuracy when properly understood; last I would place the position of the bones of the pelvic arch. As I have previously stated, every precaution should be taken to keep hens in laying condition, especially in the late summer and early fall, because just as soon as their production is checked for any reason, they naturally use their food supply to make feathers, and when a hen is molting she is rarely ever laying. The molt is dependent upon egg production and not egg production upon the molt. We used to say, "our hens are molting, so they are not laying." We now say, "our hens have quit laying, so they are molting."

FIG. 32—TYPE IN GOOD AND POOR LAYERS

The carcasses of heavy-producing pullet No. 3411 and poor producer No. 2411 in profile show clearly one difference in type. The lines of the back and keel of the poor producer on the right are almost parallel to each other, whereas in the good producer on the left they are at a slight angle, being widest at the rear and thus affording greater capacity. Photo from New Jersey Exp. Station.

Question—How should the average poultry keeper go about culling his flocks?

If the egg production is noticeably under 50 per cent he should go over his flock as early as the latter part of June, picking out those birds that have already quit, as evidenced by the condition of their external characters, and promptly dispose of them. He should then repeat this process every two weeks if necessary to keep his production up to 50 per cent, and continue to do so throughout the summer, until by fall about half will have been disposed of in the ordinary flock. The remaining 50 per cent left will include the most persistent layers and the heaviest producers for the year.

Question—Is there any working rule to go by in estimating what proportion of the flock is laying?

Yes, we have found that the per cent production during the summer months is a good indication of the proportion of the flock which is laying, also of the number that should be disposed of. Speaking generally, a 50 per cent production means that practically all of the birds in the flock are laying. When this production drops below this point, doubling the percentage, whatever it may be, will give one an index as to the proportion of the number of birds laying. For illustration, if we are getting a 40 per cent production we are safe in assuming that 80 birds in 100 are laying, and by actual test we have found that 20 in each 100 can be culled out and disposed of without noticeably reducing the total number of eggs produced. If we are only getting 30 per cent it means that about 40 out of each 100 are nonproducers and should be culled out and sent to market.

Question—Do these foregoing facts in regard to culling apply with equal force to larger breeds than Leghorns, or do they relate chiefly to observations in the latter breed?

A great many of our observations in regard to culling have been on our Vineland contest flocks where we have 60 pens of Leghorns and 40 pens of heavy breeds. Our observations therefore, apply fully as much to the latter as to Leghorns. However, it should be understood that the practical application of culling methods is much harder and less accurate in the heavy breeds than in the Leghorns, owing to the greater accumulation of body fat and to the slower disappearance of the same when laying begins. Also, in Rhode Island Reds, the presence of the reddish horn in the beak and shanks makes it much harder to detect the true condition as to pigmentation. There is no question about the fact that the same general rules apply to all yellow-skinned and yellow-shanked birds, but their application is, of course, a matter of practice.

Culling Methods Illustrated With Leghorn Hens

The Photos Here Reproduced Show the Correct Position in Which to Hold Hens When Testing for Egg Laying Ability—After Testing the Live Hens They Were Killed and Plucked and Again Posed Before the Camera in Order to Make Every Step as Plain as Possible

IN ORDER to make plain to the beginner the various steps in culling, the series of illustrations shown in Fig. 17 to Fig. 34 has been prepared, these being secured especially for this purpose at the New Jersey Experiment Station, through the kindness of Professor H. R. Lewis and his assistants, Mr. V. G. Aubry and Dr. W. C. Thompson. The following comments in regard to these illustrations are by Professor Lewis. In this connection, the reader's attention is also called to the series of illustrations for Plymouth Rocks in Chapter IV, supplied by Cornell University, and the Rhode Island Red series in the same chapter, supplied by Storrs Agricultural College, also the eighteen color plates on pages 5 to 8, prepared from photographs supplied by Cornell University. These plates show in natural colors, the various differences in pigmentation exhibited by good and poor-laying fowls, or resulting from length of rest period, whether due to broodiness or other causes.

The hens shown in the illustrations were selected to illustrate a good and a poor layer respectively, the high producer being shown in Fig. 18 (pullet No. 3411, estimated production on April 26—120 eggs), and the low producer in Fig. 19 (pullet No. 2411, estimated production 40 eggs). Both birds were scored April 26th of this year. It is not probable that any one could certainly tell from these illustrations which of the two was the better layer, but when they are examined for the different characters already mentioned, the inferiority of No. 2411 becomes obvious.

Fig. 17 shows how to examine a hen for general con-

FIG. 33—MEASURING THE THICKNESS OF THE PUBIC BONES

There is little or no actual difference in the thickness of the pubic bones in different hens, but there is a great difference in the apparent thickness, which is produced by the fat underlying the skin and surrounding the bones. The good layer on the reader's left has comparatively little fat and the skin is thin and pliable so that there is a limited amount of tissue between the bone and the finger. In the poor layer on the right, the skin is thick, with a heavy layer of fat underneath, thus making the pubic bones appear more than twice as thick as in a good layer. Photo from New Jersey Experiment Station.

dition and external characters. This is a good way in which to hold the bird, and while in this position color (pigmentation) of the ear lobe, beak, face, eye ring, and shank should be noted, also the size, color, and texture of the comb. At the same time, or before the bird is taken in hand, note the condition of plumage, and all general evidences of health and vigor. Remember in this connection that fowls may be pale in color as a result of poor health, depredations of lice, etc., and that the degree of yellow varies with individuals, environment, rations, etc. If the fowl is sick, shows any deformities, is broken down behind, or otherwise is plainly defective, it is needless to proceed any further with the examination.

A fowl with white eye ring, moderately yellow upper beak, and quite yellow shanks, is shown by this test to be productive, but to have been laying only a short time. Late in the summer after the fowls have ceased laying, the pigment begins to come back and will be found first in the vent, then in the eye ring, face, and lower beak, all of which may be almost normal in color, while the upper beak and the shanks will still be faded. This condition indicates to the experienced observer that the fowl while not laying at the time of the test, probably made a good record for the year.

In Fig. 20 is shown the method of determining the spread of the pubic bones. The fowl in this illustration is No. 3411 (see Fig. 18), and is here shown to be clearly a "three-finger" fowl; that is, three fingers (pretty good-sized ones at that) can be placed between the points of the pubic bones. Fig. 21 illustrates low-producing pullet No. 2411 undergoing a similar test and showing only a "two-finger" space.

The distance between the pubic bones and the end of the keel bone is determined as in Fig. 22. It took four fingers to span the distance in No. 3411, an indication of ample abdominal capacity. Fig. 23 shows No. 2411 with only a "two-finger" space between pubic bones and keel. Taken in connection with Fig. 21, showing the small spread of her pubic bones, her limited capacity is plainly indicated, even to the most inexperienced.

In applying comb tests remember that size alone is not a reliable guide, since the size of the comb depends not only upon breed, but upon the individual fowl. The general character of the comb, its texture, its "feel", and its freedom from the scale that usually is found on the combs of nonproducers,—all are excellent indications of productiveness. The comb test is not of much assistance to the observer in determining length of laying period, but clearly indicates whether the fowl is actually laying or about to lay at the time of the test.

Examination of Good and Poor Layers after Being Plucked

After pullets No. 3411 and No. 2411 were handled and "scored" in the manner just described, they were killed and plucked and again photographed in different positions in order to bring out still more clearly the peculiar differences in bodily structure which accompany or result from high and low production.

In Fig. 24, hen No. 3411 is at the reader's left and hen No. 2411 at the right. In the former note the large moist vent, the greater depth of abdomen, looseness of skin, and absence of excessive accumulation of fat. The poor producer at the right however, shows a small, dry vent with less depth of body, more body fat, and the tight skin characteristic of hens of her class.

Fig. 25 shows still more clearly the difference in abdominal capacity and in shape. Note the full, soft, pliable body and the large abdomen of the high producer at the left. The condition of the abdomen in this bird, which is characteristic of high producers generally, is readily contrasted with the small, tight-skinned abdomen of the low producer at the right.

Fig. 26 illustrates another way of determining pliability of skin and the general looseness of abdomen. In this illustration the high producer is at the right, as is readily seen by the greater elasticity of the skin, also by the noticeable difference in depth of body as measured from keel to backbone.

Fig. 27 is a companion view of Fig. 22. The hen here shown is high producer No. 3411 with a span wide enough to admit all four fingers of the operator's hand, thus showing that she had ample capacity for eating and digesting large quantities of food and for accommodating the greatly enlarged egg organs characteristic of the heavy-laying hen. Remember, however, that wide span occasioned by a short keel, has no value as a mark of capacity.

Fig. 28 is a companion view to Fig. 23 and shows poor producer No. 2411, with her contracted abdomen in which the distance between the end of the keel and the pubic

FIG. 34—EGG ORGANS AND DIGESTIVE SYSTEMS OF HIGH AND LOW PRODUCING HENS

After undergoing the tests illustrated in Figs. 20 to 33, hens No. 3411 and No. 2411 were opened to show the appearance of the reproductive and digestive organs. Both hens were laying at this time, but the high producer on the right had a much larger ovary and oviduct than the low producer. There was a greater difference in the appearance of these organs than is indicated by the photo. Photo from New Jersey Experiment Station.

New Jersey State Agricultural Experiment Station

CULLING CHART

PRODUCTIVITY BY EXTERNAL CHARACTERS

Classes	Pigment Shank, Beak, Ear, Vent		Vent Condition, Size		Pelvic Development Width, Thickness		Span		Plumage	Comb
1	Ivory	Very Moist	Very Large	Very Wide	Very Thin	Very Wide	Old all present		Bright	
2	Tint	Moist	Large	Wide	Thin	Wide	Old some absent		Dull	
3	Medium	Dry	Medium	Medium	Medium	Medium	Growing new		Dry	
4	Yellow	Very Dry	Small	Narrow	Thick	Narrow	New throughout		Shriveled	

Class Descriptions

Classes
1. To keep for special matings
2. To keep for general laying and breeding
3. To hold for month or until laying ceases
4. To sell immediately

Disqualifications

a. Poor health or sickness
b. Lack of vigor or stamina
c. Broken down physically as result of heavy laying

NOTE:—This chart is designed for use in the summer and fall to aid in the elimination of non-productive hens, and to aid in the selection of the best hens.

FIG. 35—CULLING CHART FOR HIGH-PRODUCING HEN

This chart was designed to provide a simple and convenient method of recording observations in culling fowls. A high and generally straight line, such as here shown, indicates that the fowl under observation was of exceptional merit as a producer. This chart records the condition of pullet No. 3411 in April, at which time she had 120 eggs to her credit. Courtesy of the New Jersey Experiment Station.

bones can be spanned by only two fingers.

Fig. 29 shows how, in high-producing hens, the pubic bones are spread apart, in this case affording sufficient space between them to admit three fingers,—a further indication of abdominal capacity, especially the upper part of the abdomen where the egg organs are located.

Fig. 30 shows the contracted pelvic arch of poor producer No. 2411 whose pubic bones were so close together that only two fingers of the operator's hand could be placed between them. In exceptionally poor producers the space between pubic bones may be reduced to not much if any more than the width of a single finger. No. 2411, while classed as less than medium in this respect at the time she was examined would, at the usual culling time in late summer or in early fall, after she had entirely stopped laying, be found to have these bones much closer together—possibly enough to make her only a "one-finger" fowl.

With the two fowls shown in profile as in Fig. 32, their difference in capacity is clearly indicated. High producer No. 3411 on the left, with the rear end of her keel bone pushed out to afford the extra abdominal space required by the various organs of a heavy layer, presents an altogether different appearance from that of the poor layer on the right. Lines parallel with back and keel extended to the front of each bird would meet in the heavy layer, whereas they would be practically parallel in the case of the poor producer on the right. This wedge-shaped profile in the good layer is an excellent illustration of what is meant by "egg type". See also illustrations showing the wedge shape in the heavy layers in Chapter VII.

Fig. 31 shows the manner of locating the sternal or lateral processes. These are flat bony structures arising on either side of the front of the keel bone and extending backward between the end of the keel and the ribs. In a good layer these processes are prominent and well spread, while in the poor layer they are depressed and much less readily felt.

Fig. 33 shows the method of measuring the thickness of pubic bones. The high producer is on the left, and the difference between the thickness of her pubic bones and that of the poor producer on the right, is here clearly shown. There is practically no difference in the actual thickness of the bones, but in good layers the skin is soft and pliable and has little fat under it, while in others the skin is stiff and thick, and under it is a heavy coat of fat which greatly increases the apparent thickness of the bones when measured in this way.

The photo from which the half-tone engraving in Fig. 34 was reproduced was taken in the spring when both birds were laying, and does not, therefore, show the difference between the egg organs of a layer and a nonlayer, but rather the difference between a good and a poor layer in these respects. The heavy producer at the left had laid consistently for the preceding five months, while the low producer at the right had only come into laying.

The egg organs of each hen are shown at the side of the body. Note the larger ovary and more numerous ovules (yolks) in the reproduction system of the heavy producer on the left. The illustration however, does not clearly show the actual difference between the two fowls. When the birds were cut open the oviduct of the heavy producer was quite noticeably larger, longer, and more vigorous in appearance than that of the low producer.

New Jersey State Agricultural Experiment Station

CULLING CHART

PRODUCTIVITY BY EXTERNAL CHARACTERS

Classes	Pigment Shank, Beak, Ear, Vent		Vent Condition, Size		Pelvic Development Width, Thickness		Plumage	Comb
1	Ivory	Very Moist	Very Large	Very Wide	Very Thin	Very Wide	Old all present	Bright
2	Tint	Moist	Large	Wide	Thin	Wide	Old some absent	Dull
3	Medium	Dry	Medium	Medium	Medium	Medium	Growing new	Dry
4	Yellow	Very Dry	Small	Narrow	Thick	Narrow	New throughout	Shriveled

Class Descriptions

Classes
1. To keep for special matings
2. To keep for general laying and breeding
3. To hold for month or until laying ceases
4. To sell immediately

Disqualifications

a. Poor health or sickness
b. Lack of vigor or stamina
c. Broken down physically as result of heavy laying

NOTE:—This chart is designed for use in the summer and fall to aid in the elimination of non-productive hens, and to aid in the selection of the best hens.

FIG. 36—CULLING CHART FOR POOR PRODUCER

The line in this chart represents the condition of poor-producing pullet No. 2411 when scored in April, at which time her estimated production was only 40 eggs. Courtesy of the New Jersey Experiment Station.

Judging Fowls for Egg Production

A Practical Score Card for Use in Selecting Layers is Here Presented—It Simplifies the Application of Culling Tests and Should be Kept for Future Reference. It Provides a Permanent Record of the Laying Condition of Individual Fowls at Time When Laying

By PROFESSOR H. R. LEWIS*

During the last week of October and the first week of November, 1919, a cooperative poultry conference was held at the International Egg Laying and Breeding Contest at Vineland, New Jersey. Representatives of the poultry departments of four of our eastern colleges and experiment stations participated. The persons in attendance were Prof. W. R. Graham, of the Ontario Agricultural College, at Guelph; Dr. O. B. Kent, of Cornell University, Ithaca, N. Y.; Prof. W. F. Kirkpatrick and Roy E. Jones, of the Connecticut Agricultural College, at Storrs, and Prof. H. R. Lewis and Victor G. Aubry, of the New Jersey Agricultural Experiment Station, New Brunswick. This conference was held at the invitation of Prof. H. R. Lewis of the New Jersey Agricultural Experiment Station, the object being to study in great detail the yearling hens at the Vineland Contest, especially to determine external body characters which can be used as an accurate measure of determining past performance.

One outgrowth of the above conference was the development of a preliminary score-card designed for use in judging birds for egg production. It is appreciated by the members of the conference that such score-card is only preliminary and is simply a first step in the development of a score-card, the final completion of which will take many years of careful study.

In working out numerical values for the score-card at this conference, the perfect bird was recognized as 100 per cent, which was allowed to be equivalent to a production of 300 eggs. Numerical values for all sections were then so arranged that each per cent of value is equivalent to three eggs, or put differently, a cut of one point in any one section is equivalent to a cut of three eggs. In working out the following score-card, the principles evolved at the judging school held at Cornell University during the past 2 years were applied in so far as possible, and some new and more recent observations added.

Score-Card

	Perfection Points	Egg-Production Value
Body Type (as seen in coop or on floor)	25	75
Head and Adjuncts	15	45
Body Conformation (as determined by handling)	30	90
Handling Quality	10	30
Legs and Toes	5	15
Condition	15	45
Total Perfection Score	100	300

The above score-card is designed to apply to hens as well as to pullets. In applying the above score-card, the following description of the various sections will aid in a common understanding of the various ideals sought for.

BODY TYPE

Perfect Score—25 Points, 75 Eggs

A bird of good body is usually well balanced in that the body itself must be deep, showing a nearly rectangular form, well developed in breast and abdomen. Great depth of body is especially desirable, but apparent depth must not be due to loose feathering, which is generally shown by an evidence of loose thigh feathers. Cochin and Exhibition Game type and feathering are usually associated with poor production. Large capacity is essential if a hen is to lay long and heavily. Such capacity is designated by a body that is deeper at the rear end of the keel than at the front end. The underline should be fairly straight and the back should be comparatively horizontal. Prominent breast development, with evidence of a long keel are desirable qualities in a high-producing hen. The general body conformation of a heavy producer conforms very closely to a rectangle with pronounced angles rather than smooth curves.

A small-capacity hen generally stands erect. The body is either very shallow and cut away at the breast and abdomen or in the case of beefy individuals, the abdomen shows a pronounced sagging at the rear of the keel due to large accumulations of fat. Extremely poor producers frequently show a hump on the back.

HEAD AND ADJUNCTS

Perfect Score—15 Points, 45 Eggs

One of the best indications in picking high layers is the fineness of the head. The head of the heavy producer is fine, showing a lean face, free from wrinkles and overhanging eyebrows. The wattles and ear lobes fit close to the head and are not loose and flabby. The face is clean cut, the eye is full, round, and prominent, especially when see from the front. An eye which gives a clean-cut wide-open appearance is desirable. The eyeball of the heavy producer is generally set in the rear of a large oval socket, showing considerable of the white eye membrane in front of the eyeball. The head of a heavy producer should be well balanced, being moderately deep and broad. The extremely fat, full head of the beefy bird and the long, thin, pointed head of the low-vitality bird are both undesirable and should call for heavy cuts in this section. The low-producing bird generally shows a depressed eye with overhanging eyebrows and wrinkled skin at the back of the eye. The extremely long sharp beak is usually possessed by the low producer, while the medium stout, well-curved beak is a mark of the high producer.

BODY CONFORMATION

Perfect Score—30 Points, 90 Eggs

When taken in the hands, a heavy producer will show, by the sense of touch, great depth of body, especially at the front and rear of the keel bone. The keel must be moderately straight, relatively long and carried well back. The space between the pelvic bones and the keel must be free from excessive accumulations of fat. Birds which are laying heavily can be readily detected by the development of the abdomen. Such birds will show pelvic arches which are widespread and a keel which is forced down away from the pelvic arches so as to give large capacity.

The poor producer generally shows a shallow body especially at the front of the keel, a small shrunken abdomen, together with all evidences of small capacity.

HANDLING QUALITY

Perfect Score—10 Points, 30 Eggs

The skin of the heavy-producing hen is thin, soft, and pliable, especially the skin on the abdomen must be thin and loose. The skin of the poor producer is generally thick, hard, and rather coarse to the touch. The thin velvety skin is almost always associated with heavy ovarian activity.

LEGS AND TOES

Perfect Score—5 Points, 15 Eggs

The shanks of a heavy producer are flat, pliable, and smooth scaled. In hens at the end of their laying year, or pullets which have been laying heavily for some time, the shanks will be bleached out. The toes should be straight and the toenails show indication of proper activity. The shanks of the poor producer are usually round, hard, and rather coarse scaled.

CONDITION

Perfect Score—15 Points, 45 Eggs

A bird to be capable of highest sustained production must be first of all healthy. She must show vigor and activity and be well fleshed. Late molting in hens is desirable. Early molting and slow maturing, as shown by the primary feathers, should be cut severely. Late developing and late maturing usually indicate low production. In applying this section to hens, health and molting conditions should be given primary consideration. In applying this section to pullets, health and maturity should be given primary consideration.

*Condensed from "Hints to Poultrymen" (N. J. Exp. Station) Vol. 8, No. 2.

CHAPTER IV

How to Cull Plymouth Rocks, Wyandottes and R. I. Reds

Characters Indicating Heavy Laying Are Similar in All Breeds, But Pigment Changes Are Made More Slowly in Large Fowls Than in Leghorns—For This Reason the Observer Must Depend More Upon Egg Laying Capacity with Rocks, etc.,—Why Wyandotte Breeders Must Give Special Attention to Capacity—Fowls of Standard Size Are Better Layers Than Those Conspicuously Over or Undersize for the Breed

DIRECTIONS for culling as given in Chapter III apply directly to Leghorns, but in a general way may be used in culling fowls of any of the yellow-legged breeds, making due allowance for such modifications in detail as are required by physical variations characteristic of breed and variety. The capacity tests for Leghorn hens, as illustrated in Figs. 20 to 23, also pigment tests, may be applied to fowls of the larger breeds in the same way and in the same order, keeping in mind however, that changes in pigment take place more slowly in fowls of the larger breeds. Pigmentation tests therefore, do not give as clear-cut results as in Leghorns but, on the other hand, capacity tests can be even more successfully applied.

It will readily be understood that in large fowls the distance between pubic bones, also the span between pubic bones and rear of keel bone will be uniformly greater than would be the case in Leghorns with similar egg records. For example, a large Plymouth Rock of quite inferior laying ability may show greater actual measurements in these sections than would be found in a high-producing Leghorn, due to the greater dimensions of all parts of her body. Other necessary readjustments in directions for culling Leghorns, when applied to the larger breeds, relate to shape of body, size and shape of comb, color of beak, etc.

Since fowls of the larger breeds generally have red ear lobes, the lobe test cannot be as readily applied as with Leghorns. However, it should be understood that yellow pigment is deposited not only in ear lobes but also in comb and wattles just as in the skin, beak, etc., and is subject to fading and renewal in precisely the same way. The presence of pigment in these parts is shown by a yellowish tinge in the red and its absence by a whitish or bluish shade as shown in color plates on pages 5, 6, and 7. It was found at the University of Missouri that the presence of pigmentation in comb and wattles may readily be detected by pinching them and noting color before the blood comes back.

The temperament of large fowls is much less nervous and high strung as compared with that of Leghorns, for which reason heavy producers in these breeds will not exhibit the same degree of activity or nervous energy as will Leghorns of the same grade. Within the breed however, it will be found that the best layers are the active, energetic, and intelligent birds. Inasmuch as there is a quite general tendency in fowls of the larger breeds toward the beefy type, the test for activity and intelligence is especially valuable and should never be ignored. Conformation of head, shape and position of eyes (see Chapter VI), are particularly helpful when applied to

FIG. 37—A GOOD-PRODUCING BARRED PLYMOUTH ROCK HEN

This hen (G61) laid 126 eggs from November 1, 1918, to August 20, 1919, when the photograph was taken. Photo from Cornell University.

FIG. 38—A POOR-LAYING BARRED PLYMOUTH ROCK HEN

This is hen No. M14 as described in text. She has an estimated production of 50 eggs from November 1st to August 20th. Photo from Cornell University

FIG. 39—A HEAVY-LAYING WHITE PLYMOUTH ROCK

This White Plymouth Rock hen, belonging to the Government Experiment Farm at Beltsville, Maryland, was not trapped until January 25 and from that time until September 11 she laid 176 eggs. During this period she produced 84 eggs in 92 consecutive days and 109 eggs in 122 consecutive days.

fowls of large breeds, because they denote to a marked degree, the intelligence or mental activity which will always be found associated with heavy layers.

Egg laying capacity as indicated by a full breast, a good spread of the pelvic bones, and a large, pliable abdomen are almost invariably associated with the capacity for heavy production. Remember, however, that there are other factors which enter into the question, such as the inherent ability to lay, normal development of the egg organs, etc., while previous care and feeding clearly have a most direct bearing upon results secured. There is room here for the use of a good degree of practical judgment in scoring birds, particularly where their previous performance and treatment or feeding has not been normal. A hen with capacity for only moderate performance may compare favorably in actual production with a hen having capacity for much greater production, but which, because of the improper feeding or management has never developed her powers fully.

In culling large fowls, one factor that is apt to cause some confusion as compared with the culling of Leghorns is the rest period or broodiness. As is shown in Chapter IX, the fact that most fowls of the large breeds go through one or more periods of broodiness during the laying season does not necessarily prove that they will, on this account, lay fewer eggs in a year than non-brooding Leghorns. With the exception of extremely high producers, fowls of all breeds have periods of rest and recuperation, and it appears to matter little, as regards the total number of eggs for the year, whether they are broody during the rest period or merely non-productive,—provided the brooding fowls are properly cared for, are prevented from wasting too much time in brooding, and are well fed.

In culling at the end of the laying season there will be little or no difference between the pigmentation of a fowl that has had one or more short rest periods during the spring and summer and that of one that has been laying more or less steadily without becoming broody. Where the broody period has been a long one, however, the fowl may show a banded beak, the position and extent of the pigmented and nonpigmented sections being determined by the time that has elapsed since the rest period occurred.

In early culling however (June and July), the observer will have to use due caution successfully to distinguish between fowls that have discontinued laying for the season and those that have stopped for a broody period and probably will resume laying again shortly. This can be readily detected in most cases as there appears to be a distinct difference in the condition of the ovary of a good laying hen that is going through a short brooding rest, and a poor producer that has ceased laying for the season. In the latter the ovary is inactive, and comb, pigmentation, and other characters take on all the marks of nonproduction, while in the former the ovary remains more or less active, pigmentation changes either are not made at all or much more slowly, while the comb often remains bright and plump. In a good laying hen, if well fed, the ovary frequently resumes yolk formation just as soon as broodiness ceases, and as it requires about two weeks for the formation of a complete yolk during which time there will be no deposition of pigment in skin, beak, etc. Hens that begin laying within three weeks of the time they become broody, may not show any change in pigmentation at all, or only about the vent. Marked variations in pigmentation, size of comb, spread of bones, etc., indicate long rest periods.

FIG. 40—HEAD OF GOOD-PRODUCING PLYMOUTH ROCK

Note particularly shape of comb, development of eye, and the "lean" appearance of the face. Photo from Cornell University.

FIG. 41—HEAD OF POOR-PRODUCING PLYMOUTH ROCK

Compare the high comb and full, beefy face of this bird with head of good producer in Fig. 40. Photo from Cornell Univ.

Special Points in Culling Plymouth Rocks

Plymouth Rocks Should be Standard Size. Length of Keel Needs Special attention.

THE Plymouth Rock is the largest of the three breeds considered in this chapter and for that reason everything that has been said in regard to making allowance for size, applies with special force to the culling of fowls of this breed. Particularly in applying the finger test to spread of pubic bones and span between pubic bones and keel, keep this point in mind.

It is not necessary nor desirable for the poultry keeper to select small hens in this or any of the popular breeds in the belief that larger size is opposed to productiveness. That appears to be true only when the fowl considerably exceeds standard weight. Speaking generally, those that approximate standard weight for the breed to which they belong, are the ones that are most normal in development and hence best fitted physically for the strain of heavy and long-continued production. There are important practical reasons why the person who keeps Plymouth Rocks should breed them approximately to standard weights. If he wants smaller fowls he should change to a breed that is naturally smaller rather than to spoil his Rocks by deliberately breeding them down to an inferior level, in which he is more likely to lose in productiveness, than to gain.

FIG. 42—A "3-FINGER" BARRED PLYMOUTH ROCK
This is the heavy-laying hen No. G61, shown in Fig. 37 Photo from Cornell University.

The ear lobes of Plymouth Rocks are red, but the eye ring or edge of eyelid, is pigmented. The upper mandible of the Plymouth Rock, in some varieties, frequently carries some dark or horn color, which interferes with the application of beak pigment tests to some extent, but the close observer will note a distinct difference in shade due to the presence or absence of yellow with its modifying effect upon the horn color. The pigmentation of the lower mandible, which is free from horn color, fades out much more quickly than in the upper, and therefore is not so helpful in estimating rest periods.

The life-like plates Nos. IX and X on page 7 show, in their natural colors, the head of a heavy-laying Barred Rock hen, also the head of a nonlayer. These plates bring out clearly the difference in pigmentation of beak and eye ring, also shape and color of comb and wattles.

FIG. 43—A NARROW PELVIC ARCH
This illustration shows limited space between pubic bones—a common character in poor producers. Photo represents hen No. M14 shown in Fig. 38. Photo from Cornell University

The shanks of Plymouth Rocks are apt to carry more or less black, particularly in pullets from cockerel matings, but seldom enough seriously to interfere with culling tests. The shape of comb, with reference to the development of serrations and the position of the blade, are as indicative of productiveness or the lack of it, as in Leghorns.

One character in Plymouth Rocks that must be watched with special care is the tendency to short keels. This has the effect of limiting abdominal capacity and is likely to cause "bagging down" behind after the pullet

FIG. 44—MEASURING ABDOMINAL CAPACITY OF A GOOD LAYER
Hen No. G61 shows a "4-finger" span between pubic bones and keel. Photo from Cornell University.

year—a common fault in fowls of this breed. This condition interferes with the proper functioning of the digestive organs, and is apt to result in the development of pathological conditions. Such fowls, even though they may have made good records, should never be used in the breeding pen. In applying the finger test to the span between pubic bone and keel therefore, note particularly whether the space between them is due to depth of abdomen or merely to shortness of keel. A short-keeled bird may show a span of three or four fingers and yet grade very low in capacity.

In culling Plymouth Rocks, keep in mind the alleged fact mentioned in Chapter VI, that size of comb is a good index as to size of egg organs and therefore of the eggs produced. This means that hens with extremely small combs may be expected to be producers of small eggs. Obviously, this does not mean that eggs produced by fowls of a naturally small-combed breed, such as the Plymouth Rock, will be smaller than those produced by

FIG. 45—LIMITED CAPACITY MEANS LIMITED PRODUCTION
Hen No. M14 has only a "2-finger" spar. between pul bones and keel. Photo from Cornell Universit

Leghorns, because this is known not to be the case. Neither is there any proof that a strain of Plymouth Rock distinguished by larger than average combs will lay larger than average eggs. But when it is known that eggs of inferior size are being produced, the members of this flock that have noticeably small combs for the breed are properly under suspicion.

Culling of Barred Plymouth Rocks Illustrated

The excellent photographs reproduced in Figs. 37 and 47, were supplied by Dr. O. B. Kent of Cornell University and are designed to illustrate the application of culling tests to types of good and poor producers, in this particular breed and variety.

The hen shown in Fig. 37 (Cornell No. G61), has a record of 126 eggs from November 1, 1918 to August 20, 1919, on which latter date this series of photos was taken. Her carriage is not of the best though this may be due largely to fright. She shows however, the wedge-shaped profile that is expected in good laying birds of any breed, the rear end of keel dropping well down below a line

FIG. 46—A GOOD AND POOR PRODUCER CONTRASTED
Good producer No. G61 is on the right. The poor layer on the left apparently has as much capacity as G61 but is of a coarse beefy type—is lacking in laying "quality." Photo from Cornell University

horizontal with the back, and having good length. In Fig. 40 the head points are clearly brought out. The face generally corresponds to the description for a good layer, as given in the official outline in Chapter III.

Fig. 42 shows the spread in the pelvic arch, while Fig. 44 illustrates plainly the hen's large abdominal capacity, measuring from the pubic bones to the rear end of the keel. This fowl has a fairly long keel bone so that in measuring the span, the fingers would be almost horizontal if the bird were in her normal position, or almost at right angles with the back.

FIG. 47—INTERNAL ORGANS OF GOOD AND POOR PRODUCING HENS CONTRASTED
The good producer (G61) is on the right and M14 on the left The difference in size of oviduct is clearly shown, also the much greater development of the intestines in G61. Photo from Cornell University

Fig. 38 shows a poor laying hen (Cornell No. M14), selected for comparison with the good layer just described. The production of this hen was estimated at 50 eggs from November 1, 1918 to August 20, 1919. She is shorter in the back than G61, and her keel bone is more or less tucked up in the rear, thus reducing her span to only about three fingers as shown in Fig. 45, with a corresponding reduction in abdominal capacity, as a result of which, good production could hardly be expected. Her head, shown in profile in Fig. 41 is of a coarser, more beefy type, than hen No. G61; the blade of her comb extends upward instead of following the contour of the neck, while her face is full and fat. Compare this illustration carefully with Fig. 40, in order to get the distinction between these two head types clearly in mind.

Fig. 46 shows G61 (on the right) and M14, plucked and hanging up, to illustrate the difference in abdominal capacity. The fact that G61 is evidently smaller than M14 is not to be taken as evidence that the smaller size contributed to her better egg record, the difference in this respect being accidental no doubt. M14 is of a coarser, more beefy type, however, from which only medium to poor production can be expected, regardless of size. It has already been shown that within the standard weights for the breed, size is not necessarily a handicap in egg production.

Fig. 47 shows these hens cut open, oviducts removed, and intestines spread out to indicate the difference in their development. It will be noted that the oviduct of G61, the good layer, is much larger than that of M14, due to the fact that the one hen is still laying while the other has entirely ceased. However, as is shown in Fig. 34, the oviduct of the poor layer is regularly much smaller in size than that of the good layer, even when both are producing. The development of the intestines of G61 would alone establish her identity as the better layer of the two, these being larger and longer, thus showing greater capacity for digesting food.

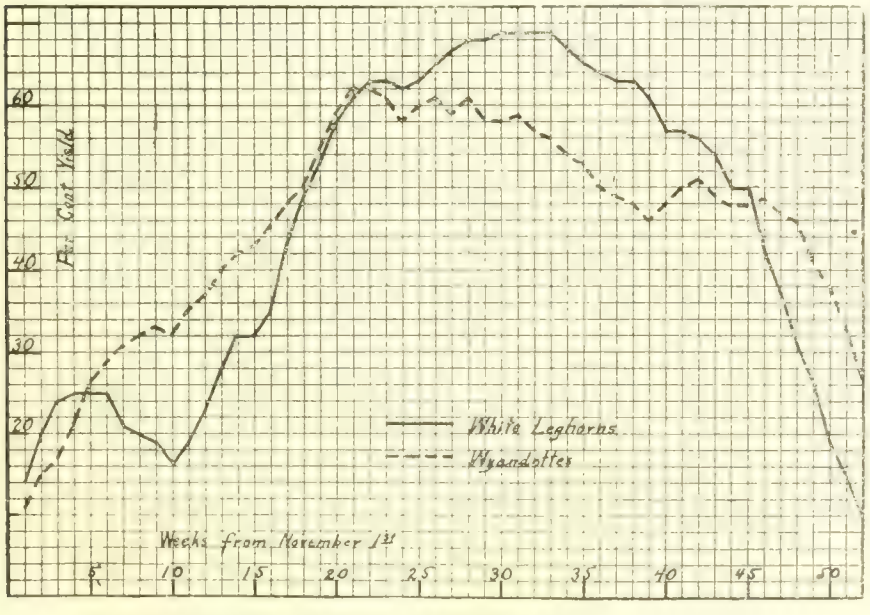


FIG. 49—GRAPH COMPARING PERCENTAGE OF PRODUCTION OF WYANDOTTES WITH LEGHORNS

The lines shown above indicate production percentages by weeks. The weekly production records of all Wyandottes and White Leghorns entered in the Storrs Laying Contest for a period of five years were used in preparing this graph. Here, while the Leghorns excelled in summer production, the Wyandottes were distinctly in the lead through the high-price months.

Culling Wyandottes---All Varieties

Wyandottes Have Proved to be Superior Winter Layers Standard-bred Type is No Bar to High Egg Production if not Carried to Extremes, Capacity Being Secured by Depth Instead of by Length as in Fowls of Some Other Breeds

THE Wyandottes have long been one of the most popular breeds of fowls. They have good size and are excellent layers. The graph shown in Fig. 49 which was prepared from five-year records at the Storrs Egg Laying Contest indicates the superiority of Wyandottes over Leghorns in cold weather production at this institution. In Figs. 48 and 50, 52 and 53 are shown some high record egg-contest layers that would be a credit to any breed. By way of contrast note the 20-egg hen in Fig. 51.

Much that has been said in regard to the culling of Plymouth Rocks applies with equal force to Wyandottes, but the difference in shape of comb must be taken into consideration. The comb of the good laying Wyandotte will be fine in texture, not too small, nor so large as to be coarse and beefy, and will be a distinct "rocker" comb instead of standing up at the rear.

FIG. 48—A SILVER WYANDOTTE HEN WITH A RECORD OF 223 EGGS IN 12 MONTHS

Photo from Missouri Poultry Exp. Station.

Color plates XI and XII on page 7 show the lifelike heads of a good layer and a slacker. Pigmentation is dependent upon production, just as in the case of Leghorns and Plymouth Rocks. Note also that the difference in pigment extends to the red of the face, comb, and wattles which has a yellowish tinge in the nonlayer that is not apparent in these parts in the productive hen.

There is a distinct difference in the body type in standard Wyandottes as compared with standard Plymouth Rocks, the latter being decidedly longer, while the Wyandottes have greater depth. This must be carefully considered in judging laying capacity, as the strict application of the Plymouth Rock standard of comparison would lead to serious undervaluation of all Wyandottes in this respect. In culling fowls of this breed the observer will expect greater relative depth of body as measured by the span from pubic bones to end of keel, capacity being secured in this way that, in the Plymouth Rock, is afforded by greater length.

The Wyandotte breeder, therefore, must give the question of capacity more attention than is necessary in either of the other breeds.

FIG. 50—A WHITE WYANDOTTE WITH RECORD OF 254 EGGS IN 12 MONTHS

FIG. 51—WHITE WYANDOTTE WITH A YEAR'S RECORD OF 20 EGGS

FIG. 52—A WHITE WYANDOTTE WITH RECORD OF 232 EGGS IN 12 MONTHS

ered in this chapter, and should bear in mind that the extremely short, almost spherical type which was popular in this breed a few years ago, is much more apt to be associated with reduced capacity than one of moderate length such as is now favored by many exhibition fowl breeders and positively demanded by practically all commercial poultry keepers using Wyandottes.

Wyandotte Type

With Wyandottes it is hardly practicable to apply the triangle test for laying type (see Figs. 82, 83, and 84). The Wyandotte is too blocky and round to meet this extreme description of type, except in cases where individual fowls approximate Plymouth Rock type in length of body. That, however, is no reason for assuming that Wyandottes are at any disadvantage with respect to their productive ability. Abdominal capacity can be and is associated with depth and breadth of body as well as with length, and it cannot make any material difference which way it is secured. Depth, or distance from back to rear end of keel bone, is a marked character of Wyandottes, as also is breadth, and with these two qualities well developed there will be ample room for digestive and egg organs, even in a comparatively short body. However, the extremely round, "snowball" Wyandotte, popular among fanciers some years ago, was quite apt to prove inferior in productiveness because, in the effort to secure the nicely rounded underline, breeders were indifferent to, if they did not actually favor, a "tucked-up" keel.

To a large extent, the exhibition Wyandotte owes much of its roundness to loose feathering, rather than to actual bodily dimensions. Among some families of Wyandottes the feathering is extremely loose, approaching the Asiatic type in this respect. This is another objectionable character to the commercial poultry keeper, however, as it is the belief of most culling experts that it usually is accompanied by inferior laying ability.

With the present tendency toward moderate length of body, the difference between the Wyandotte fancier and the commercial poultry keeper is comparatively slight. If the former will yield a little on this point, there is no practical difficulty in the way of effecting an entirely satisfactory combination of exhibition quality and capacity for high egg production,—and most certainly is it in the best interests of the breed to do this.

Merits of Wyandottes as an Egg Breed

The practical merits of Wyandottes are well established by the records made by fowls of this breed at the International (Storrs) Egg Laying Contest. A summary of the production of the leading breeds at this contest (fifth year) shows that the Wyandottes there led all others, not only in numbers of eggs produced, but in their market value. The following quotation in regard to this is from Bulletin No. 89 of the Storrs Experiment Station:

"The table presented herewith, gives the number and weight of all eggs produced by each of the principal breeds represented in the contest, and the average value per dozen. It will be noted that the Plymouth Rocks lead in weight of eggs per dozen, while the Wyandottes hold last place. As the last column shows a value of 35.3 cents per dozen for Wyandotte eggs against 34.6 cents for eggs from Plymouth Rocks, one may wonder whether large eggs are, after all, worth no more on the market than small ones. The explanation lies in the fact that the Wyandottes produced a larger proportion of their eggs during the months of high prices. Furthermore, the factor of size was not considered in determining the values presented in the last column. All eggs which weighed over one and one-third ounces (.08 lb.) were considered marketable at current prices. In a competitive market this would not be true."

FIG. 53—A HEAVY LAYING CONTEST PEN OF SILVER WYANDOTTES

This pen was entered in the Fifth Australia Egg Laying Contest, and the hens averaged 192 eggs each in twelve months.

Table Showing Value of Eggs Per Dozen

(Based on total number of eggs produced by all pens of named breeds entered in Fifth International Laying Contest.)

Breed	No. Birds	Eggs per Bird	Total Number of Eggs	Total Value	Wt. per Dozen in Oz.	Value per Dozen
Plymouth Rocks	170	160.4	27,273	$787.41	26.4	34.6c
Wyandottes	170	169.6	28,803	846.92	23.5	35.3c
R. I. Reds	210	158.7	33,327	961.63	24.4	34.6c
White Leghorns	350	165.4	57,890	1,653.93	23.8	34.3c
Miscellaneous	100	147.2	14,719	413.82	24.3	33.7c
All Breeds	1000	162.0	162,012	$4,663.71	24.3	34.5c

Culling Rhode Island Reds

Pigment Tests Are Not as Readily Applied to Reds as to Many Other Breeds. Standard Body Type However is Exceptionally Favorable to Development of Ample Abdominal Capacity

THE typical Rhode Island Red is a longer bird than the Plymouth Rock in proportion to its depth, is narrower across the back, and a little higher on its legs. If not bred for too narrow a back, which will result in pinching the pelvic arch (an objectionable character in any laying breed), the standard Rhode Island Red hen conforms to the generally accepted requirements as to egg laying capacity to an unusual extent.

As compared with Wyandottes, the Rhode Island Red can have a shorter span between pubic arch and keel and still have equal capacity, but any tendency toward short keels should be avoided, just as in Plymouth Rocks. An obstacle in applying pigment tests in Reds is the horn-colored beak, which color also is frequently found in shanks and toes. For these reasons selection is not as readily made as with any of the breeds previously mentioned, nor is it possible to determine past production with the same degree of accuracy. Even expert demonstrators do not find it possible to cull R. I Reds as closely and as accurately as Leghorns or even Rocks and Wyandottes, but there is no practical difficulty in eliminating the poorest producers nor in selecting the best, and with experience a high degree of accuracy can be realized.

Culling of Rhode Island Reds Illustrated

The color plates on page 7 illustrate how pigmentation is modified by the horn-colored beak common in fowls of this breed. With experience however, this test can be applied with a good degree of accuracy. The photographs from which Figs. 54 and 63 were reproduced, were taken expressly for this book, under the personal direction of Professors Kirkpatrick and Jones of the Poultry Department of Storrs (Conn.) Agricultural College. These two fowls here shown were selected from a typical farm flock of 300 on July 14, 1919. Trap-nest records were not available but estimating on the basis of external characters, the production of the hen shown in Fig. 54 (a yearling Rhode Island Red) from November 1,1918 to July 14, 1919, was 150 eggs. Note the full, deep body and clean, alert head. The yearling Rhode Island Red hen shown in Fig. 55 was selected from the same flock, her estimated production for the same period being 70 eggs. This hen differed distinctly from the other with respect to body shape and appearance of head and eye.

FIG. 54—A GOOD PRODUCING YEARLING RHODE ISLAND RED HEN

Note the full, deep body and the clean-cut head. Photo from Storrs (Conn.) Experiment Station.

FIG. 55—A POOR PRODUCING YEARLING RHODE ISLAND RED HEN

Compare this bird with the one shown in Fig. 54, noting particularly the difference in depth of body and in expression of eye. Photo from Storrs (Conn.) Experiment Station

Fig. 56 shows a good spread of the pelvic arch, allowing three fingers to be readily placed between the ends of the pubic bones, whereas in the hen in Fig. 58 these bones are much closer together, allowing only two fingers to be placed between them, notwithstanding the fact that this hen was actively laying at the time the test was made. Such hens rarely make good records.

In Fig. 57, which illustrates the capacity test, it will be seen that the demand for room in the body cavity of the high producer has forced the breastbone downward until there is ample room for the whole width of the hand between the pubic bones and the rear end of the keel. This means that there is plenty of room for complete development of the egg organs and also capacity for the large digestive system necessary to maintain the hen and keep the egg organs properly supplied with egg-forming material, functioning properly. Compare the span of the hen in Fig. 59 with this one to see how contracted is the body cavity of the poor producer, her breastbone being so close to the pubic bone that there is only room to admit two fingers between them. Fig. 61 shows these fowls killed and plucked in order to make plainer the marked difference in the spread of the pelvic arch. Fig. 62 emphasizes the difference in abdominal capacity, the

FIG. 56—A "3-FINGER" RED HEN
This is the high producing hen shown in Fig. 54. Photo from Storrs Experiment Station.

FIG. 57—GOOD PRODUCING RHODE ISLAND RED HEN
Posed to show span between pubic bones and keel. Photo from Storrs Experiment Station.

fingers being placed in the same position as in Figs. 57 and 59. Fig. 60 illustrates in another way the difference in size and development of the rear part of the body.

Fig. 63 shows these high and low producing hens in profile with the high producer on the left. The body of this bird is full and round, having greater depth in the rear. The lines of the back and breastbones are nearly parallel in the high producer, while in the low producer the keel slopes toward the back.

The ovary and oviduct development of these two hens is shown in the exceptional photograph reproduced in Chap. XVI. While both hens were laying when killed and there is an egg in process of formation in each oviduct, note in that illustration the difference in size of vent, size and length of oviduct, and observe particularly the number and size of developing yolks taken from each.

Summary

Pigmentation tests do not give as clear-cut results with Plymouth Rocks, Wyandottes, and Reds as with Leghorns.

The presence of yellow pigment has a modifying effect upon the red color of comb, wattles, and ear lobes.

Yellow pigment in comb, wattles, etc., can be plainly detected by pinching these parts.

The best layers in large breeds are intelligent, energetic, and active, though not so nervous and high strung as Leghorns.

FIG. 58—A "2-FINGER" RED HEN
This is the low producer shown in Fig. 55. See also Fig 59 for further evidence of inferiority as a layer. Photo from Storrs Experiment Station.

FIG. 59—LOW PRODUCING RHODE ISLAND RED HEN
Posed to show limited abdominal capacity, the keel being so close to the pubic bones that only two fingers can be placed between them. Photo from Storrs Experiment Station.

Capacity tests are especially helpful in culling fowls of large breeds.

Egg laying capacity is indicated by a full breast, good spread of pelvic bones, and a large abdomen.

In culling fowls of the breeds mentioned in this chapter it is particularly important to note the conditions under which they have been kept.

The observer must distinguish between fowls that have stopped laying for the season and those that have stopped temporarily on account of becoming broody.

In any breed, fowls that approximate standard size are better layers than those that are conspicuously over or under weight.

FIG. 61—HIGH AND LOW PRODUCING RHODE ISLAND REDS

Posed to show difference in spread of pubic bones. The high-producing hen is shown on the reader's left in the illustration. Photo from Storrs Experiment Station.

FIG 60—HIGH AND LOW PRODUCING RHODE ISLAND RED HENS

Posed to show difference in development of rear of abdomen. This illustration shows, with unusual clearness, the much greater abdominal capacity of the good producer on the left as compared with the poor producer on the right. Also compare the large, moist vent of the high producer with the small, puckered vent of the other. Both of these hens were laying at the time they were killed, but the one on the right had produced a comparatively small number of eggs, and probably never would produce many. Photo from Storrs Experiment Station.

Those who keep Plymouth Rocks may breed them for standard weight without any fear that such size will affect their productiveness.

Where the upper mandible of the Plymouth Rock is so dark as to interfere with pigment tests, the lower mandible may be used.

In selecting Plymouth Rocks, give special attention to length of keel; too-short keels are objectionable.

Plymouth Rock hens with extremely small combs are apt to produce small eggs.

Wyandottes have proved superior layers in numerous egg laying contests, particularly at Storrs.

There should be no difficulty in applying pigment tests to most varieties of Wyandottes, remembering, however, that such changes take place more slowly than in the Leghorns.

Abdominal capacity in Wyandottes may be secured by depth, instead of length, as in Rocks and Reds.

The triangle test for egg type cannot readily be applied to Wyandotte hens.

The extremely round or "snowball" type of Wyandotte should be avoided in the commercial laying flock, if it involves a "tucked-up" keel and, therefore, reduced abdominal capacity.

Present tendency among Wyandotte breeders is toward moderate length of body.

At the Fifth International Laying Contest, at the Storrs Experiment Station, Wyandottes led all other breeds in number and market value of eggs produced.

In moderately good laying R. I. Reds, the keel line may be no more than horizontal with line of back.

More skill is required in culling R. I. Reds than Leghorns, but a good degree of accuracy can be attained.

Rhode Island Reds are longer than Rocks and Wyandottes, and in type conform well to requirements as to egg-laying capacity.

Reds should not be bred too narrow in the back, and short-keeled birds should be rejected.

Pigment tests are less readily applied to Reds on account of their horn-colored beaks and for this reason more attention must be given to capacity.

FIG. 62—SPAN BETWEEN PUBIC BONE AND KEEL ILLUSTRATED IN DRESSED FOWLS

The bird on the left in this illustration is the high-producing R. I. Red hen, shown in Fig. 54, and the one on the right, the low-producing hen shown in Fig. 55. Note the greater distance between keel and pubic bone, also the much rounder breast of the heavy layer, caused not by fat but by the more prominent sternal processes. Photo from Storrs Experiment Station.

CHAPTER V

Culling Methods Applied to Anconas, Campines, Minorcas, Orpingtons, Langshans, Brahmas, etc.

The So-called Popular Breeds Have no Monopoly in Egg Production--Remarkable Records Have Been Made by Representatives of Each of the Breeds Mentioned Above--General High Average Production is Readily Attainable if the Fowls Are Bred Systematically to That End--Breeders Should See to It That Standard Requirements Are not Allowed to Conflict with Characters Essential to High Egg Production

POPULARITY of Leghorns, Plymouth Rocks, Wyandottes, and R. I. Reds among practical poultry keepers is unquestioned. It is only now and then, relatively speaking, that other breeds receive serious consideration in establishing a commercial laying flock. But it does not follow from this that fowls of these breeds most in popular favor are necessarily the only ones that can be brought to a general high average of production. As has been stated in Chapter II, the capacity for developing a high degree of productiveness is a common inheritance of fowls in practically all breeds. It is only necessary that they be systematically bred for this quality, and that no artificial requirements are set up that oppose its development, or that make its achievement so difficult that it becomes a practical impossibility.

There is, for example, no reason for believing that the inherit capacity of Leghorns for heavy production is any greater than that of any of the breeds mentioned in the title of this chapter. On the contrary, the egg laying contests in this and other countries have brought to public notice fowls in practically all of them that have made authoritative records that closely parallel the best performance of Leghorns. It rests entirely with breeders to say whether or not such records shall be more or less exceptional. This will be determined largely by their attitude toward "fancy" points—by whether they will develop these at the expense of practical qualities or, by systematically selecting and breeding from their best producers, will increase their productiveness until it equals or exceeds the performance of the best of the four popular breeds.

With the exception of the Anconas and Light Brahmas pigment tests cannot be used in any of the breeds represented in this chapter as all the rest are characterized by dark or black shanks and white skin. Those who have nonpigmented breeds should give especial attention to capacity, to head parts, etc., and will find that while a little more experience is required, they can, with practice, reach a good degree of accuracy in identifying the layers, whether the purpose be to bring up the average of production in the general flock or to practice selective flock breeding, and thus year by year improve the laying qualities of their favorite breed.

Culling Anconas

Anconas are practically Leghorns, as regards their type and general characters, and the culling methods that are applied to Leghorns may all be used on Anconas with about equal accuracy. The beak of the Ancona is yellow with the upper mandible shaded with black. Ear lobes are white or creamy white, and the legs are yellow or mottled with black.

The body type of the standard Ancona is practically the same as that of the Leghorn. Breeders however, should bear in mind the objection to this type as raised by the commercial poultry keeper who contends that the back and under curve of the standard Leghorn limits abdominal capacity. In other words, the commercial egg producer wants a fowl with more depth in the rear than is shown by the standard Leghorn, and generally he wants greater length of body. This subject is treated more fully in Chapter VII, but it is proper here to call

FIG. 63—HIGH AND LOW PRODUCING RHODE ISLAND RED HENS IN PROFILE

The high producer on the left shows a keel bone and back almost parallel, as compared with the tucked-up appearance of the keel of the poor producer on the right. A still better producer would show rear end of the keel pushed out enough to give the body a slightly wedge-shaped appearance. Photo from Storrs Experiment Station.

FIG. 64—AN ANCONA WITH A RECORD OF 331 EGGS [illegible] FIRST YEAR; 803 IN 3 YEARS

This famous Sheppard Strain Ancona not only [illegible] but proved an exceptional layer in her second and third ye[illegible]ars also. Three of her daughters have made two-year records of 596, 594, and 552 eggs [illegible]tively.

attention to the existence of this demand, and the Ancona breeder cannot afford to ignore it. The black in the upper mandible of the Ancona and in the shanks, interferes somewhat with pigment tests, but not to a serious extent. Head points are the same as for Leghorns, and the tests for activity and disposition are identical.

Where the shanks are quite dark, the color of the bottom of the foot generally will be found a good index to pigmentation changes in this section. Fowls of this breed have not been well represented in egg laying contests, but the few that have been entered have made an excellent showing. In this connection it is fair to say that in comparing the records made at various contests by the different breeds, one is apt to get an altogether wrong impression of their relative laying ability if h considers only the number of high-producing fowls or pens reported. Other things being equal, the breed having the largest number of entries will of course, always have the greatest number of high producers to its credit. To form a fair estimate of their performance therefore, it is necessary to keep in mind the small number of fowls of the less popular breeds entered in laying contests. Where this is done, the relative showing made by Anconas and other comparatively neglected breeds should prove highly encouraging to those truly interested in developing their productive possibilities in full measure.

FIG. 65—WHITE ORPINGTON HEN

Has a record of 207 eggs.

Particular attention is called to Fig. 64 illustrating an Ancona hen which has not only made an extraordinary egg record but has transmitted her ability to her offspring, as is shown by the records made by her daughters. While photos of fowls as they are ordinarily posed are apt to be misleading as to the actual appearance of the birds, it will readily be seen that Queen Bess and the heavy-laying Ancona shown in Fig. 68 fully meet modern requirements as to abdominal capacity, etc.

Culling Campines

Campines are similar to Leghorns in general appearance and characters. The respective standard weights of hens and pullets are the same, but the Campines are longer in body, thus perhaps giving more body capacity. The beak is horn color and the shanks leaden blue. A good type of heavy-laying Campine is shown in Fig. 70. Pigmentation tests are out of the question with fowls of this breed.

It will be found, however, that capacity and condition tests may readily be applied, and by the "feel" of the abdomen one can learn much in regard to their present and past performance. The observer who finds a Campine with well-spread pubic bones, a good span between these and the rear of keel, a soft, pliable, thin skinned abdomen, prominent sternal processes, and good head points generally will unhesitatingly place her in the good to high-producing class though, in the absence of pigmentation, he may have to be a little more conservative in estimating exact production, since persistence in laying or length of the productive period is not so readily determined.

Culling Minorcas

Minorcas belong to the same class (Mediterranean) as Leghorns, but are larger, longer in body, and excellent layers of white eggs of the largest size, being especially valued by persons who cater to high-class trade in table eggs where white shells are at a premium.

The greater length of body in Minorcas, as compared with Leghorns, appears to be a distinct practical advantage, and they can be bred to a high average of production, particularly where breeders avoid going to extremes in weight, size of comb, etc. No other breed laying white eggs equals the Minorca in size of eggs produced, their only competitor in this respect being Light Brahmas, whose eggs are about equal in size but with brown shells. The records of the fowls shown in Figs. 69 and 71, from pens entered in Mis-

FIG. 66—BLACK ORPINGTON HEN

Has a record of 207 eggs

FIG. 67—BUFF ORPINGTON HEN
Has a record of 223 eggs.

souri (Mountain Grove) Laying Contests, show what is possible in the way of high egg production in this breed. These record layers plainly show capacity. Photos of these hens were taken Nov. 1st.

Minorcas have black beaks, and black or slate colored legs and cannot be culled by pigment tests, for which reason the breeder will find it necessary to study more closely the general type of his birds, their capacity, condition, and head points. To what extent the large combs of Minorcas are associated with the extra-large eggs produced by them has not been clearly shown, but it obviously is not practical to go to extremes in comb development, particularly where severe winters are to be expected. Large combs do afford exceptional opportunities however, for observing differences in shape, texture, condition, etc. To the careful observer such combs tell a surprising number of details as to productiveness. See Chapter VI for full instructions in this method of culling.

Culling Orpingtons

Orpingtons have attained a fair degree of popularity as "utility" fowls, though they are not often found in the yards of extensive commercial poultry keepers. The general appearance of Orpingtons is "beefy", which along with the characteristic white skin no doubt interferes greatly with their popularity in many quarters. There is no room to question their excellence as egg producers however. The records made by different varieties of Orpingtons at contests held in this and in other countries have shown that they have this character developed to a high degree. A few photos of heavy-laying Orpingtons are reproduced in this chapter (see Figs. 65 to 67, also 72). Whole pages could be filled with such, showing only fowls with official contest records.

It rests with Orpington breeders to determine the future of this truly valuable breed. Selection for high producers in the breeding pen, avoidance of extremes as regards roundness of shape, looseness of feathering, and size, will anticipate every practical objection that the commercial poultry keeper can urge against them. The white beak and shanks of the Orpington eliminate pigment tests and, as in the case of most of the other breeds mentioned in this chapter, dependence must be placed in capacity tests, development and shape of eye, comb, etc., along with activity and intelligence.

FIG. 68—A HEAVY-LAYING ANCONA
Has a record of 218 eggs.

In all breeds looseness of feathering is held to be an undesirable character in layers, and as there is a marked tendency to this in many strains of Orpingtons, special attention is here directed to it. It may be well to repeat here that while many of the "points" used in culling are still more or less tentatively held, the tendency of expert demonstrators to discount loose feathering appears to rest on a fairly well-proved theory regarding its undesirability, and Orpington breeders can well afford to take this subject under serious consideration.

Culling Langshans

Langshans belong in what usually is termed the meat class, though their standard weights are no greater than those of Plymouth Rocks. The ideal Langshan stands much higher on its legs than the Plymouth Rock and is rounder in body, looser in feathering, with lightly feathered legs, black beak and shanks, and a white skin. That they are capable of making excellent production records is shown by reports of laying contests in Australia and at the National Contest at Mountain Grove. To meet the requirements of the culling operator, extreme development in length of leg, roundness of body, and looseness of feathering must be avoided. The illustrations here given show that it is possible to combine excellent production however, with standard type. This

FIG. 70—TYPE OF HEAVY-LAYING CAMPINE
This hen, owned by Homestead Campine Farm, does not have a season's trap-nest record but was an exceptional winter layer, and during the breeding season laid at the rate of 5 and 6 eggs a week.

FIG. 69—A HIGH RECORD BLACK MINORCA

FIG. 71—A 200-EGG BLACK MINORCA

FIG. 72—BLACK LANGSHAN—RECORD, 204 EGGS

breed deserves a higher standing among "utility" poultry keepers than it now has. The distinctive breed characters previously mentioned will need especial attention in culling, especially if this is done with a view to selective flock breeding. Remember, however, that abdominal capacity may be secured to a large extent by depth as well as by length, as in the case of Wyandottes. Langshans with excellent records are illustrated in Figs. 72 and 74. Both of these hens were in pens entered in National (Mo.) Egg Laying Contests.

Culling Light Brahmas

The average commercial poultry keeper, who is apt to associate comparatively small size with high egg production, seldom considers Light Brahmas (the largest of all the breeds recognized in the Standard) as having any possibilities in the way of record egg production, classing them almost invariably as a "meat" breed. As a matter of fact, some of the highest egg records ever made are credited to fowls of this breed, and while a greater measure of ability is required in their management than with fowls of the smaller breeds, they are, when properly handled, excellent producers, in spite of their size. As is the case with other loose-feathered fowls, the roundness of the Brahma is more a matter of plumage than of body shape, and the standard Brahma, if not bred for extreme development of exhibition points, has ample capacity. In New England especially, Light Brahmas have always been more or less in favor as producers of market eggs. In uniformity of color and in size of eggs produced, this breed has no equal. Light Brahmas in laying contests have not particularly distinguished themselves, though this may be due in part to the fact that they are not at all likely to do their best under contest conditions where rations and methods of feeding are more or less standardized and, as a rule, much better adapted to the requirements of smaller and more active fowls.

FIG. 73—A LIGHT BRAHMA WITH RECORD OF 335 EGGS

One of the first 300-egg producers on record was a Light Brahma bred and owned by the veteran I. K. Felch. More recently we have "Molly Wellington" (see Fig. 73) with a record of 335 eggs in twelve months, also a Felch-strain Brahma. It is not to be expected that high egg production will be secured in Light Brahmas along with extreme weight, but the breeder who adheres to the normal size for fowls of this breed will find them responsive in a marked degree to well-directed efforts to secure greater productiveness.

Light Brahmas have yellow skin, shanks, etc., and while they carry a dark strip down the upper mandible and have feathered legs, these offer no serious difficulty to the application of pigment tests. Owing to their size it is to be expected that pigmentation changes will take place more slowly than in Leghorns, or even in Plymouth Rocks. In selecting Brahmas for the breeding pen, the breeder will want to avoid extreme length of legs, shortness of body, coarseness of skin, and the general beefy tendency to which some strains in this breed are inclined. Otherwise he should have no difficulty in combining high average production along with good size and with that beauty of plumage which is one of the striking characters of this breed.

Summary

Fine egg records have been made by fowls of all the breeds described in this chapter.

Excellent egg laying strains can be developed in any of these breeds if systematically bred for this quality.

Pigment tests cannot be used in connection with culling fowls of these breeds, with the exception of Anconas and Light Brahmas.

Where pigment tests are not applicable, special attention must be given to capacity tests.

Anconas are practically Leghorns, and can be treated like them in culling.

Breeders of Anconas who wish to increase the popularity of their fowls should be careful not to go to extremes in type, but should note carefully the requirements of commercial poultry keepers as regards abdominal capacity.

Where the shanks of Anconas are too dark for pigment tests, the bottom of the foot should be considered.

FIG. 74—BLACK LANGSHAN RECORD, 200 EGGS

Campines are similar to Leghorns, and can be culled in the same way, except that pigment tests cannot be used.

Minorcas are of good size and long in body, and therefore more accurately culled by capacity tests than fowls of smaller breeds.

Many regard it as probable that the large combs of Minorcas are associated with the extra-large eggs produced by them.

While the general appearance of the Orpington is "beefy", fowls of this breed have made some extraordinary records in egg laying contests.

Excellent laying strains in Orpingtons are being developed by breeders who avoid extremes in regard to exhibition qualities.

Looseness of feathering is considered an undesirable character of good layers—a point that needs to be especially considered by Orpington breeders.

Langshans, while belonging to what is termed the "meat class", have made extraordinary records in laying contests.

Extremes in length of leg, roundness of body, and looseness of feathering, are to be avoided in developing laying strains of Langshans.

Abdominal capacity in Langshans is secured by depth rather than length of body, being similar in this respect to Wyandottes.

Light Brahmas are capable of great development as egg producers where they are not bred for extra-large size and extreme exhibition qualities.

CHAPTER VI

Culling by General Appearance, Conduct and Molt

The Laying Ability of Fowls is Indicated by a Number of Details in Appearance and Conduct Intelligence Is a Highly Important Character in Good Layers—The Molt an Extra-valuable Point in Selecting the Heaviest Layers for Next Year's Breeding Pen—How to Estimate the Date When Hen Stopped Laying by Her Wing Molt

CAREFUL observance of the general appearance and conduct of fowls is an important aid in determining the probable value of fowls as layers, independent of pigment tests, pelvic arch measurements, etc. It is not possible to estimate actual production in this way with much accuracy, but no one who has cultivated the habit of carefully observing his hens should go far wrong, at any season of the year, in classifying them into layers and non-layers.

In considering the fowl's general appearance, state of health should, of course, receive first notice. Fowls that exhibit any of the signs of low vigor or health (see Chapter XI) are hopeless from the viewpoint of production, no matter what good "points" they may appear to have. One evidence of good health is bodily activity. All fowls are naturally quite active, and slow-moving, sluggish, indolent birds are never highly productive and seldom are in good health. A popular measure of activity in older fowls is the length of the toenails. The active, busy fowl that is on the move all day long, scratching and digging in the litter or in the run, searching for grain, worms, etc., is apt to have comparatively short toenails. On the other hand, a hen with overgrown toenails is almost certain to be an indolent, if not unhealthy, individual, and therefore, of little value as a layer. However, a good deal depends upon the conditions under which the birds are kept. For example, fowls on concrete floors will have much shorter toenails than equally active ones on dirt floors or on open range.

Along with poor health may be included, as undesirable qualities, all important physical defects, such as crooked backs, lameness, etc. Among these, though not noticeable unless the fowls are handled, may be included crooked breastbones. At Cornell University, it has been found that there is a larger percentage of crooked breastbones in heavy layers than in medium or poor ones, due possibly to the fact that the best producers draw more heavily upon material stored in the body so that the strength of their bones is below that of poor layers. In view of this fact, it is not advisable to discard fowls simply because they have deformed breastbones, but they certainly should not be used in the breeding pens, as this character or the tendency to it appears to be more or less hereditary.

Appetite is a distinguishing character of the good layer. The fowl that is constantly on the hunt for something to eat—that never seems quite satisfied with what is given her—is almost invariably producing heavily. Appetite is much more closely associated with production than is sometimes realized. Attendants at egg contests, for example, have found that they can estimate with a good degree of accuracy the probable production during any given week, by the appetites of the fowls. A falling off in feed consumption is a pretty certain indication that the egg yield for the ensuing week will show a more or less definite slump, and when consumption picks up and is in excess of a corresponding previous period the attendant knows that the egg yield is going to increase, and knows this in advance of any recorded improvement.

The disposition of fowls is regarded by close observers as an important indication of their probable value as layers. At the Vineland Contest for example, hens are classified as to disposition into "wild", "distant", and "tame", and it has been found that the "distant" hens are almost invariably the best layers. These are the hens that are neither wild and suspicious, constantly on the watch for trouble, nor so tame that they are constantly under the feet of the attendant. Extremely quiet and gentle dispositions are rarely associated with the highly developed, nervous organization that goes along with heavy production. The hen that, while not especially wild, yet keeps her distance—is unafraid but ready for emergencies—is the hen that lays. These distinctions as to disposition, while more readily noted in Leghorns, can also be applied in some degree to fowls of larger breeds.

Regardless of whether the observer believes in a special "egg type" or not, he cannot question the fact that there can be no ability to produce eggs on a large scale unless there is ample capacity for digestion of food and abundant room for development of the egg organs. Consequently abdominal capacity is one of the first points to be noted, and indication of it may be accepted as an important point in favor of the individual. However, the beginner will need to exercise due care in his observations, especially with large fowls in which an accumulation of fat in the abdomen is apt to give it a distended appearance, often mistaken for large capacity when the birds are not handled. With the appearance of abdominal capacity therefore, should be associated softness, pliability, and a loose, comparatively thin skin. While a reasonable amount of fat is always found in heavy-laying fowls, except possibly toward the close of a long laying period, any tendency to extreme fat should be avoided. Avoid coarse, rawboned, and beefy individuals, which may or may not be inclined to ac-

FIG. 75—A 261-EGG RHODE ISLAND RED HEN Photo from N. J. Ex. Sta.

cumulate fat, but which in any case are rarely profitable producers of eggs.

The character of the feather coat should receive attention, as it is believed that loosely feathered fowls are much less apt to be good layers than those whose feathers are reasonably close and tight. Looseness of feathering, as a rule, goes along with coarseness, slow maturity, and other characters associated with poor production.

Significance of Head Points

A great deal of importance is attached to head points in the selection of laying hens. Included in this term are such characters as comb, wattles, beak, face, eyes, ear lobes, etc. The heads shown in Fig. 76 illustrate points that are sought in the high producer and those that are to be avoided as indicating inferior laying ability. It perhaps should be explained that some undesirable points are indicative of general or permanent inferiority, while others simply show that the fowl is not productive when examined.

The comb is regarded as an especially good index to the condition or activity of the ovary, and is especially helpful in culling Leghorns, etc. When the ovary is developing yolks at a rapid rate, the comb, whether large or small, will be engorged with blood, giving it sometimes the appearance of being swollen as if from some injury. It will be bright red in color, warm, and with a waxy feeling. If the fowl is one that has laid for a time and has then gone through a rest period, her comb as she approaches laying again will present a slight scaly appearance.

After the fowl gets well underway in laying, the condition and appearance of the comb change. It still remains large, but is not so warm to the touch and without the peculiar swollen appearance which it had just when beginning to ... The color then is not so bright and the blade may be quite dark at times due to the fact that the blood is being directed to the ovary and oviduct rather than to the comb and other extremities. After the fowl ceases laying, the comb shrinks in size, but before this shrinkage becomes perceptible there is another change, the comb now becoming lighter in color and with a powdery appearance not amounting to a scale but different enough from the appearance of the comb of the laying hen so that many observers feel that they can more promptly pick out hens that have stopped laying by applying this test than in any other manner.

A fairly good general test is the shape of the comb. In single comb birds the points of the good layer's comb generally are broad at the base as compared with the "pencil" points of the poor producer. The rocker-shaped comb—this is, one that follows the contour of the neck—is believed to be a good indication of productiveness, while a comb with blade sticking up at the rear is apt to be worn by a distinctly poor layer. While this point appears to "hit" a good deal oftener than it "misses", it is not to be too implicitly relied upon, as there are numerous exceptions to the rule.

The eyes are well worth careful study. The heavy layer generally will have prominent eyes and these will be more or less parallel in the head, whereas the eyes of the poor layer will "toe in" toward the beak. According to Dr. Kent of Cornell University, the eye of the heavy layer usually is inclined to be oval rather than round, with the eyeball located in the center or back of the centre, while the eye of the poor layer is round or, if oval, ... the eyeball located toward the front. This is well illustrated in Color Plates IX and X, also XI and XII.

HIGH PRODUCER FULL LAYING	LOW PRODUCER NOT LAYING
1. Full, bright, waxy comb and wattles.	1. Small, hard, dried comb and wattles.
2. ... face.	2. Fat face.
3. ... beak, eye rings, ear lobes, face.	3. Yellow beak, eye rings, ear lobes, face.
4. Full ear lobe.	4. Wrinkled ear lobes.
5. Bright, round eye.	5. Dull, snaky eye.

Side View of Head

Front View of Head

FIG. 76—HEAD PARTS OF HIGH AND LOW PRODUCERS

The photos shown above are excellent illustrations of the appearance of comb, wattles, and face in high and low producing fowls respectively. Photo from Cornell University.

Tests for General Appearance and Conduct Applied to Hens

The preceding comments in regard to appearance and conduct apply with about equal force to both pullets and hens. In observing the latter however, there are some indications of good laying or a lack of it that are not generally noticeable in the case of pullets, such as tendency to overfatness; dull or snaky eyes, quite inconsistent with the nervous temperament of the good layer; empty crops at night, a condition never associated with good egg production; too much time spent on the perches during the day and all such indications of poor health or indolence. Among hens of the larger breeds bagging down behind is especially to be watched for and such birds promptly discarded. The development of spurs in hens is usually regarded as indicating old age and a consequent failure of the egg organs to function, resulting in the development of secondary sexual characters. If, along with the spurs, there is an abnormal development of comb approaching the appearance of that of a male, it may be accepted as certain that the egg organs have permanently ceased to function. The development of spurs alone,

however, is not a reliable indication of this change, as these frequently appear as the result of an accident or scaly leg. Spurs have frequently been observed on comparatively young hens in which production was known to be fully equal to that of the rest of the flock.

Culling Pullets

It is to be hoped that the reader will not make the common mistake of depending chiefly on the annual culling campaign to detect his nonlayers but will, by constant observation and repeated culling, get rid of most of his inferior pullets by the time they have reached maturity. The poultry keeper who is in earnest about keeping up the efficiency of his flock and maintaining economic egg production, will begin culling almost as soon as the chicks are hatched. Weakly or sickly chicks, or those that are crippled or handicapped by any form of physical disability or malformation, should be disposed of without delay. Even though they may live and grow, they will do so at a slow rate and the feed used in raising them will cost more than the value of the chick, whether it is ultimately sold as a table fowl or, worse still, is kept in the laying flock. Evidences of constitutional weakness that may develop during the growing period are indications of inferiority that should not be ignored. It has been clearly demonstrated that constitutional vigor is vitally important in heavy production. No matter what the heredity of a fowl may be, and no matter what its apparent capacity for production, if it is lacking in constitutional vigor, in ability to digest and assimilate large quantities of food and transform this into the delicate and highly nutritious compounds contained in the egg, its productiveness is certain to be only moderate at best and the danger of loss through disease is greatly increased and cannot wisely be ignored.

One evidence of inferior laying ability in pullets is slow development. As a rule it has been found that the first pullets of a given brood to come to maturity and begin laying are the best layers in that brood. Where the poultry keeper does not know the age of the pullets, it is difficult for him to judge accurately with regard to their development since he is apt to confuse the slow developing pullet of an early brood with a rapidly maturing pullet of a later one. It is desirable, therefore, to know the exact age of the pullets—information that the poultry keeper readily can provide by a simple system of leg banding that will enable him to distinguish between different hatches. It is not necessary to employ numbered leg bands for this purpose. The simple, round, colored bands now in common use will answer as well, and the different broods are more readily distinguished. A permanent record, if desired, may be provided by the use of the toe punch.

The comb of the pullet, even though quite small is, as has already been suggested, a good index to the condition of the ovary and therefore a fairly certain indication of the approach of laying maturity. The beginner may have some difficulty in distinguishing between the bright red color of the healthy, immature pullet's comb and that of the maturing pullet, but there is a distinct difference, and with a little handling of the birds the caretaker can soon become familiar with the engorged appearance, and the peculiar waxy, or "oily" feel, which is a distinct characteristic of the fowl that is about to lay.

For instructions in estimating the probable future egg yield of pullets see Chapter X.

The Molt in Its Relation to Egg Production

The renewal of the worn-out feather coat regularly takes place in late summer and early fall, and while this is the natural time for the molt, it proves a serious inconvenience to the poultryman since it results in a stoppage in egg production just when the season of highest prices is beginning. In growing stock the feathers are changed several times, but so gradually that it takes careful work to determine with certainty the exact number of molts. Referring to the investigations at Cornell, it is stated in "Hints to Poultrymen" (New Jersey Experiment Station) that "by staining the feathers in the wings and tail, it was observed that three successive lots of feathers were produced in the period between the fourth or fifth weeks and the thirteenth week. This sequence of molts corresponds closely with the molts of young wild birds. After the thirteenth week no changes were observed until just before the young birds reached maturity, when they went through a complete change, the females taking on their full plumage. In these early molts, as in the later annual ones, the sequence with which the feathers are changed is practically the same, namely, the older feathers are always shed first."

FIG. 77. HEAVY LAYING HENS USUALLY ARE LATE MOLTERS

This Leghorn hen laid 120 eggs up to October 16th, when photographed. She produced 23 more eggs before stopping to molt and began laying again on January 7th. Photo from North Carolina Experiment Station.

How the Molt Progresses

The regular order for the molt is first, neck feathers, then body, tail, and wing. In the neighborhood of three months are required for the complete molt when it takes place early. In late molting the change appears to proceed at a more rapid rate, and sometimes is not complete, many old feathers being carried over. In a slow molt the feathers drop a few at a time and in some cases the change is scarcely noticeable. The neck molt often begins as early as May and a few pin feathers may be found in this section four to six weeks before the body feathers begin to drop.

The marked irregularity in the occurrence of the molt in various individuals suggests the possibility of developing still wider variations in molting dates. For example, in almost any large flock it will be found that some hens

molt as early as July, while others may retain their old plumage until well along in winter, and occasionally one will go through the entire winter season without molting at all. It is common knowledge also that the molt can be hastened or retarded to some extent, and there are some practical poultrymen who believe, or at least hope, that strains of fowls may presently be developed in which the molt will proceed so gradually and be extended over so wide a period of time that it will scarcely have any direct effect upon production.

In the adult molt there is a great deal of variation in the way in which the molt normally progresses. In some cases the fowls lose almost all of their feathers at one time, while others molt slowly, section by section. A good illustration of this sectional molt is presented in Fig. 79. Dr. B. F. Kaupp of the North Carolina Experiment Station, who furnished the photo from which this illustration was reproduced states that "the feather tracts are molted complete, also that every other tract is molted at a time. The feather tract of the wing is completely molted, but not the tract on either side, which will not molt until the feathers in the bare tract have grown out."

Season and climate probably have some influence upon the date and duration of the molt, but there are few definite data on these points. Apparently fowls that molt in the summertime require considerably more time for the operation than those that molt in cold weather. About six weeks are required for growing a new feather, but the length of the time required to make a complete change in plumage will be affected by the rapidity with which the old feathers are dropped, also, possibly, by difference in rapidity of the growth of new feathers. At Cornell University where several flocks were under observation, the average time taken for a complete molt was 95 days, or slightly over three months.

Effect of Molt Upon Production

To the poultry keeper, the chief interest in the molt is with reference to its effect upon egg production. It is generally assumed that the almost complete cessation in fall production, observed in flocks of hens one year old or over, is due to the coming on of the molt. As contrasted with this, some investigators are of the opinion that egg production controls the molt rather than that the molt controls egg production. In other words, it is held that as long as hens continue to produce eggs the molt will be postponed, but that an interruption in production at almost any time from July on, is apt to be followed by molting. For example, wide publicity was given to a plan for forcing the molt which was suggested as a means by which the poultry keeper could get his hens through the molt and have them come into laying in the fall, after which it was expected that they would continue laying throughout the winter.

Utilizing the fact already noted—that a break in egg production must precede the molt—those who wished to produce a "forced" molt simply cut down the rations of the fowls thus stopping egg production. To do this it often was necessary to reduce the feed to one-third or less of the quantity normally consumed by the fowls, and to continue these starvation rations for two to four weeks. As soon as production ceased and the feathers had begun to drop freely the feed was increased and gradually changed to a good laying ration. July or August usually was selected for the attempt so that the molt might be completed and production resumed early in the fall. It was found that there is no serious difficulty in securing an early molt in this way, though it often appears to be only a partial one, the finish occurring later in the fall. The forced molt has few advocates now, not because it is not a comparatively simple matter to bring it on almost at will, any time after the first of July, but because there is no practical advantage in doing so, since expectations in regard to fall and winter production are seldom if ever fully realized.

What actually happens where the forced molt is attempted is to lose the eggs the hens would naturally produce during late summer and early fall with no compensating winter production. For example, in one experiment a pen of 27 hens that had laid 321 eggs in August was divided September 1st, and 13 were put through the forced molt while the rest were kept on full feed. During September the forced-molt pen laid 26 eggs while the other laid 147. In October the production was 3 and 128

FIG. 78—BEWARE OF THE EARLY MOLTER

This S. C. White Leghorn hen laid 81 eggs in her second year, stopping on June 20th, when she went into a full molt, after which she did not resume laying again until March of the following year. At the time photo was taken, August 16th, her new coat of feathers was thoroughly grown except the tail feathers which had not reached full size. Photo from North Carolina Experiment Station.

respectively. There was no noticeable difference in the winter production of the two pens so that the adopting of the early-molting method meant simply a loss of 250 eggs in total production.

Early and Late Molters as Winter Layers

It is now generally conceded that the late molters are the best layers in the flock and, as a rule, these hens prove to be the best layers the following winter, in spite of their late molt. No definite date can be named, before which fowls may be considered early molters and poor layers, and after which they may be considered late molters and, therefore, desirable to be retained in the flock. As extremes, July and August certainly are "early", and December clearly is "late"; but in considering the mid-season molters for their probable egg-laying ability, other tests also must be applied.

It should be remembered in this connection, that while late molters are practically certain to be the best layers during the following year, the medium-late molters, that is those that stop laying and molt earlier in the fall, often prove to be the best winter layers. The hens that do not begin to molt until November may not secure their new coats and be ready to resume laying until winter is well along. Many believe, also, that the medium layers will

FIG. 79—SECTIONAL MOLT IN HENS

The above is an excellent illustration of the way in which hens sometimes molt in sections. That is, one section or feather tract molts while those adjacent to it retain the old coat until the molting section has acquired its new feathers. Photo from the North Carolina Experiment Station

produce the best hatching eggs early in the season. This should make it clear that while late molting is an almost certain indication of heavy laying it is not wise to go to extremes in selection by this method. While the total production of medium-late molters may be somewhat lower, the net profit realized from them may be even greater than that secured from the extremely late molters. Speaking generally the practical thing to do is to keep production up to the maximum point throughout the fall avoiding, as far as possible, anything that will tend to check production and give the molt a chance to begin. The hens that under this treatment go through an early molt and have their new coats fully developed by the last of September may safely be eliminated as undesirable. All that molt later than this should be kept over, provided pigmentation and capacity tests and head points are favorable, while the extremely late molters, if in good physical condition, scarcely need to be subjected to any other tests unless to be used as breeders. Where, as sometimes happens, there is difficulty in distinguishing between extremely late molters and those that have molted so early that their new coats have already begun to show wear, pigment tests usually will settle the question.

The Wing Molt as an Indication of Productiveness

Flight Feathers Are Molted in Regular Order, and Renewed in a Certain Time—Hence, the State of the Wing Molt Shows Just How Long the Hen Has Been Unproductive

By FRANKLANE L. SEWELL

THE experienced poultry husbandman who keeps daily accurate records and observes causes and effects, learns that nothing that affects his birds comes just by accident. There are long-established natural laws governing all that happens. The beautiful plumage of wild birds never ceases to interest the lover of nature, and the plumage that so marvelously clothes our domestic fowls and gives them a new dress every year causes the fancier to marvel at the all-controlling mind that evolved these laws of nature.

Students watching the progress of their fowls in preparation for exhibition have often noticed that it requires about six weeks for them to molt and grow the larger feathers. Credit for bringing out the significance of this rest period, showing the relation between the production of eggs at this time and the length of time it takes to molt and grow new wing flight plumage, must be given to Dr. O. B. Kent of Cornell University whose interesting lecture on this subject at the Cornell Judging School forms the basis of this article.

Trap-nest records have proved the way wing-flight feathers are molted to be a fair indication of the hen's period of egg production during certain seasons of the summer and autumn. At such times the hen may take somewhat protracted periods of rest, or may quit laying altogether in which case she is apt to turn her attention to growing new plumage.

During the past year Prof. Kent has been studiously observing the manner of and the time required for bleaching the skin, shanks, and plumage of the yellow pigment which is taken from the bird's body by continued egg production. While in daily contact with the birds and their trap-nest records, he studied also the molting of the wings of wild birds and the latter suggested to him that there should be some correlation between the periods of laying and molting in our domestic fowl. The result of his study is a revelation to fanciers, and the knowledge of the existence of such a correlation gives them a keener interest in observing the changes of plumage in the wings, which section has always been significant to the breeder of quality in color and vitality.

The hen's history and her capacity for egg production not fully indicated by any one section. Those who wish to become expert judges of fowls—of their utility qualities combined with those show-quality points already standardized, have a broad field for investigation. Earnest students like Prof. Kent are constantly learning something new—or perhaps we should say, becoming conscious of some old law that breeders of poultry have never applied in any practical way.

Kindly note the seven illustrations of wings shown on page 55. In Wing 1 the numbers one to ten show the order in which the wing flights are molted normally. When the wing begins to molt the first feather to be replaced by a new one is the first inside flight feather marked "1" in the drawing. Nature has provided a regular order in which these feathers are replaced.

In the case of the wild fowl, the protection—the very life of the bird—so largely depends upon flight in escaping from its enemies that, if their wing-flight feathers were all molted at once, there would be a period in each bird's life when it would be at the mercy of those enemies whose chief desire is to devour it. Nature wisely planned that the season of molting for a fowl's wing-flight feathers should extend over twenty-four weeks, each feather in the sector requiring six weeks to develop in full, each succeeding feather being dropped about two weeks after the one just preceding it. It is the natural habit for the wing molt to begin almost immediately after the hen ceases to lay. Apparently, the strength ceasing to be

needed for egg production goes into the formation of those important flight feathers.

An average hen would lay out her clutch of eggs and then molt first the inside flight feather (No. 1) of both wings, then No. 2, 3, 4, etc., in regular order, as indicated in the wing at the top of the group. In all but the top wing shown herewith, special emphasis has been given the flight feathers under consideration by using strong black lines, while dotted lines are used to show the remaining construction of the wing. Other parts of the wing are molted with less regularity, often in groups, and they did not appear to show any relation to the periods of egg production.

In Wing 2 the flight feathers have been in what we may call the normal process of molting sixteen to seventeen weeks. All but the end flight has dropped. From indications the ninth feather has been growing about one week. The eighth feather has grown about three weeks, the seventh about five weeks, the sixth has been full grown from six to seven weeks. The numbers on the feathers of the wing in Wings 2, 3, 4, 5, and 6, refer to the weeks (at least) that the wing has possessed the new feathers. The shaded, un-numbered flight feathers in Wings, 2, 4, 5, 6 and 7 represent the old feathers that have not been molted.

Wing 3 represents flight feathers as having uninterruptedly molted during the full twenty-four weeks. The first inside flight feather has been in at least the full time or twenty-four weeks, as indicated by the number 24. Each of the other feathers was molted two weeks later until the last or end feather, which was the 10th in turn. It has just finished its six weeks and attained its full growth. It will be noticed that the end feather and those near the end in the wing of a normal fowl are not so long nor so large as those that are numbered in the top wing 3, 4, 5, 6 and 7, for example.

In Wing 4 the flight feathers have been in process of molting for about six weeks and the first feather is full grown. The next one shows four 'weeks' growth and the next under that, two weeks.' In the natural course this bird probably has rested from laying for the six weeks it has taken to proceed thus far in molting.

In Wing 5 one easily reads by the feathers that the bird has used eight weeks in molting; that is, two weeks for the short feather showing about one-third growth, four weeks for the one two-thirds grown, six weeks for the one full grown, and as that feather must have been started two weeks later than the first feather, eight weeks must have passed in order for the wing to show that condition on examination.

In Wing 6 the last molted feather is about as far along as the shortest one in Wing 2, which would indicate about a week's growth. So by allowing two weeks for each of the other feathers molted, it is apparent that this hen has been molting for twelve weeks—and in all probability has not laid during that length of time. And the bird may go on molting and producing no eggs until her

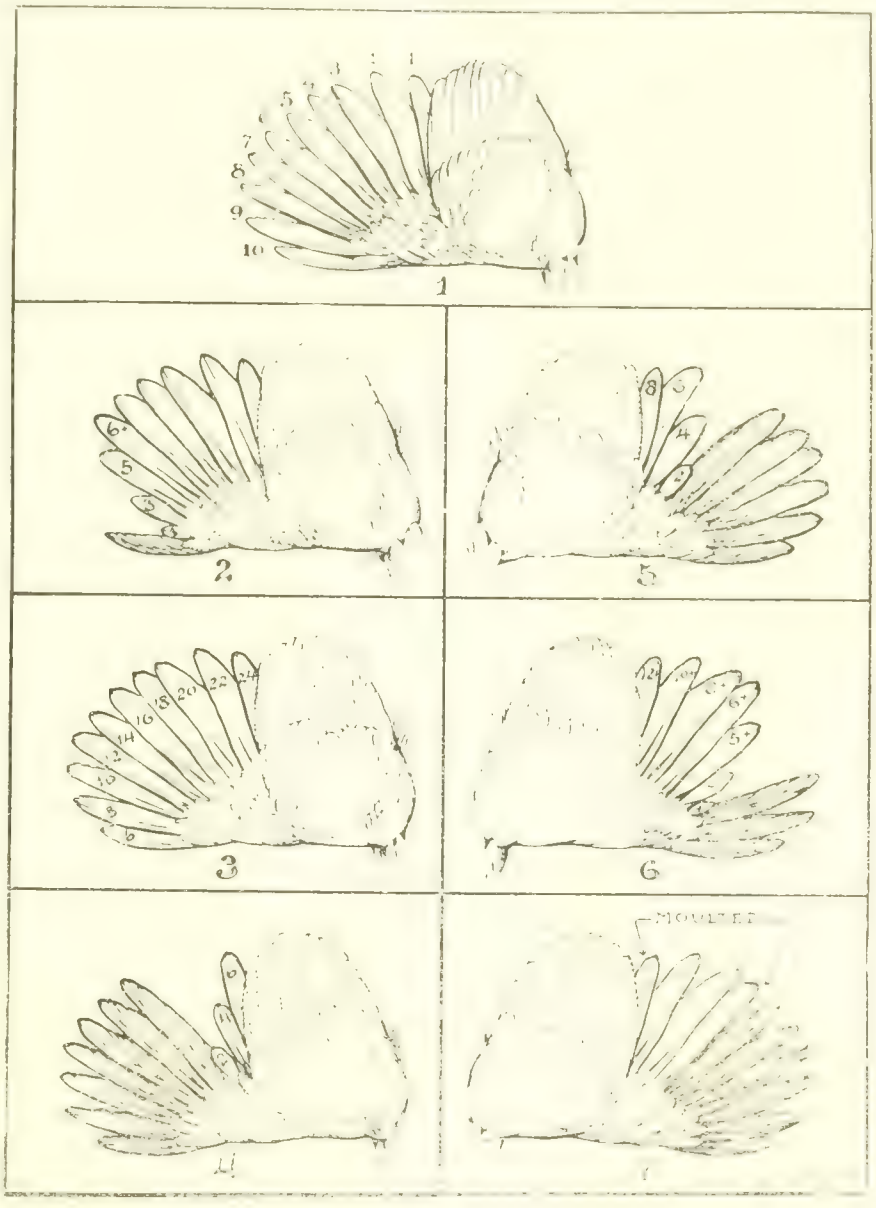


FIG. 80—HOW A HEN MOLTS HER WING FEATHERS

Wing 1 shows the order in which a hen normally molts the wing flight feathers. The inside flight feather, marked 1, is the first to be molted, and the others drop in regular order, about two weeks apart. Wing 2 has been in process of molting from sixteen to seventeen weeks. It takes six weeks for a wing flight to mature, so the new feather marked 1 has had only about a week's growth, the others, two, three, and five, while the one marked 6 has completed its growth. In wing 3 all the flight feathers have been molted and the new feathers have attained their full growth, taking in all twenty-four weeks. Wing 4 shows six weeks of molting; wing 5, eight weeks; wing 6, from twelve to thirteen weeks. Wing 7 shows a "vacation" molt. Sketch by Sewell

wing feathers are replaced and full grown, as in the case of Wing 3, which means that for 24 weeks she would lay no eggs. Not many fowls have the vitality to lay while they are molting.

Can Be Bred to Lay More Eggs Per Annum

Producing eggs throughout the greater part of the year can be brought about successfully only as a result of selective and pedigree breeding just as great producing dairy cattle have been brought into being by breeding strong vitality through a line of individuals particularly fashioned and cared for in order to develop certain organs whose line-bred habits and inbred qualities serve the purpose the breeders had in view. This method of breeding leads toward ideals and standards that are right.

The conjunction of bloods from abnormal freaks that simply exhausted themselves in producing great quantities of eggs, would not result in forming reliable egg-laying strains; but line breeding heavy layers for a number of generations will produce heavy laying strains of domestic fowl.

Wing 7 is that of a persistent layer that took a "vacation" of perhaps six to eight weeks. Probably she had the vitality to start laying soon after the fourth feather had started, possibly when it was about a week old, gaining strength enough to finish those feathers already started, but she did not cast any more quills. In estimating the number of eggs such a hen has laid, it is safe to guess that she stopped laying at least six weeks. Other indications might show that she is not in full lay. The fact that she stopped molting and did not continue, as indicated by the full growth of the last feather produced, leads one to conclude that her substance was again contributed mostly to egg production instead of feather making.

In examining the fowls for wing molt it is important to bear in mind that, according to Dr. Kent, "the good, high-laying birds do not molt all of their flight feathers. They go through what I call a "vacation" molt, that is they drop a few of the wing feathers and then go on laying again. I do not believe that a bird molts and lays at the same time; that is, sheds feathers and lays. She may grow feathers and lay, but not drop them and lay. Hence the longer period over which a hen lays the shorter will be her molting period and, therefore, the fewer the wing feathers shed. The wing molt thus shows when the hens stopped laying, and makes it possible to pick out the persistent high-laying birds from the drones almost any time from June to January".

Summary

The general appearance and conduct of fowls is an important aid in determining their value as layers.

Health, activity, appetite, and temperament should be particularly noted.

Abdominal capacity is one of the first points to be noted, exercising due care to avoid being misled by apparent capacity resulting from accumulation of fat.

Avoid too-loose feathering—a character which usually goes along with coarseness and slow maturity, and hence nonproductiveness.

The comb is a good index to the activity of the ovary.

Good layers are apt to have rocker-shaped combs with broad serrations. Poor layers usually have combs high in the rear, with "pencil points".

The eyes of the good layer are prominent and more or less parallel in the head rather than "toeing-in" toward the beak as is usually the case in poor layers.

Bagging down behind may indicate overfatness or a tumor. It often results from a short keel.

The presence of spurs on the legs of hens is not necessarily an indication of age or nonproductiveness.

Culling should begin as soon as the chicks are hatched, and should be continued throughout the growing period.

Discard all your pullets that at any time show lack of health or vigor, or any important physical defects.

Early maturity is generally regarded as an indication of superior productiveness.

The comb of the maturing pullet indicates with remarkable clearness the stage of development of the ovary.

The regular order for the molt is first, neck feathers, then body, tail, and wing.

Late molters molt more rapidly than early molters.

The occurrence of the molt in various individuals is extremely irregular, heavy-laying fowls particularly molting quite late in the season and often dropping only part of their feathers.

The average time taken for a complete molt is about three months.

The molt can be "forced", but there is no practical advantage in doing so.

Late molters are almost invariably the best layers.

Medium-late molters are believed to produce the best hatching eggs early in the season.

Hens that have their new coats fully developed by the last of September may usually be thrown out as unprofitable producers.

The feathers of the wing are molted in pairs.

By noting progress of wing molt in the fall, it is possible to determine with a fair degree of accuracy the length of time for which the hen has been nonproductive.

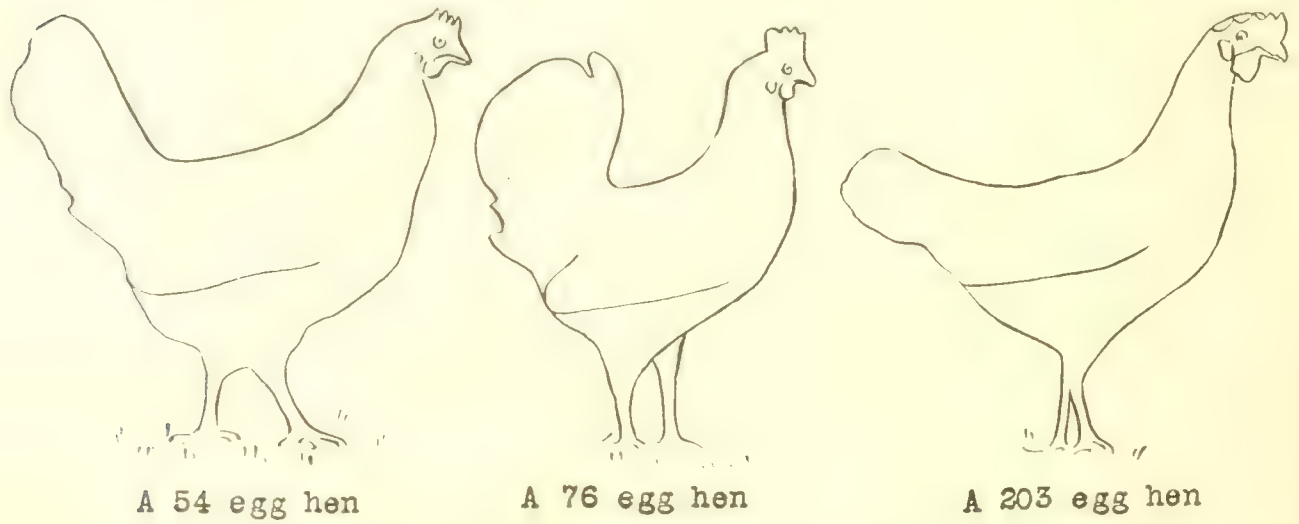


FIG. 81—TYPES OF GOOD AND POOR LAYING LEGHORN HENS

The above outlines indicate the general shape of the hens whose trap-nest records are here given. These outlines were prepared by Dr. O. B. Kent of Cornell University, and are intended to illustrate the descriptions of type given in the Official Culling Outline.

CHAPTER VII

Culling by Egg Type and Physical Tests

Is There an Egg Type?—Why Abdominal Capacity Is of Great Importance in Securing High Records—Laying Capacity and Laying Ability Are Not the Same Thing—Condition of the Abdomen a Reliable Indication of Productiveness—Pubic Bone Measurements Are Mainly Capacity Tests—How to Secure Individual Hen Records Without the Use of Trap Nests

THE question of whether or not there is an egg type is more or less in dispute among poultry keepers generally, though many of those who have carefully studied external characters in their relation to production are fully convinced that there is such a type and that it is fairly distinct. General belief in the existence of an egg type will depend much upon what is included in the term. If it is intended to convey the impression that heavy layers, regardless of breed, have a distinctive body shape that can be relied upon as certainly indicating their rank as producers, there probably are few who could be enlisted in its support. Not only does breed type have to be reckoned with in this connection but, as is well known, even fowls within the breed vary more or less widely as to shape, and without necessarily being handicapped as producers thereby. However, if type is taken to mean simply BODY CAPACITY, plus a few other characters that are known to be the direct result of high production in any breed, then there would seem to be little ground for controversy since there certainly is a physiological distinction between the good and the poor layer, whether readily observed in the live fowl or not.

Every one who has had occasion to compare good and poor layers by handling them, has been impressed with the fact that heavy laying in fowls of any breed does have a marked influence upon the condition and shape of the body. The active egg organs of the high producer weigh in the neighborhood of one-half pound more than when these are in a dormant condition, and the digestive organs also are decidedly larger. These internal changes necessitate a considerably increased abdominal capacity and cause other definite changes which taken together may fairly be said to form an egg type.

As a matter of fact, the various tests for body capacity, such as pubic bone tests, span between pubic bone and keel, location of sternal processes, etc., as prescribed in the Official Culling Outline (see Chapter III) and more fully described elsewhere in this book, are designed simply to afford a means of identifying egg type by physical measurements for abdominal capacity. And the observer who carefully studies his fowls and who learns to measure body capacity with his eye instead of with his fingers, recognizes egg type whether he calls it by that particular name or not.

Accepting the foregoing definition of egg type, it is plain that its presence may be indicated without conformity to any special body shape. For example, the Leghorn egg type as described by Prof. H. R. Lewis in Chapter III and as illustrated herewith, calls for a fowl in which the keel bone drops below a line parallel with the backbone, giving the bird a wedge-shaped appearance from front to back, as in Fig. 85. Such a hen also will have a well-filled breast which gives her a triangular appearance when viewed from in front, as in Fig. 82. When viewed from the rear in the position shown in Fig. 83 she always will have a wedge-shaped appearance due to the large, well-filled abdomen. If the numerous illustrations of record-laying Leghorns given in this book are carefully compared with this description, their general adherence to it will readily be noted. It is understood of course, that many fowls may have good capacity and yet be nonlayers by reason of malformed or injured egg organs, a condition that the average operator is not apt to note until he handles the fowl.

In heavy layers of breeds characterized by depth of body rather than length, such as Wyandottes, Orpingtons, etc., this wedge shape may never develop so that it can be noted in the contour of live fowls, and yet the greater body capacity will be obvious, particularly to any one who handles them.

In birds with large, rectangular bodies, such as the standard Rhode Island Reds, the increased abdominal capacity necessary for heavy egg production often is secured without forcing the keel out of a position parallel with the backbone. It is rare, however, for a hen of any breed to make a good record whose keel is noticeably "tucked up" at the rear so as to produce a wedge-shaped appearance with the base toward the front.

Egg type would be more readily recognized were it not for the fact that the outline of the live bird is affected so largely by the development and position of feathers and by the fowl's general carriage and position. The angle at which the hen carries her tail, the tightness or looseness of her plumage, whether she is observed when in full feather or at some stage in the molt, the position in which she happens to hold herself when under observation—all of these factors quite materially affect her general outline and render very much more difficult the problem of establishing the exist-

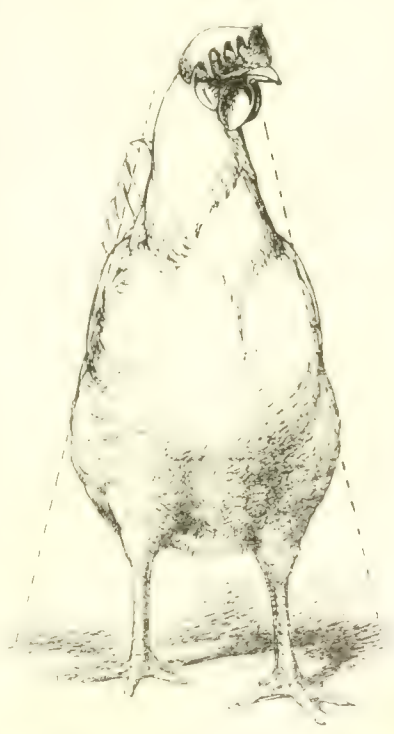


FIG. 82—GOOD EGG TYPE—FRONT VIEW

ence of a laying type and of describing it.

At the Second Annual Judging School at Cornell in 1919, this subject was quite thoroughly discussed and at one of the concluding sessions the following amendment to the Official Culling Outline, descriptive of egg type, was adopted without a dissenting vote among the students, in whose number were included well-known government workers, poultry fanciers, judges, and commercial poultry keepers. (This amendment, which was accompanied by the drawings reproduced in Fig 81, appears in the Official Outline in Chapter III, but is repeated here for convenient reference.)

TYPE

In order to make a record a hen must not only lay long but heavily. In order to lay heavily she must have sufficient body capacity to digest large amounts of food rapidly. Large capacity in a laying hen is shown by a body that is deeper at the rear end of the keel than at the front end. The under line should be fairly straight as shown in the illustration, and the back should be comparatively horizontal.

FIG. 83—GOOD EGG TYPE—REAR VIEW

A small capacity hen stands erectly. The body is either very shallow or, in the case of beefy individuals, the abdomen shows a pronounced sagging at rear of keel. A small capacity hen generally possesses a hump on the back. The comb generally has sharp, narrow points, with the blade pointing up.

A general body conformation of a heavy producer conforms very closely to a rectangle, with pronounced angles rather than smooth curves.

A male shows the same general characteristics except that the abdomen is not so deep.

The keel bone should be long and the body relatively deep in proportion to weight or length.

Culling by Physical Tests

Under the head of physical tests comes the observation of such characters as the condition of the abdomen and vent, the development and position of the pelvic bones and keel, etc. All of these characters are helpful in estimating the fowl's past performance and, to some extent, in determining her prospective production. The condition of the abdomen and vent shows quite clearly the relative value of the birds as producers, while the position of the pelvic bones is regarded by many as affording a clear idea not only of the fowls' previous performance but, in the case of pullets, of their probable value as producers and, in the case of males, their ability to transmit heavy-laying ability.

The condition of the abdomen of the heavy-laying hen is so distinctive that even the most inexperienced should have no difficulty in judging between extremes in handling the birds. In good layers the abdomen will be found to be large for the breed, well developed, free from excessive fat either under the skin or around the abdominal organs, and it has a characteristic loose, flabby condition that cannot possibly be confused with the firm, hard abdomen of the nonlayer This peculiar condition of the abdomen is clearly brought out in Fig. 91 which contrasts looseness of skin in this section of a heavy-laying hen, with that of a nonproducer. Any one who has had any experience in handling fowls will realize from the appearance of the photos the marked difference in the pliability of the skin in the heavy layer and in the loose, flabby condition of the abdominal walls.

By condition of the vent is meant its relative size and appearance which, in the heavy layer, is always large in size and relaxed, with more or less moisture present. This is well illustrated in Fig. 90. The nonlayer or the comparatively poor layer has a vent much smaller and less moist. Some demonstrators determine whether the hen has laid within the last day or two by spreading the first and second fingers of the hand on either side of the vent and pressing down. If the hen has laid recently a quantity of watery fluid will escape, but practically none will be present if no egg has been laid within twenty-four to forty-eight hours.

The pelvic bones of the fowl consist of three bones in pairs. These are known as the ischium, ilium, and pubis. These bones are separate in the baby chick but are more or less fused in the adult fowl, and are capable of expanding but slightly, so that the pelvic arch as a whole varies little in the mature fowl under any condition. The location and general appearance of these bones is shown in Fig. 84. Taken together they form what is known as the pelvic arch.

In practice the poultry keeper gives little attention to the pelvic arch as a whole, but centers his attention almost exclusively upon the position of the rear of the arch, or the posterior ends of the pubic bones. The spread of these bones varies widely in the fowl at different stages of laying. They are readily found in the live fowl when held in the position shown in Figs. 56 and 58, being located on either side of the vent and a little below it. The space between these two bones may measure anywhere from one to four inches, depending upon the size of the fowl and its productiveness. These bones naturally curve in toward each other, the curvature being comparatively slight in heavy-laying fowls, while in nonlayers they may be turned in at a decided angle, with the ends approaching each other quite closely.

The Pubic Bone Test

The usual method of measuring the distance between the pubic bones is by means of the fingers, the term, "one finger", "two finger", "three finger", etc., referring to the number of fingers that can be accommodated in the space between the bones. The hen shown in Fig. 58 for example, is a "two-finger" fowl and therefore inferior, or at best only a medium layer, whereas the "three-finger" hen shown in Fig. 56 is a good layer, though not necessarily one of the best in which a spread of "four-fingers" is

expected. The signifiance of this character as a means of judging the past or prospective laying ability of a fowl is in the fact that it indicates abdominal capacity.

The thickness of the pubic bones means their thickness as observed in the live fowl when the end of the bone is felt between the fingers. This thickness varies widely, ranging anywhere from an eighth of an inch up to in the neighborhood of one inch. Pubic bones do not actually vary in thickness, at least to any noticeable extent, but are always quite thin,their apparent thickness being due to the skin and fat overlaying them. In nonlayers there usually will be found a thick layer of fat which, with the stiff, unpliable skin itself, results in making the pubic bones appear quite thick when felt with the fingers, as is shown in Fig. 89. In the laying hen, however, any fat that may have accumulated in this section of the body is quickly absorbed, while the skin itself becomes much more pliable, thus greatly reducing the apparent thickness of the pubic bones which thus become an important clue to the laying ability of the fowl. Along with spread of pubic bones and their thickness is noted their pliability which is quite marked in good layers. This greater pliability is due in part to their freedom from the thick blanket of fat that usually covers them in a poor layer, but without doubt the bones themselves are more pliable, due to some modification in their texture.

The position of the keel has even more significance than the pubic bones, as a measure of capacity. The keel, or the breastbone, as it is commonly called, is indicated at "B" in Fig. 84. This bone is not attached to the skeleton at the rear but swings from the shoulders. As a pullet develops and comes into laying, or as an adult hen after passing through a rest period resumes production, the egg organs increase in size and weight, and the rear end of the keel is pushed downward and outward to give more room. The distance between the end of the keel bone and the end of the pubic bones is usually spoken of as the span, and is measured by the fingers. Illustrations of narrow and wide spans are presented in Figs. 57 and 59.

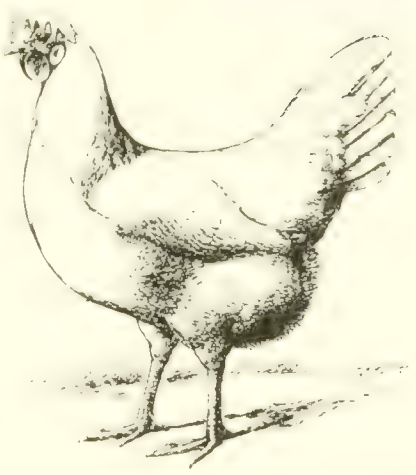


FIG. 85—GOOD EGG TYPE—SIDE VIEW

For this test to be of value in judging for egg production, it is important to note that the measurement of the distance between keel and pubic bones must be vertical rather than horizontal. Obviously, a fowl, the end of whose keel bone is practically on a level with the end of the pubic bone, as shown in Fig. 88, has much less abdominal capacity than the one shown in Fig. 86, though so far as the actual distance between the bones is concerned they have approximately the same span.

FIG. 84—"X-RAY" SKETCH SHOWING PELVIC ARCH AND KEEL

a. Pubic bones, forming rear part of pelvic arch.
b. Rear of keel or breastbone.
c. Lateral or sternal processes.

Some Exact Measurements

The point should be made plain that not only do fowls differ among themselves in width of span, spread of pubic bones, etc., but these measurements will vary noticeably

Table Showing Weekly Measurements of a White Leghorn Pullet, Taken at Cornell University

Date Measured		Keel to Tail	Comb Height	Pelvic Arch	Pelvis to Keel	Weight in lbs.	Eggs laid in following week
Feb.	2	9.9	4.3	4.3	6.1	3.65	
	9	10.5	4.5	4.4	6.4	3.80	
	16	11.2	4.5	4.7	7.6	3.90	
	23	10.8	4.0	5.2	7.0	4.05	0
Mar.	1	11.2	4.7	5.3	8.0	4.10	4
	8	11.1	4.5	5.5	8.0	3.90	4
	15	10.2	5.2	5.1	7.6	3.65	2
	22	10.6	5.0	5.0	7.5	3.55	2
	29	10.1	4.9	4.6	6.2	3.30	3
Apr.	5	10.3	5.5	4.5	6.5	3.35	4
	12	9.9	4.6	5.1	6.5	3.15	5
	19	11.2	4.8	4.7	6.8	3.30	5
	26	10.4	4.8	5.0	7.1	3.40	5
May	3	9.3	4.6	4.2	5.9	3.10	0
	10	9.3	4.5	3.9	5.4	3.10	1
	17	11.1	4.5	4.5	7.7	3.40	5
	24	10.7	4.7	4.9	7.7	3.50	6
	31	10.7	4.7	4.8	6.1	3.35	2
June	7	9.6	4.5	3.7	5.3	3.00	0
	14	10.4	4.5	4.5	6.1	3.35	4
	21	10.8	4.8	5.0	7.9	3.70	6
	28	10.8	4.9	4.7	7.8	3.40	3
July	5	9.3	4.5	4.0	5.3	3.20	0
	12	10.6	4.5	4.6	6.6	3.55	2
	19	11.2	4.8	5.0	7.7	3.70	5
	26	11.0	5.0	4.8	7.1	3.40	4
Aug.	2	10.9	4.7	4.8	7.8	3.25	1
	9	10.1	4.4	3.9	5.5	3.10	0
	16	10.7	5.0	4.8	6.8	3.55	0
	23	11.2	4.3	4.5	7.2	3.70	4
	30	11.0	4.8	5.1	7.9	3.75	5
Sept.	6	11.3	5.5	4.6	7.3	3.65	5
	13	10.9	5.0	4.6	6.8	3.50	2
	20	11.4	4.9	4.8	6.7	3.75	0
	27	10.7	4.4	4.2	6.3	3.50	
Oct.	4	10.5	4.5	3.7	6.5	3.35	
	11	10.1	3.9	3.8	5.9	3.30	
	18	10.0	3.8	3.4	5.3	3.30	
	25	9.5	3.7	3.5	4.8	3.25	
Nov.	1	10.0	3.8	3.7	5.9	3.40	

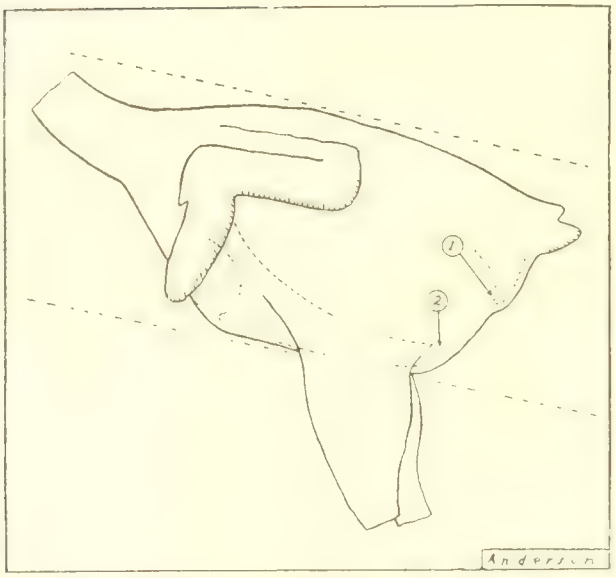


FIG. 86—LOCATION OF PUBIC BONES AND KEEL IN "GOOD CAPACITY" FOWL

1—Pubic bones; 2—Keel.

in the same fowls when bodily dimensions in laying and nonlaying conditions are contrasted. At Cornell University, Dr. Kent took weekly measurements of a White Leghorn Pullet as she approached laying maturity, and throughout her first laying year, carefully recording the variations that took place in the characters noted. These measurements are reproduced in the accompanying table and are worthy of careful study. (See page 59.)

In the foregoing table, measurements are recorded in centimeters; weights in pounds and decimals of a pound. "Pelvic arch" corresponds to spread of pubic bones as the term is used in this book. "Pelvis to keel" corresponds to span between pubic bones and keel. Measurements prior to Feb. 2nd are omitted to save space.

It will be noted that up to March 1, when the pullet began laying, there was a gradual increase in all dimensions. After that the measurements follow the egg yield closely, the abdomen noticeably contracting after even a single week of idleness, and promptly expanding again as soon as egg production was resumed. On Oct. 25th, after 6 weeks of nonproduction, comb, arch, and pelvis-to-keel measurements were at their minimum for the entire period. The distance from keel to tail, while reduced, was greater than at three former periods (evidently this dimension is not so closely correlated to production). As was to be expected, the greatest fluctuations were in comb and pelvis-to-keel dimensions. The last measurement recorded (Nov. 1st) shows all dimensions increasing again, also weight, and an early resumption of laying would be expected if conditions generally were favorable.

In connection with the keel bone the lateral processes also should be observed. These processes are well illustrated in their natural position (C) in the excellent "X-Ray" drawing by Artist Sewell, reproduced in Fig. 84. The value of lateral processes in tests for productive-

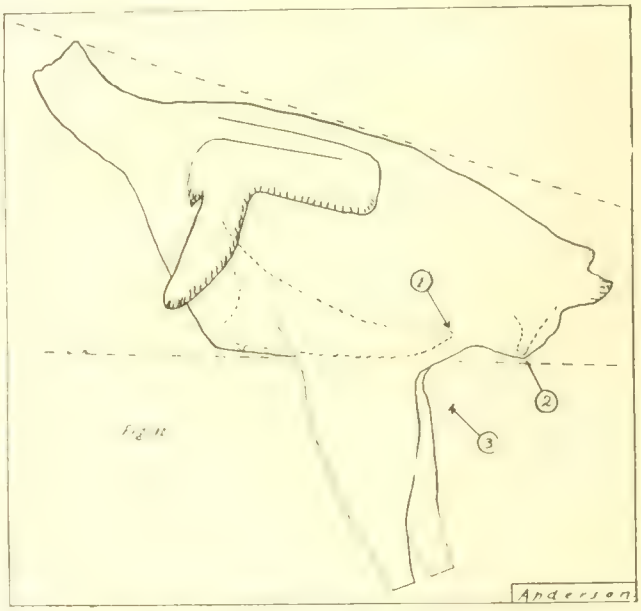


FIG. 88—A FOWL OF EXTREMELY INFERIOR CAPACITY

The distance or span between 1 and 2 in this outline is the same as in Fig. 86, but abdominal capacity is much less. To get fair capacity "1" should be at point indicated by "3".

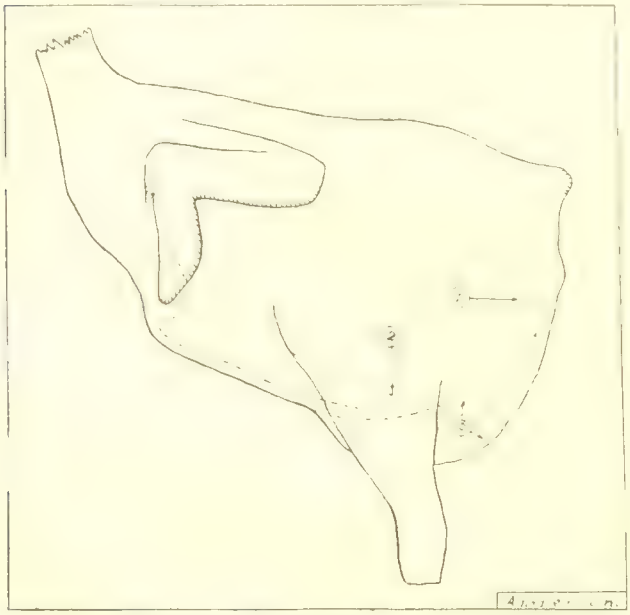


FIG. 87—HOW A SHORT KEEL MAY CAUSE "BAGGING DOWN"

The abdomen of a normally shaped hen would follow dotted line at "3", instead of the lower solid line.

ness is that they indicate abdominal capacity, also condition. Fowls that are laying heavily, and therefore eating heavily, will have the lateral processes well spread out, and because of the comparatively thin, fat-free skin and highly pliable abdomen their bones will readily be felt by the fingers when placed as in Fig. 93. In the well-fed nonlaying hen the walls of the abdominal cavity will have a comparatively heavy layer of fat, while the lateral bones themselves will be drawn in somewhat and so less easily located.

Where it is particularly important to make no mistake in determining which hens are laying (as in culling valuable breeding stock), physical tests are not only simple and accurate but less laborious than trap nesting. Persons who wish to use trap nests but who have trouble with the hens laying on the floor will find that the method described in the following article overcomes this difficulty. The method here described has also been in regular use at the Utah Experiment Station for several years.

Experiment in Accurate Method of Culling

These Experimental Records Show that Almost Complete Accuracy Can be Realized in Individual Egg Records Without the Use of Trap Nests

By PROF. ROY H. WAITE*

IN applying this method of testing hens, it is recommended to examine the entire flock in the morning before the hens have begun to lay. Test at least three days in succession, for hens do not lay every day. You can only determine which ones are to lay the day you test. Shut the hens in the poultry house the night before testing, unless you get out early enough in the morning (before daylight) to catch them from the roosts. If you have a droppings board under the roosts you can fasten the hens underneath it and catch them readily. The hens are more easily managed if the catching closet is made dark. I find that an old door or platform or other opaque material placed against the droppings board makes a very satisfactory catching closet.

Catch the hens one at a time and examine. If you have two pens, place the layers in one and the non-layers in the other. If you have only one pen it will be necessary to mark the layers in some manner so that they can be distinguished when it becomes time to dispose of the nonlayers. Leg banding is a very satisfactory method of marking. You should be able to get most of the layers out in two days.

FIG. 90—STRIKING COMPARISON OF HIGH AND LOW PRODUCERS

Hen on left is the high-producing R. I. Red, shown in Fig. 54; the one on the right is shown in Fig. 55. Photo from Storrs Experiment Station

FIG. 89—COMPARING THICKNESS OF PUBIC BONES IN HIGH AND LOW PRODUCERS

Note how the accumulation of fat under the skin has given the pubic bone of the low producer on the right the appearance of being two or three times as thick as in the high producer. Photo from Storrs Experiment Station.

A study of trap-nest records shows that the large majority of hens do not skip laying more than one day at a time when they are in good laying condition. A few hens skip two days at a time and a small percentage skip three and sometimes as many as ten or more. It will thus be seen that a two or three-day test will get out a majority of the best layers, but if you wish to get out every laying hen, test over a longer period. Of course if the flock is just beginning to lay, a three-day test will not tell you much.

Method of Feeling the Egg

Study Fig. 94 carefully and note the position of the egg in the fowl's body on the day of laying. It is suspended near the back and well toward the rear of the body. Learn its position with reference to the pelvic bones for one of these serves as a guide to the fingers when testing. There is only the skin, a thin layer of mesentery, and the wall of the oviduct between the fingers and the egg when the test is made.

Hold the bird to be tested with its right side down, its shanks or legs in your right hand, and its back resting in the palm of and on the fingers of the left hand (see Figs. 96 and 97 herewith). Slip the fingers of the left hand under the bird's body until the tips pass the pelvic bone. Then gently, yet firmly, press the tips of the fingers into the side of the fowl's body and up under the pelvic bone towards the back. If an egg is present it will be felt as a hard lump.

The operation will seem rather awkward at first, but after a little practice the fingers become "educated" to the feel, and the effort in testing becomes mainly that required in catching the birds. In making the test do not mistake the gizzard for the egg. The gizzard is lower down in the abdominal cavity. The egg is well up toward the back. While learning, it may be of some assistance to check on your results by feeling the egg in the oviduct. This can be done by pushing the forefinger into the vent of the hen and up the oviduct until the egg is felt.

FIG. 91—GOOD AND POOR PRODUCERS CONTRASTED AS TO FLEXIBILITY OF SKIN

The skin of the high-producing hen on the left is much more pliable and freer from abdominal fat than the low producer on the right. Photo from Storrs (Conn.) Experiment Station.

*Extracts from Bulletin 221, Maryland Experiment Station.

If it seems more natural to you there is no reason why you cannot hold the fowl's legs with the left hand and feel the egg with the right. It seems more natural to me to catch the bird with my right hand and there is no lost motion when I feel for the egg with my left hand.

After a little experience you will find that the method of testing is so simple that you will not have to pick the bird's feet from the floor, but can feel the egg while holding her in a natural upright position.

Experiments

A test of four flocks was made and the results are given in Tables I-IV inclusive:

TABLE I
Single Comb White Leghorn Hens

Date	No. of hens	No. of eggs shown by test	No. of eggs gathered
August 13	69	No test made	14
August 14	69	15	14
August 15	69	14	14
August 16	28*	13	14**
August 17	28	7	7
August 18	28	18	17
August 19	28	7	6***
August 20	28	15	15
August 21	28****	5	5
August 22	26	16	16
August 23	26	4	4
August 24	26	14	14
August 25	26	6	6
August 26	26	9	9
August 27	26	14	14
August 28	26	6	6
August 29	26	15	14
August 30	26	9	9
August 31	26	12	12

* Sold 41 hens.
** One egg on roost before the test was made.
*** One egg eaten. Remains of shell found.
**** Two hens sold.

The results obtained by this experiment would seem to indicate that the method of testing laying hens is very satisfactory for the Leghorn breed. In none of these birds was there the least difficulty found in locating the egg. The slight discrepancy between the number found by the test and the number gathered on Aug. 14, 18, and 29 could easily be explained by hens eating eggs that had become broken or by error in counting the hens as they were tested. It is significant that in no case were any eggs found in any of the pens where nonlayers, as shown by the test, were placed.

FIG. 92—METHOD OF CATCHING FOWLS
With a light screen (C-D) across pen, and an assistant at B, operator (A) can handle fowls rapidly. Courtesy of Utah Experiment Station.

TABLE II
Barred Plymouth Rocks

Date	No. of hens	No. of eggs shown by test	No. of eggs gathered
August 14	38	No test made	5
August 15	38	2	2
August 16	38	6	6
August 17	38	2	3*
August 18	38	3	4**

* Neglected to examine nests after testing at about 8 o'clock.
** One egg laid in cull flock. Two birds escaped before being caught. One of these may have laid.

These results (Table II.) would indicate that the test can be applied to the heavier breeds. This flock was exceedingly fat, and the test was a little more difficult than with the Leghorn flock, but it was entirely practical.

FIG. 93—LOCATING LATERAL PROCESSES IN HIGH AND LOW PRODUCERS
This illustration shows how lateral processes are found Note the larger capacity of the fowl on the left with well-spread processes. Bones are plainly felt in this case while in bird on right they are not noticeable unless considerable pressure is exerted.

TABLE III
Mixed Breeds Flock

Date	No. of hens	No. of eggs shown by test	No. of eggs gathered
August 18	6	No test made	4
August 19	6	1	1
August 20	6	4	4
August 21	8*	1	1

* Two broody hens released.

These results (Table III) show that the ordinary mixed farm flock can be tested. There was no difficulty at all in finding the eggs inside these hens for they were in good laying condition as regards flesh.

TABLE IV
White Wyandotte Hens

Date	No. of hens	No. of eggs shown by test	No. of eggs gathered
August 18	4	No test made	1
August 19	4	2	2
August 20	4	1	2
August 21	4	0	0
August 22	4	1*	2
August 23	4	0*	1

* Bird No. 53 laid but did not react to test.

Three of the Wyandotte hens were easy to test, but in one (No. 53) the egg seemed to be

formed in front of the usual place and while it could be felt by making a special effort, the test would not be practical if all fowls were as difficult to test as this hen. The egg she laid was ill-shaped and small, therefore were she put into the nonlayer class to be sold there would be no great loss. The results of this experiment, while not so conclusive as those of the other breeds, indicate that the test is practical with Wyandottes.

Time Required for Making Tests

The first flock I tested was the White Leghorns. It required a little less than twenty minutes to go over the sixty-nine birds the first time. This is about seventeen seconds per bird. With practice a person soon becomes very proficient and can make the test almost as fast as the fowls can be caught. The hens soon get accustomed to being handled and become easy to manage. The eighth time I tested this flock of Leghorns there were twenty-six birds and the time required was two minutes and twenty seconds. This is a little less than six seconds per bird, or ten birds per minute.

Injury to the Birds

In no case did the testing seem to injure the birds in any way. The egg is so near the surface and the pressure required is so gentle that there is no danger of injury if the test is properly made. There are no vital organs in the region where the egg is held before laying. The principle danger of injury is in catching and handling the birds. Laying hens should be handled gently at all times.

Time of Year to Make the Test

The flock can be tested at any season of the year, but of course the greatest saving is made by taking out the hens that stop laying during the summer. This is especially true of those flocks in which a large percentage of the hens stop laying in late summer and do not begin laying again until late winter.

FIG. 95—BONY FRAME OF A HIGH AND A LOW PRODUCER

On the left is shown the bony framework of the high-producing Rhode Island Red hen shown in Fig. 54. The one on the right is the low producer shown in Fig. 55. In this photo, spread of pubic bones is indicated by the white strips. The difference in distance between pubic bones and rear end of keel also is clearly seen, while the greater spread of the lateral processes in the heavy layer on the left are shown with exceptional clearness. Photo from Storrs Experiment Station.

The Value of the Test to the Poultry Breeder

This method of recording eggs laid will enable the poultry breeder to keep more reliable records of the flock from which he intends to select his hens for breeding than the method of trap nesting, and will save a vast amount of time. By using this test the breeder with his small flock will be able to keep individual records of his fowls for he can "mark up" his egg record early in the morning and then go about his regular work the balance of the day.

In making the test regularly a definite system should be adopted so that the fowls will become trained to know what to expect. By doing this, much time will be saved and the birds will not be injured by being frightened. It is surprising how quickly they learn to run up to the attendant to be examined.

The records published by the Utah Station and our results obtained so far at this station show that the external test is more accurate than the trap nest, in making certain that the eggs laid are credited to the proper hen. By these methods of testing, the floor eggs are credited to the hen that lays them. On the other hand, there is some indication that an egg is occasionally held over until the next day before being laid, in which case the hen would be credited with the same egg twice.

FIG. 94—POSITION OF EGG IN BODY OF FOWL

The egg remains in the uterus of the ovary for several hours while the shell is being formed, and in this position is readily felt by the fingers, holding the bird as shown in Figs. 96 and 97. Photo from Maryland Experiment Station.

FIG. 96—TESTING FOR PRESENCE OF EGG

This illustration shows the proper way to hold a fowl while making the test to determine which hens are laying. Photo from Maryland Experiment Station.

Identifying Layers By Tests at Utah Experiment Station

The advantages of this method of detecting layers are thus described in Bulletin 162 of the Utah Station:

"One of the chief advantages of this method is in the time saved. In a trial for time, two men working together went through 30 pens in a long house and through 16 colony houses, testing over 500 hens in 37 minutes. When the testing was done they were free for other work until time to gather the eggs in the afternoon. In running trap nests on the same fowls it took one man more than one-half his time of a ten-hour day to look after the nests, record the eggs, and free the fowls.

"Where only the individual egg record is desired and no pedigree breeding is to be done, this method of obtaining the record saves the expense of equipping the houses with trap nests. It also lessens the labor required in caring for the fowls and gives a more complete individual record than the trap nests now in common use.

"By keeping a careful record of the number of eggs tested and gathered with a note on the difference as a check, it was possible to reduce the number of unrecorded eggs to one-half of one per cent. During the year 1915 the test showed 42,886 eggs. The sum of the eggs short at time of gathering was 110 and the sum of those in excess was 128. The error will be greater than this unless the work is carefully done soon after daylight. Since some hens lay shortly after leaving the perch, it is necessary to make the test early enough to catch these early layers.

"As there is no way by which the eggs of a certain hen can be identified, individual pedigree breeding cannot be carried on by this method. For this reason the trap nest must be used during the breeding or hatching season in breeding experiments requiring an individual pedigree. At the Utah station, since nearly all the houses are equipped with trap nests, they are available for the pedigree-breeding work during the hatching season. As soon, however, as this time is past the trap is tied down and the record kept by testing.

Summary

There is no distinct body type that can be relied upon to certainly indicate the rank of fowls as producers.

There is, however, a physiological difference between the good and poor layers and the careful observer usually can detect it.

Pubic bone tests, measurement of span, location of sternal processes, etc., are valuable chiefly as tests for abdominal capacity.

A keel in which the rear end drops down sufficiently to place it at a slight angle with the back is accepted as a good indication of abdominal capacity.

In fowls having long bodies, capacity may be secured without this wedge-shaped development.

Hens whose keels are noticeably "tucked up" in the rear are seldom, if ever, good producers.

The chief difficulty in recognizing body changes due to production is the fowl's heavy coat of feathers and the way in which apparent shape is affected by carriage and position.

In any breed, a heavy-laying hen must have sufficient body capacity to be able to digest large amounts of feed.

The abdomen of the heavy-laying hen will always be found to show a characteristic loose, flabby condition that need never be confused with the firm, hard abdomen of the nonlayer.

The vent of the heavy layer is large in size, relaxed, and moist.

The pelvic arch as a whole varies little in shape but the rear part of it, represented by the pubic bones, varies greatly in its spread at different stages of laying.

Fowls in which only two fingers can be placed between the pubic bones are inferior, or at best only medium layers.

If three or more fingers can be placed between the bones, the hen usually is a good layer.

In nonlayers, the pubic bones appear quite thick, owing to the abdominal layer of fat with which they are covered.

The laying hen has little fat under the skin of the abdomen, hence the pubic bones appear quite thin.

The span between pubic bones and keel is an important measurement for abdominal capacity.

Actual tests show that the comb, spread of pubic bones, and span between pubic bones and keel follow closely the variations in productiveness in fowls.

Well-spread lateral processes are an indication of good capacity.

It is possible to secure accurate individual egg records by physical tests, without the use of trap nests.

FIG. 97—HEN KILLED AND PLUCKED TO SHOW POSITION OF HAND IN TESTING

This illustration shows the position of fingers in testing hens for productiveness without the use of trap nests. Photo from Maryland Experiment Station.

CHAPTER VIII

The Value of Pigmentation Tests in Culling

What Makes Skin, Beaks, Shanks, Etc., Yellow, and Why the Color Fades When the Hens Begin to Lay—How to Determine Approximately How Long Hens Have Been Laying and the Number of Eggs Produced, Doing so by Observing the Degree of Yellow in Different Sections of the Body—Why the Pigment Comes Back into the Faded Sections as Soon as Laying Stops

THE APPLICATION of pigmentation tests to different sections of the fowl's body is, in the case of all yellow-skinned fowls, a valuable aid in determining present productiveness, also in estimating the probable length of time during which the fowl has been laying. By pigmentation, as the term is here used, is meant the yellow color naturally present in skin, eye ring, beak, and shanks in fowls of such breeds as Leghorns, Plymouth Rocks, Wyandottes, Rhode Island Reds, etc. In the case of Leghorns the color also is observable in the ear lobes. This yellow color, wherever found, is due to the presence of xanthophyll, a pigment that is always present in certain feeds, such as yellow corn, alfalfa, clover, and other plants, and which is taken up by the fowl's digestive organs and distributed to practically all sections of the outer surface of the body.

Several observers, working independently, have definitely established the fact that egg production has a distinct influence upon the color of the parts mentioned, the effect being to reduce the natural yellow color until, in the case of long-continued production, the loss of pigment, commonly described as "fading", leaves the fowl's beak and shanks practically white or pinkish white, remaining so as long as the fowl is productive. This change takes place regardless of the amount of pigment present in the rations. For a brief history of the discovery and development of this method of detecting layers or nonlayers, see Chapter I. General directions for applying pigmentation tests are given in Chapter III, and need not be repeated in this chapter which is devoted to consideration of special phases of the subject.

Pigmentation of Comb and Wattles

In all yellow-skinned breeds, yellow pigment is present in face, comb, and wattles, just as in eye ring and beak, and it fades out with production and returns when laying ceases, in precisely the same way. The pigmentation of these parts has received little attention because not distinctly visible, though close observers will note a decided difference in the shade of red in comparing these parts in layers and nonlayers, the comb and wattles of the latter having a yellowish cast. This is brought out in some of the color plates on pages 6 and 7. An apparent exception to this rule is often encountered in hens whose combs appear white rather than yellowish red, due to the presence of a fine scale—see Plate II, page 5. Yellow pigment when present can readily be detected in comb and wattles simply by pinching them with the fingers and noting the color before the blood comes back.

Observations in Loss of Pigment at Storrs Experiment Station

By way of presenting definite data on loss of pigmentation due to egg production, the following extracts are reproduced from an article originally published in "Science", in 1915, by A. F. Blakeslee and D. E. Warner of Storrs Experiment Station. For their investigations these observers used the fowls entered in the International Laying Contest conducted at that institution, and as these fowls were all handled substantially alike, the possible influence of environmental factors could be largely ignored:

"The amount of yellow was measured by means of the Milton Bradley color top which, when spinning, acts as a color mixer. The top readings of the White Leghorns listed in Tables I and II were taken at three different periods in October. Table I shows the percentage of yellow in ear lobes of 312 birds according to the records of October 19-21, together with monthly and yearly egg records for the different color groups. In Table II the records at the three different readings have been used.

TABLE I

Average Egg Records For Different Amounts Of Yellow In Ear Lobes Of 312 White Leghorns

Per Cent Yellow.	5-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-7
No. birds	7	36	40	16	20	31	33	41	39	30	13	4	1	1
Average No. eggs in September	19.7	18.2	16.9	16.4	10.3	5.5	6.1	4.9	4.0	3.6	2.4	1.3	0.0	0.0
Average No. eggs in October	15.3	14.2	11.7	8.1	3.2	0.5	0.2	0.2	0.2	0.1	0.0	0.3	0.0	0.0
Average No. eggs in year	197.1	187.9	184.3	164.3	148.5	139.1	139.6	134.2	138.2	137.8	124.7	100.8	70.0	83.0

TABLE II

Percentage Of Hens Laying And Average Number Of Days Since Laying For Different Amounts Of Yellow In Ear Lobes

Per Cent Yellow.	5-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-7
No. records	41	125	80	67	62	92	94	94	108	84	44	28	9	4
Average days since laying	0.4	1.6	7.3	17.1	26.2	37.9	41.5	44.0	45.1	51.3	55.9	61.4	50.3	71.0
No. records—laying	36	98	44	17	3	0	1	0	2	0	0	0	0	0
Per cent records—laying	87.8	78.4	55.0	25.4	04.8	0	01.0	0	01.9	0	0	0	0	0

A bird laying on the day of record, or on a later day within the month, is considered to be laying and credited with a zero. If she laid on the day before the record but not later, she is credited with 'one day since laying'; and in a similar way a longer period of inactivity in laying is indicated by a larger number of days since laying. With the exception of a few cases where this was not possible, three records were taken of each bird.

"Since October is the season of decreasing egg production, the majority of the birds increased their quantum of yellow, and consequently most birds are listed in more than a single color grade. Beginning with the 41 records in the 5-10 per cent color grade, which show an average of only 0.4 days since laying, the number of days increases consistently with the amount of yellow in the ear lobes. The percentage of records that indicate actual laying drops rapidly from 87.8 per cent for 5-10 per cent yellow, to zero for grades of yellow above 30 per cent. The three cases of laying among records above 30 per cent yellow were for sporadic layers.

FIG. 98—BROWN LEGHORN
Record 210 Eggs

"The table shows that it is practically certain that a bird with an ear lobe showing more than 30 per cent yellow at the time of the records is not in a laying condition. Observations regarding the percentage of yellow in the ear lobes of 312 birds on October 20th show that in general, as the percentage of yellow increases, the egg production falls off, and that the correlation is most marked during the periods nearest the time when the records were taken. A distinct correlation with color seems to show in the yearly average but is largely an indirect one. It is generally only the best birds—those that make the large yearly records—that are laying in October. Therefore, any method that selects the laying birds at this season will select at the same time the birds laying above average throughout the year, and consequently give high yearly totals. Thirty per cent seems to be a critical amount of yellow. Above this amount comes the sudden drop in egg production for the months of September and October and also above 30 per cent yellow the yearly totals fall to between 130 and 140 with but slight change thereafter."

Nature of Yellow Pigment in Egg Yolk, Skin, and Body Fat of Fowls

It is chiefly to the investigations of Professor L. S. Palmer, of the Dairy Department, University of Missouri, that we owe such definite information as we possess in regard to the nature of the yellow pigment in the egg yolk, skin, and body fat of fowls. These investigations are briefly summarized in the following extracts from an article by Professor Palmer published in the "Journal of Biological Chemistry" (Vol. 23, No. 1).

"A physiological relation between the primary egg-yolk pigment and the xanthophylls of the feed is reasonably well established by published observations of the influence of various feeds upon the color of the yolk. Thus the Maryland Agricultural Experiment Station has carried on feeding trials of this character in which yellow corn, comprising about half the ration and fed as a scratch feed with bran, gluten meal, and meat scrap to laying hens, was compared with a ration in which the yellow corn was replaced by whole wheat, and in another case with equal parts of yellow corn and wheat. The eggs from the lot receiving yellow corn all showed yolks with a deep yellow color; those from the lot receiving corn and wheat showed yolks with a fair yellow color; while the eggs from the wheat-fed lot had yolks noticeably very pale colored. The simplest explanation of this result is found in the fact that yellow corn is very rich in xanthophyll.

"In feeding experiments conducted by the author, a gradual reduction in the amount of pigment deposited in the yolk accompanied the change from a ration carrying a moderate amount of xanthophyll (preliminary ration) to a ration carrying a very small amount of xanthophyll. In eight days the color of the yolks of the nonpigment group had become so pale that the hard-boiled yolks showed scarcely enough color to measure with a tintometer. Very little further reduction in color occurred until the bran was removed from the ration on March 16. In eight days the color had reached the lowest level attained, the tintometer reading of the raw yolk showing only 3.2 units of yellow and 1.0 unit of red. It is not probable that the color of the yolks of this lot of hens would have been reduced further. The ration still contained a small amount of xanthophyll, certainly sufficient to account for all that was deposited in the yolks when it is considered that the pigment found there represented the accumulated pigment carried in the blood through the period during which the yolk was being formed

"Very interesting results were obtained on increasing the xanthophyll in the ration in the case of the xanthophyll-fed hens. As anticipated, a considerable increase in the color of the yolks accompanied the addition of more xanthophyll. A marked increase in the color was noted on the second day after the change in ration. This was no doubt due to the fact that the greatest part of the yolk is formed during a relatively short period of time. As a matter of fact, it was observed, in the case of the highly colored yolks from the eggs laid on February 24 and 26, that it was the outer part of the yolks that was more intensely colored. The high color obtained at the beginning of the experiment did not persist, however, but a gradual reduction occurred until the level of the preliminary ration was reached. This was judged to be due to a failure to consume the scratch feed which contained by far the greater proportion of the xanthophyll of the total ration. When this was remedied by reducing the scratch feed to one-third instead of two-thirds of the ration, and increasing the amount of yellow corn in the mash by a corresponding amount (March 16), a rapid rise in the color of the yolks occurred at once, a maximum of 7.8 units of yellow and 5.1 units of red being reached on the fifth day after the change. The pronounced orange tint of the color is notable, the tintometer reading showing 5.1 units of orange and 2.7 units of yellow,—nearly twice as much orange as yellow.

"Experiments made with carotin in place of xanthophyll as the color pigment gave results in every respect

similar and nearly identical with the results from the hens fed a pigment-free ration".

Sequence of Pigmentation Changes

In Chapter III was given a brief statement of the way in which the pigmented sections of the fowl's body vary with respect to the rate at which the yellow color is removed and restored again after laying has ceased. A more comprehensive statement of the cause of the change in pigmentation, and of the sequence in which it occurs, is given in Cornell Ex. Bul. No. 21, as follows:

"The intestines and their contents, the ovary, and the oviduct decrease very decidedly in size and weight after a fowl stops laying, and yet the total weight of the hen, as records show, tends to increase. This is due to the depositing of a layer of fat nearly all over the body just underneath the skin, and of a thick mass of fat in the abdomen. A hen is able to deposit this layer of fat only when she is not forming yolks at a rapid rate, since they are composed very largely of fat. In fact, during heavy production, a fowl draws on the reserve of fat held in the body.

"Of course such a change in fat deposition could not occur without its becoming manifest externally. When a hen stops laying, fat is deposited around the pelvic bones so that they feel blunt and stiff as compared with those of a laying fowl. When a hen becomes sick and all the fat in the body is used up, the pelvic bones feel very thin and pliable. The emaciated condition alone would show that the fowl could not possibly be laying. In a healthy fowl the apparent thickness of the pelvic bones is a fair indication of production. The thicker the bones (bone and fat) the longer it is since the fowl stopped laying. The backs of the shanks fill up with fat and become firm and round after a hen has stopped laying for some time. The face fills out and the back parts of the wattles drop down, giving the face a full, coarse, masculine appearance, and the top line of the wattles is more nearly perpendicular to the line of the eye and beak.

"These changes in fat have a direct bearing upon changes in color or pigmentation, but fortunately, while it takes several weeks for sufficient fat to accumulate to be apparent, in the yellow-skinned breeds the yellow pigment that accompanies the fat is noticeable when only a small amount of fat is deposited or withdrawn. A heavy-laying hen is pure or nearly pure red in comb and face, and flesh color in beak and eye ring, while a hen that is not laying is distinctly yellow in beak and eye ring, while the red of face and comb has a yellow cast. The rate at which yellow pigment disappears from any section depends mainly on the rapidity or amount of the circulation through the part affected, the nature of the food supply, and the amount of fat stored within the section.

How to Apply Pigmentation Tests in Culling

"If the hens are given an abundance of green feed or yellow corn, the yellow pigment will color highly any fat that is in the body, so that only a little fat is needed to become apparent. Consequently, hens on good grass range do not bleach out nearly so quickly as those that are confined to bare yards and are not given green feed. The heavy breeds, because of their coarseness, carry much larger supplies of fat, and hence do not bleach out so quickly as the light breeds. This difference is especially noticeable in the shanks. In considering color changes it should be borne in mind that they indicate what a fowl has done, not what it will do.

"While all the color characters so far described are applicable to all yellow-skinned breeds, Leghorns and Anconas show a change in the color of their ear lobes also. The color of the ear lobes does not change so quickly as that of the vent or the eye ring, and does not have such universal application, but because of its prominence it is of considerable value in selecting Leghorns."

FIG. 99—SCENE ON COMMERCIAL POULTRY PLANT AT PETALUMA, CALIF

Even a small percentage of poor layers in a flock of this size means a serious financial loss annually to the owner. Systematic culling will make a great difference in the net profits realized.

The Physiological Relation Between Fecundity and the Natural Yellow Pigmentation of Certain Breeds of Fowls

This Article Gives the Results of Some Recent, Highly Interesting Investigations Which Afford a New Explanation for the Well-known Fact That the Natural Yellow Color of Skin, Beaks, Shanks, Etc., of Leghorns and Other Yellow-skinned Fowls Fades Out as a Result of Heavy Egg Production

By Prof. L. S. PALMER and Prof. H. L. KEMPSTER

EDITORIAL NOTE:—During the last few years Professor L. S. Palmer of the Dairy Chemistry Laboratory, University of Missouri, assisted by Professor H. L. Kempster, Head of the Poultry Department of the same institution, has investigated various questions relating to yellow pigment in fowls, doing so with painstaking care and thoroughness. Important data secured in the course of these investigations have been published under the above title in the "Journal of Biological Chemistry", Vol. 39, No. 2 (Sept. 1919), of which the following article is an abstract. In this article the authors express their opinion that the common explanations of why the vent, ear lobe, beak, and shanks of yellow-skinned fowls fade when heavy laying occurs are unsatisfactory, and advance a new theory which will appeal to many as offering a reasonable explanation for some known facts that do not appear to harmonize with the common explanation of the way in which pigmentation changes take place.

PRACTICAL poultrymen have recognized for several years that a close relation exists between the amount of yellow pigment in the shanks, ear lobes, beak, etc., of hens of certain breeds of poultry. Data collected at various Experiment Stations, especially at Storrs Agricultural Experiment Station, show that in hens which naturally carry yellow pigmentation a positive correlation exists between pale shanks, ear lobes, beak, etc., and a more or less heavy egg production. The results show however, that use of this observation as a practical guide in the selection of heavy and light-laying hens must be made only immediately after the close of the laying season.

The hypothesis which has been advanced and adopted by Blakeslee and Warner in explanation of the relationship which has been observed between fecundity and pigmentation is that the growth of the egg abstracts the pigments from the body tissue with the resulting negative correlation between egg production and the quantity of yellow pigment present in ear lobes, shanks, beak, etc.

The theory here advanced is that the fading of the yellow pigmentation in the visible skin parts as a result of fecundity is not due to the subtraction of pigmented fat from these parts and the subsequent incorporation in the egg yolk, but that the normal appearance of xanthophyll (yellow pigment) in the beak, shanks, etc., of yellow-skinned breeds is the result of a natural excretion. Fecundity merely deflects this path of secretion to the egg yolk, thereby removing the source of pigment to the visible parts of the fowl. The result is that the pigment present in the skin at the onset of fecundity is gradually excreted towards the epidermis where it either becomes oxidized (decolorized) or wears away as the result of structural changes of the epidermis.

In support of this theory two full-grown White Leghorn cockerels which had been grown on a carotinoid-free* (colorless) ration, and which as a result showed complete absence of pigment in the skin, etc., were fattened on a colorless ration. The birds were then fed a ration containing a large proportion of yellow corn. Within 72 hours yellow color began to appear and on the fifth day the shanks and beak began to show a yellow color. The following day it was plainly visible in the ear lobes, eye ring, etc. On the eighth day one of the birds was killed and an abundance of pigment was found in the blood serum, Malphigian layer of the epidermis, beak, ear lobes, comb, and shank. The remaining bird was fed on a yellow corn diet for 42 days, and by this time not only were the shanks, beak, ear lobes, etc., highly colored but his plumage also had a distinctly creamy, almost yellow appearance.

This bird and four other highly colored cockerels were then put on a carotinoid-free (pigmentless) ration, and killed at various intervals. After 60 days it was no longer possible to detect yellow color in the ear lobes. The comb, when pressed, failed to show any yellow appearance; the base of the beak was distinctly lighter in color than the tip, and the shanks also had begun to show a noticeable fading. The feathers which had been smoothly creamy were now mixed with white and yellow feathers. The bases of the feathers were colorless. The blood serum was free from xanthophyll, although the adipose tissue was distinctly yellow. Ninety days after the change to a colorless ration, the beak, ear lobes, comb, skin, eye ring, and vent of the birds were entirely colorless, and a marked decolorization of the shanks had taken place. After 200 days no pigment remained in the shanks except that deposited under the thick horny layer on the sides of the leg. If these birds had thinner shank skins like the females of this breed they would have been, no doubt, entirely colorless by this time.

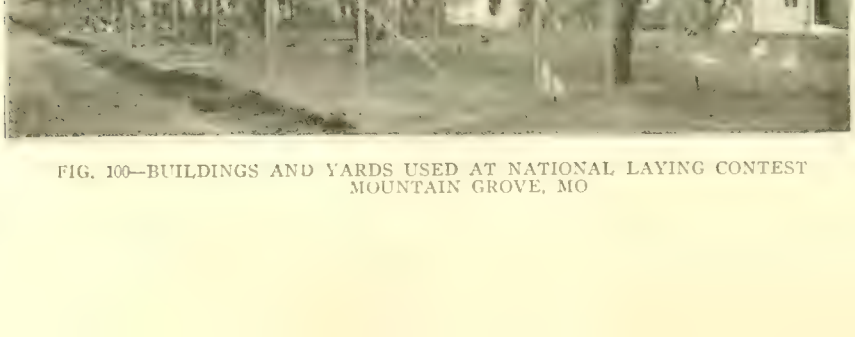


FIG. 100—BUILDINGS AND YARDS USED AT NATIONAL LAYING CONTEST MOUNTAIN GROVE, MO

*(To guard against confusion on the part of the reader it should be explained that "carotinoid" is a general term including both carotin and xanthophyll (the pigment in egg yolk), as well as carotin which enters but slightly into pigmentation in fowls. The carotinoid-free ration described in this article is, therefore, one that contains NEITHER xanthophyll nor carotin.--Ed.)

Microscopic examination of vertical sections of the skin taken from the bottom of the foot showed that the yellow pigment is deposited in the outer parts of the epidermis and especially in the rete of the Malphigi largely as granular masses. These granular masses are also seen lining the blood capillaries in the lower corium layer. Fat is found in the subcutaneous layers. There is almost complete absence of fat in the epidermis. The fact that the pigment found in the epidermis took a distinct color stain which does not occur if fat is present shows that the yellow pigment of the epidermis is not dissolved in fat.

That the color of the shanks is not due to the pigment of the fat was also shown by the feeding of Sudan III to a bird raised on a colorless ration. After 8 days of feeding Sudan III no trace of the dye was found in the shanks, skin, ear lobes, beak, etc., although the bird showed an abundance of pink color in the fat.

As the xanthophyll gradually faded from the shank skin, microscopic observations showed first a disappearance of the pigment from the corium, then from the outer layer of the epidermis which gradually extended to the rete of Malphigi, the last pigment to disappear being the xanthophyll at the base of the Malphigian layer.

The interpretation of the observations is that when the supply of xanthophyll is cut off by reason of its removal from the food, any pigment present in the corium layer of the shanks, etc., is normally deposited in the rete of the Malphigi. At the same time the xanthophyll deposits in the outer layer of the epidermis either wear off by normal replacement of the outer cells by those lower down, or is oxidized (decolorized) by contact with the air. The xanthophyll deposits in the rete of the Malphigi gradually become a part of the outer layer of the epidermis, and are lost also, until the skin becomes free from visible yellow pigment.

FIG. 101—A WHITE ROCK HEN WITH RECORD OF 281 EGGS IN 12 MONTHS

According to the hypothesis advanced, if fecundity deflects the path of excretion of the xanthophyll from the skin to the ovaries, and thereby removes the supply of yellow pigment from the shanks, etc., it is to be expected that no restoration of the xanthophyll in these parts can be effected as long as fecundity continues. As proof of this theory hens which were laying and had been fed since hatching on a xanthophyll-free ration, were fed rations which were rich in xanthophyll. After 30 days' feeding of yellow corn in one case and green food in another the yolks were highly colored. No pigment whatever was deposited in the ear lobes, beak, shanks, etc. It was also found that the adipose tissue was also practically colorless, a further proof that fecundity deflects the path of excretion of xanthophyll to the ovaries.

Shank, Beak, and Ear Lobe Color as a Criterion of Fecundity

Absence of color in the shanks, etc., at the end of a laying period is indicative of a recent long period of fecundity. This is true whether this results in the laying of a large or a small number of eggs. Two birds selected at random from the University flocks were examined. One showed no color in the beak, eye ring, or ear lobes, and very little in the shanks. The fat also showed 12 per cent yellow color. The other showed yellow color in the beak, shanks, etc., while the fat contained 47 per cent of yellow. Both were laying and the egg yolks were the same color. An examination of the egg records showed that the "colorless" bird had laid 134 eggs against 131 for the "yellow". The explanation of these apparent inconsistencies is readily seen when one compares the trap-nest records. Hen 2754, the yellow-shanked bird, did not lay from July 17 to September 29, while the other bird, 2854, had stopped laying for a shorter period—July 25 to August 25. The difference in appearance October 28 was not due to a wide difference in egg production but because 2754 lost her fecundity for a sufficiently long period to restore the normal path of excretion to the shanks, etc., and had thus regained her skin pigmentation. Hen 2854 lost her fecundity for a short time, or not at all, so that she went into October and up to the time she was killed, with pale shanks, etc., which had resulted from a deflection of pigment from these parts during continuous fecundity since February 13.

Absence of pigmentation is therefore, an index of continuous fecundity rather than of heavy laying.

Conclusions

1. The fading of the yellow pigment from the ear lobes, beak, shanks, etc., of hens of the Leghorn and American breeds during fecundity is due to the fact that fecundity deflects the normal path of excretion of the xanthophyll from these parts of the skin to the egg yolk.

The xanthophyll deposited in the epidermis of the above mentioned parts gradually disappears as the result of the natural physiological change in the structure of the skin.

The thicker the epidermis, the more slowly will the xanthophyll disappear.

2. The xanthophyll in the epidermis of the ear lobes, beaks, shanks, etc., of Leghorn and American breeds of fowls, is largely in granular form with little or no fat associated with it. It is found chiefly in the rete of Malphigi but also along the blood capillaries of the subcutaneous tissue.

3. It is impossible to restore xanthophyll to the skin of hens as long as fecundity exists, no matter how large an excess of pigment is fed.

4. Adipose tissue also fails to take up the xanthophyll from the food during egg laying even on rations

rich in xanthophyll, the pigment being excreted wholly in the egg yolks.

5. The fading of the ear lobes, beak, and shanks of the Leghorn and American breeds of hens as the result of egg laying is an index of **continuous fecundity** only,—not of heavy egg laying.

6. Yellow color in these parts, immediately after the end of the laying season, indicates either intermittent fecundity or a more or less recent loss of fecundity.

Accuracy of Pigmentation Tests

There is a good deal of variation in the accuracy of reported pigmentation tests, apparently depending in some instances upon the skill of the operator, and in others on the season at which the test is applied. As a rule, pigment tests are apt to be somewhat misleading if applied too early in the season, and general opinion favors making the tests in September and October. Storrs Bulletin No. 92 states that "records taken in July, September, and October indicate that October, at the end of the pullet year, is in general the best time in which to use the color test in selecting superior layers."

In all culling operations, allowance must be made for natural differences in pigmentation in individual fowls. Some hens inherit much lighter colored shanks, beak, etc., than others, and hens regularly carry less color than they did as pullets. The ration, and even the soil on which the fowls are yarded, also has a great deal to do with the degree of color normally present. Where this fact receives due consideration, pigment tests have been found to be quite satisfactory.

Because of the different sections affected and their variations in rate of loss and recovery of pigment, such tests afford a variety of combinations that offer exceptional opportunities for close estimates on production. The inexperienced however, are apt to be confused by the way in which different degrees of yellow merge into one another, and even expert demonstrators always employ other tests as checks on their conclusions.

No matter how clear cut the pigment tests may appear, head points, body capacity, condition, plumage, etc., should always be considered, particularly with fowls of the general-purpose breeds, or where details in regard to feeding and general care are not known.

The Missouri State Poultry Experiment Station is conducting an interesting test during the current year (1919-1920), comparing the production of twenty "low producer" hens culled from farm flocks by comparatively inexperienced operators, with that of an equal number of hens from the same flocks, selected as good layers. This test began September 15th, and at the end of the fifth month (February 15th) the total production of the selected layers was 669 eggs as against 437 from the culls. This comparatively high showing for the "cull" flock is due to the fact that included in the number are a few individuals that are much better layers than some that were in the "layer" flock.

In a personal letter to the editors of this book, Herbert E. Cosby, Extension Poultry Specialist, in charge of this test, makes the following statement: "The forty hens in this test afford an interesting study. Two hens, in particular, were sent in as decided culls. They were quite yellow in beak, vent, and shanks, and the pubic bones were close together. For this reason they were culled out in September, the operator failing to observe that these hens had thin, straight pubic bones, good body depth, bright eyes, and, above all, old plumage. I believe that possibly five of the twenty "cull" hens will prove to be good layers.

"To often people cull their flocks and, after keeping the culls a few days and getting no eggs, conclude that they have certainly identified the poor producers, and dispose of them as such, failing to correlate all the principles of culling and failing also to take into consideration the fact that probably many of these hens were not in condition to be culled at the time they were examined."

Pigment tests are most reliable when applied to extremes—that is, hens that are characterized by bright yellow vent, eye ring, beak, and shanks, are reasonably certain to be nonlayers, whether observed in June or October. Similarly, those hens that at any time are quite noticeably faded out in these sections are almost certainly laying heavily. Whether such should be classed as high producers however, will be determined to some extent by the season of the year in which the observations are taken. For example, if a flock is scored for production during June, the observer is apt to include among the good layers many hens that have laid only during the natural season and whose total or yearly production is quite small. Later in the season, or from August to October, these poor layers are rarely productive, and only the best layers in the flock are laying at this time, consequently, if the birds are scored for productiveness then, those that are thoroughly bleached out, showing that they are still laying, will be found to be the most persistent producers in the flock, and hence the ones that have the largest egg yields to their credit.

FIG. 102—PARTIAL VIEW OF BUILDINGS AND YARDS AT VINELAND EGG LAYING CONTEST

As an illustration of the degree of accuracy realized at different seasons in pigment tests, also of the relative value of color tests as applied to vent, beak, and shanks, the following data from Circular 197 of the California Experiment Station are given:

"These tables which were compiled from observations made during the spring and summer of 1917 upon trap nested S. C. White Leghorns of different ages as they would be found in a typical flock, show in detail how yellow-color observations compare with actual trap-nest records. The trap-nest records are for the year ending August 31, 1917, which represents about the normal laying year from molt to molt. While these tables indicate considerable inaccuracy in color observations as compared with actual trap-nest performance, especially as regards the medium and poor layers, the general trend of the results secured is such as to warrant a reasonable measure of dependence on such observations in culling and grading for egg production.

"A study of this table would indicate that May is perhaps somewhat early and September a little late in this section of the country to secure best results from the use of yellow-color indications for culling. This is probably due to the fact that the fowls do not lay enough eggs before June to affect sufficiently the yellowness of their shanks; and by September, many of the poor layers whose production approaches the line of separation between the culls and the profit-earning hens, have already begun to slow down rapidly in their laying. The average production of the pale birds however, is so uniformly high in the June, July, and September observations as to show that the better layers may be picked out with considerable accuracy during these months."

TABLE

Showing How Yellow-Color Observations Made On S. C. White Leghorn Hens Of Varied Ages Compare With Their Average Trap-nest Records For The Laying Year Ending August 31, 1917.

Date observed	Shade of color	Shanks No. hens	Shanks Aver. eggs	Beak No. hens	Beak Aver eggs	Vent No. hens	Vent Aver. eggs	Shanks and Beak No. hens	Shanks and Beak Aver. eggs	Shanks and Vent No. hens	Shanks and Vent Aver. eggs	Total Total hens	Total Total eggs
	(Pale	290	147.2	294	140.8	401	148.7	240	153.6	272	153.1	1,497	150.7
5-17-17	(Medium	163	148.5	136	150.3	73	145.2	85	149.4	42	150.2	499	148.7
	(Yellow	65	132.8	78	134.4	40	135.9	48	131.5	35	130.6	266	133.0
	(Pale	364	157.4	370	158.1	394	157.3	354	158.7	354	157.4	1,836	157.8
6-30-17	(Medium	36	132.5	27	123.5	7	113.1	15	116.2	...	.....	85	121.3
	(Yellow	8	112.7	8	121.7	..	.....	6	118.0	...	.....	22	117.5
	(Pale	202	161.5	196	164	207	162.8	195	164.3	198	162.9	998	163.1
7-20-17	(Medium	9	139.2	11	150.3	3	116.3	6	145.8	...	.....	29	137.9
	(Yellow	5	122.5	7	105.5	5	113.2	4	113.2	3	151	24	121.1
	Pale	305	158.4	271	162.2	271	161.9	262	162.4	273	161.8	1,382	161.3
9-12-1	Medium	74	135.8	53	136.0	56	143.6	29	122.2	34	135.4	246	134.6
	Yellow	84	127.4	105	139.2	64	138.3	71	135.7	54	134.1	378	135.0

Pigmentation Changes Shown in Color Plates

On pages 5 to 8 of this book are presented a number of color plates illustrating pigmentation changes which indicate different stages in egg production. These plates were prepared, having in mind the directions already given, both in this chapter and in Chapter III, for making pigment tests, and should be carefully studied in order clearly to understand the changes that take place, and their practical significance. In the footnotes under the plates, also in the fuller description of them given on page 9, are estimates of the exact length of laying period, as determined by amount of pigment present. It should be understood that these estimates represent general averages. In practice there will be rather wide variations from these estimates occasioned by breeding, rations fed, age of fowls, yarding conditions, etc.

Leghorn hens in confinement, and given a ration limited in pigment will lose their yellow color in all sections at a much more rapid rate than will fowls of the larger breeds. It has been found at Cornell that with Leghorns in close confinement, the fading of the skin around the vent progresses far enough to be distinctly noticeable by the time the first egg is laid. Bearing in mind the fact that it requires in the neighborhood of two weeks for the complete development of an egg yolk, and remembering the explanation of Professors Palmer and Kempster to the effect that activity in the oviduct promptly diverts the course of excretion of pigment from the skin to the ovary, it will readily be seen how this may occur. Under extreme conditions a few days of laying are sufficient to bleach out the eye ring, ear lobe, and the base of the beak, and the entire beak may become free from pigment in much less time than the estimates given in connection with these color plates. With fowls of larger breeds and with Leghorns on range, the estimates given will be found to be fairly accurate.

Summary

The yellow color of skin, beaks, and shanks, in fowls of the yellow-skinned breeds, is due to the presence of xanthophyll, a pigment common in certain poultry feeds.

Egg production causes a rapid fading out of this pigment, leaving the naturally yellow section white or pinkish white in color.

Carotin (the yellow pigment in carrots, butter, etc.) has practically no influence on yolk or skin color.

Rate at which pigment disappears from any section depends upon the ration, the amount of fat stored up, and the rapidity of blood circulation.

Hens on grass range do not bleach out as rapidly as hens in confinement.

The skin around the vent is first to lose its color, followed in turn by eye ring, ear lobe, lower mandible, upper mandible, and shanks.

Yellow color comes back after laying ceases in the same order in which it went out, but more rapidly.

According to some observers, yellow pigment is excreted through the skin in the case of nonlayers, but is promptly diverted to the ovary when this is active.

Experiments indicate that no yellow pigment will be deposited in skin, shanks, etc., as long as the fowl is laying, regardless of how much may be in the ration.

Absence of yellow in naturally yellow-skinned fowls indicates a long laying period, but not necessarily the laying of a large number of eggs.

Accuracy of pigment tests depends upon skill of operator and on the season.

Pigment tests in the fall are more apt to be accurate than in summer, but are fairly accurate for extremes at any season.

CHAPTER IX

How Egg Production Is Affected by Cycle and Rhythm, Rest Period, Broodiness, Weight, Etc.

Many Apparently Unimportant Characters are Closely Correlated With Productiveness in Fowls—Meaning of Rhythm and Cycle, and How These May Indicate Future Production—How the Summer Rest Period and Weight of Fowls Limit the Number of Eggs Produced—Method of Estimating Production by Weight of Eggs Laid

THERE are various characters or peculiarities in egg production that have a more or less direct bearing upon the number of eggs laid by fowls, and some perhaps that are as helpful in estimating their productiveness as are pigment, pelvic arch, and capacity tests. Usually they require an exact knowledge of individual performance for a longer or shorter period, such as is afforded by trap-nest records. While not, therefore, practicable for the use of the average poultry keeper, some of these tests are highly interesting and valuable, even though some still are in the experimental stage.

The cycle and rhythm in which the individual fowl produces eggs is an especially valuable index to her fecundity. By cycle, as the word is commonly used, is meant the number of consecutive days during which a hen lays without missing a day, while "rhythm" means the regularity and the promptness with which the cycles are repeated. In order to observe cycle and rhythm, trap nests are necessary, or daily physical tests as described in Chapter VII.

In every flock the hens with the poorest cycles and rhythm will almost invariably be the poorest layers, but the exact character of their cycles and rhythm, perhaps even the fowls' relative standing as producers, will be determined quite largely by whether or not conditions are reasonably favorable, not only for the flock as a whole, but for individual requirements. Many fowls, because of timidity or lack of adaptability to the ration regularly fed, never get a chance to develop cycles and rhythm that fairly represent them. This really has no practical bearing upon the matter, however. The mere fact that they are not able to function normally under conditions that permit other fowls to do so is a good-enough reason for discarding them.

Professor H. R. Lewis of the N. J. Experiment Station, having the trap-nested pens of the Vineland Egg Laying Contest under his supervision, is in an exceptionally favorable position for studying cycle and rhythm. His method of utilizing these in estimating production is described in the following article:

Observations on Cycle and Rhythm at the New Jersey Experiment Station

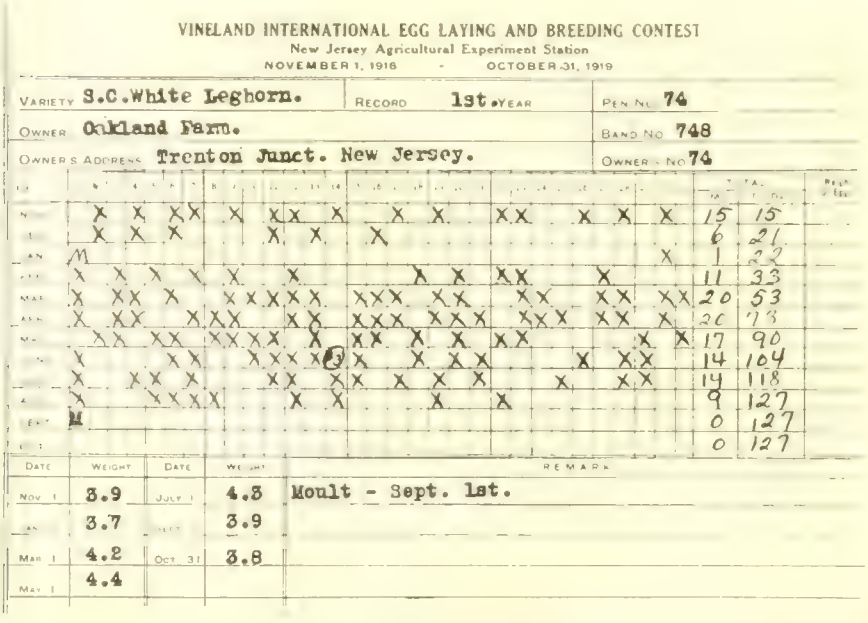
The Well-known Differences in Egg Records Made by Hens Are Largely Due to Distinct Variations in Their Inherent Ability as Producers—This Ability Appears to Be Indicated by the Cycle and Rhythm in Which Eggs Are Laid

By PROF. H. R. LEWIS

WE have had an exceptionally good opportunity to study the relation of cycle and rhythm to egg production through the records secured at the Vineland contest, and have come to attach quite a good deal of importance to this.

By cycle is meant the number of eggs which a bird lays successively without a skip. Hens have two-egg cycles, three-egg cycles, and longer. Leghorns generally lay with a very regular rhythm, but short cycles frequently repeated. The American breeds generally have longer cycles with longer rest periods.

By rhythm is meant the frequency or order in which the cycles are repeated. For example, in November and December, as the pullets start to lay, we find one which lays one egg and skips a day, one egg and skips, repeating this performance regularly. We may say that she is a 50 per cent producer. On the other hand, if we find a hen which lays three eggs, skips a day, three eggs, skips a day, and repeats this cycle and rhythm with great regularity, we may say this hen is a 75 per cent producer, and far superior as a winter layer to the 50 per cent bird. Again we frequently find hens which lay an egg and skip two or three days, lay



VINELAND INTERNATIONAL EGG LAYING AND BREEDING CONTEST
New Jersey Agricultural Experiment Station
NOVEMBER 1, 1918 - OCTOBER 31, 1919

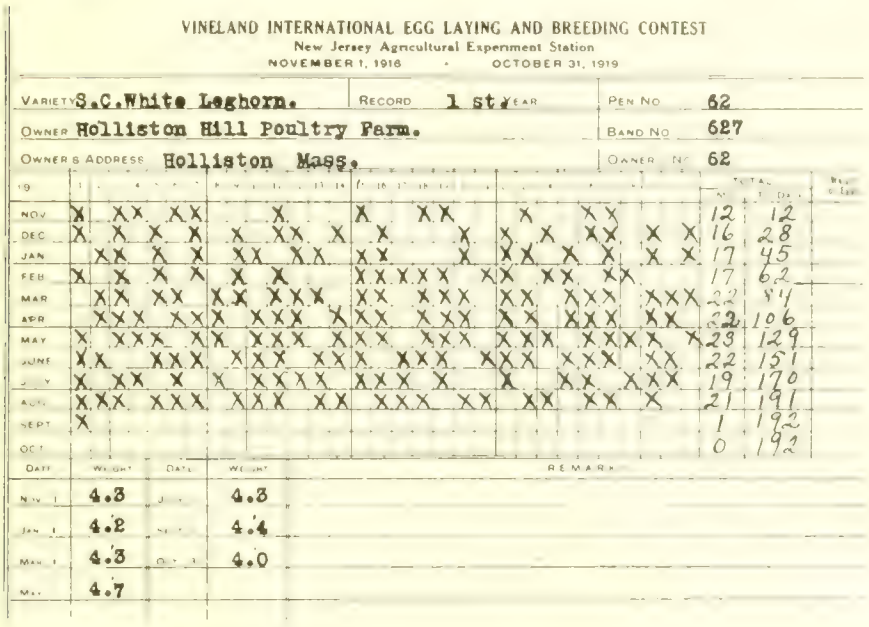
VARIETY S.C.White Leghorn. RECORD 1st YEAR PEN No. 74
OWNER Oakland Farm. BAND No. 748
OWNER'S ADDRESS Trenton Junct. New Jersey. OWNER No. 74

DATE	WEIGHT	DATE	WEIGHT	REMARKS
Nov. 1	3.9	July 1	4.3	Moult - Sept. 1st.
"	3.7	"	3.9	
Mar. 1	4.2	Oct. 31	3.8	
May 1	4.4			

FIG. 103—EGG RECORD OF A HEN WITH POOR CYCLES
Courtesy of the New Jersey Experiment Station.

another egg and skip three days. Such birds are only 25 per cent producers, and are very poor specimens to keep for sustained production. We are convinced that the trapping of pullets in their laying year and the determination of their cycle and rhythm is one of the best methods by which we can foretell, in a practical way, the probable future production of the individual being studied.

By way of illustrating cycle and rhythm, the daily egg records of three contest hens are reproduced in Figures 103, 104, and 105 which show clearly the way in which cycle and rhythm may be used as a measure of production.


VINELAND INTERNATIONAL EGG LAYING AND BREEDING CONTEST
New Jersey Agricultural Experiment Station
NOVEMBER 1, 1918 · OCTOBER 31, 1919

VARIETY S.C.White Leghorn. RECORD 1 st YEAR PEN NO 62
OWNER Hollisten Hill Poultry Farm. BAND NO 627
OWNER'S ADDRESS Hollisten Mass. OWNER NO 62

19	TOTAL No.	TOTAL Dz.
NOV	12	12
DEC	16	28
JAN	17	45
FEB	17	62
MAR	22	84
APR	22	106
MAY	23	129
JUNE	22	151
JULY	19	170
AUG.	21	191
SEPT	1	192
OCT	0	192

DATE	WEIGHT	DATE	WEIGHT	REMARK
NOV 1	4.3	JULY 1	4.3	
JAN 1	4.2	SEPT 1	4.4	
MAR 1	4.3	OCT 31	4.0	
MAY	4.7			

FIG. 104—EGG RECORD OF A LAYING HEN WITH GOOD CYCLES
Courtesy of the New Jersey Experiment Station.

Fig. 103 shows a bird with very poor winter production and with no tendency toward development of cycle and rhythm. In the natural laying season, or from March to April, she attained a fairly good production, though showing an undesirable and ununiform production.

Fig. 104 shows a better hen, one which early indicated a tendency to produce an egg every other day through the winter, and which, in the spring, maintained a fairly sustained cycle and rhythm, laying three eggs and skipping one day with a good degree of uniformity.

Fig. 105 shows an exceptionally fine example of pullet development with a good laying cycle and uniform rhythm. It will be noted that this hen started in November, regularly laying three or four eggs with only a skip of one day, and maintained this with great uniformity throughout the year, increasing the length of the cycle during the heavy producing season, or in March and April, dropping back again toward the four-egg cycle in June and July. Birds which develop such long and pronounced cycles in the winter of their pullet laying year are almost without exception remarkable producers.

On the Rhythm of Egg Production

Hens, Particularly if Good Layers, Tend to Produce Eggs According to a More or Less Regular Schedule as to Time of Day—Rhythm Appears to Be Independent of Egg Formation

BY DR. H. D. GOODALE*

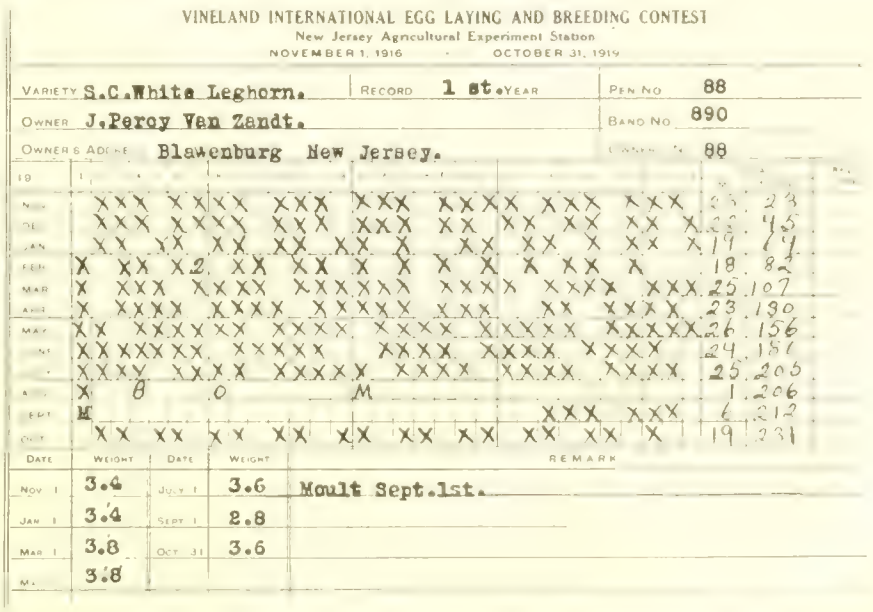
EDITORIAL NOTE—The author of this article was one of the first to note the rhythmic nature of egg production, and his observations here recorded shed much light on this subject. To avoid possible confusion, it may be well to explain that the term "rhythm" is not here used in quite the same sense as in the article by Prof. Lewis. There is, however, no contradiction between the two. Dr. Goodale recognizes a "daily rhythm" and larger "superimposed rhythm". In Professor Lewis' article, and in common usage, the "daily rhythm" now is called "cycle", "rhythm" being used to indicate the rate of repetition of "cycles", or the "superimposed rhythm" as here described by Dr. Goodale.

THE term rhythm of egg production is used rather than rate, in order to emphasize the rhythmical character of egg extrusion. Although true that the observed rhythm is by no means regular, still each hen often tends to produce eggs according to a fairly characteristic rhythm. Superimposed on the daily rhythm are evidences of other rhythms having a beat measured by months or years. Of course, from another standpoint, egg production is a more or less continuous process.

Rhythm as Shown by Time of Day the Egg Is Laid

The time of day at which the eggs have been collected from the trap nests has been recorded at half-hour inter-

*Journal of American Association of Instructors and Investigators in Poultry Husbandry, Vol. 1, No. 3.


VINELAND INTERNATIONAL EGG LAYING AND BREEDING CONTEST
New Jersey Agricultural Experiment Station
NOVEMBER 1, 1916 · OCTOBER 31, 1919

VARIETY S.C.White Leghorn. RECORD 1 st YEAR PEN NO 88
OWNER J.Percy Van Zandt. BAND NO 890
OWNER'S ADDRESS Blawenburg New Jersey. OWNER NO 88

19	TOTAL No.	TOTAL Dz.
NOV	23	23
DEC	22	45
JAN	17	62
FEB	18	80
MAR	25	105
APR	23	128
MAY	26	154
JUNE	24	178
JULY	25	203
AUG.	1	204
SEPT	6	210
OCT	19	229

DATE	WEIGHT	DATE	WEIGHT	REMARK
NOV 1	3.4	JULY 1	3.6	Moult Sept.1st.
JAN 1	3.4	SEPT 1	2.8	
MAR 1	3.8	OCT 31	3.6	
MAY	3.8			

FIG. 105—GOOD CYCLES WITH FREQUENT AND UNIFORM RHYTHM
Courtesy of the New Jersey Experiment Station

vals, and as they are collected at least every hour and a half, the time when collected represents approximately the time when the egg was dropped. This data has not yet been reduced, but some interesting facts are easily observed on inspection.

Most hens lay for a period of several days and then skip one. The first day of a series the hen lays early in the morning. The time she lays the next day depends largely on the character of her particular rhythm. If the rhythm is such that she lays only every other day, she usually lays about the same time each day, i. e. 10, 0, 11, 0, 10, 0, 11. If she lays two days out of three, the first egg is laid during the morning and the second during the afternoon, i. e. 10, 3, 0, 10, 2, 0, 9, 1, 5, 0. As

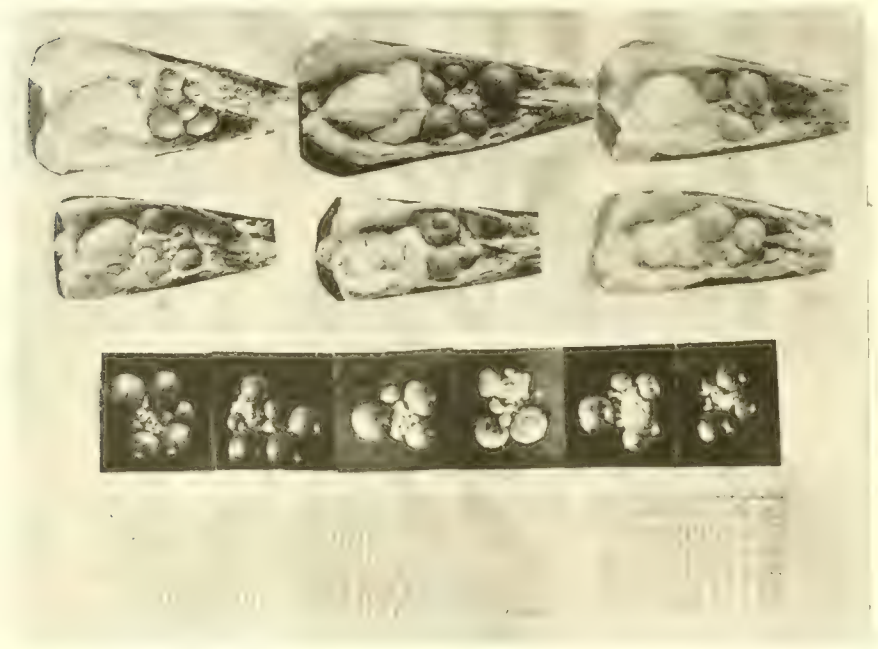


FIG. 10b—HOW CYCLES AND RHYTHM ARE PRODUCED

This illustration shows the egg organs, the ovaries removed, and 60-day records of six hens. Hen No. 1 had cycles of good length (as is shown by her daily record) and good rhythm. Hen No. 6 had neither good cycles nor rhythm. Hen No. 3 had good cycles but with a poor rhythm, while hens Nos. 4 and 5 had good rhythm but poor cycles. Hen No. 2, while a good producer, was irregular in both cycles and rhythm. The varying number of yolks in the ovaries and the different stages of their development explain the cause of variations in cycle and rhythm. Photo from Dr. C. T. Patterson.

the period lengthens, the number laid in the morning increases until the larger proportion are laid before noon. Thus: 8, 9, 10, 10, 10, 10, 9, 10, 9, 5, 11, 11, 5, 11, 11, 2, 2, 4, 0. There is, however, much variation.

Types of Rhythm

As a working basis, we may assume an egg a day as a standard rhythm, and, although this rhythm is rarely reached for extended periods, we may refer the observed rhythm to it. Some hens lay every other day or, we may say, a 1-2 rhythm, others 2-3, i. e. 2 days out of 3, others 3-4, and so on. Occasionally the series may be repeated without the intervention of a zero day.

None of these types are characteristic of any one hen. Many individuals, however, seem to center about a particular rhythm, e. g. 2-3. While these individuals may fall to the 1-2 type, they do not often, except in the spring, exceed the 3-4 type. While little stress can be laid on this point, it is interesting to note this tendency particularly in certain individuals.

Rhythm and High Egg Production

Pearl found on the basis of winter egg production that his birds fell into three classes, viz., high, mediocre, and zero producers. The dividing line between the high and mediocre producers came at about 30 eggs. Our statistics are in essential agreement with this statement. Observation, however, shows great variation in the number of eggs laid by birds in the over-30 class. Broodiness, age, and time at which laying commences in the fall all influence the number of eggs laid. But aside from these factors, birds of the same age, beginning to lay at approximately the same time, and which do not become broody, do not lay at the same rate.

Here are two full sisters, hatched the same day, one of which, after making due allowance for the advantage gained by a two weeks' start of the better bird, laid 43 against 69. The records show that one bird laid only about every other day, while the second laid about 5 days out of 6. The rhythm, then, is an important factor in determining the absolute number of eggs laid.

Rhythm and High Egg Production

The curve of the winter egg production of our flock does not slope evenly to the base line, but forms a shoulder at 70-80 eggs. This shoulder I take to be an indication, from a genetic standpoint, of a group of individuals differing genotypically in their capacity for egg production from the remainder of the high class. The existence of this group must be due in part to the high frequency pullets. Various causes may interfere with the normal rhythm, such as environment, season, method of management, and internal factors, as broodiness. The inheritance of egg rhythm is a subject on which we have little data. Full sisters, however, may lay at different rates so that if rhythm is inherited it indicates segregation.

Rhythm Independent of Formation and Growth of an Egg

One of the most interesting things in connection with the rhythm of egg production as observed by Pearl is the existence of hens which never lay an egg, but which visit the nests according to a definite rythm. We are able to add to this record for we find the hours of such visits fall into the same sort of rhythm as normal hens. These facts point strongly to the existence of some mechanism other than the formation and deposition of an egg which controls the extrusion of the egg. It is interesting to note that if one of these hens is removed from the nest before she is ready to leave, she returns and persists in doing so until, shall we say, she thinks she has laid her egg.

Laying hens often visit the nest at the proper day and hour, but fail to lay. Such hens usually lay the day previous and the day after in regular routine, though at times they may pay two or more such nonproductive visits in succession. One hen laid well during the winter, and then stopped producing eggs although continuing

to visit the nest in about the same rhythm as when laying. (In Chapter XVI the reader will find a physiological explanation of how the foregoing may occur.—Ed.)

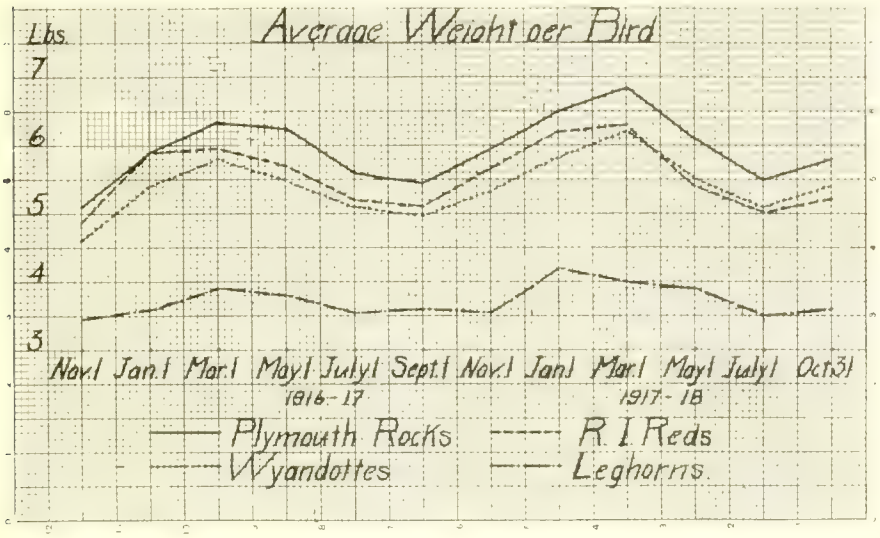


FIG. 107—AVERAGE WEIGHT OF FOWLS OF DIFFERENT BREEDS AS ENTERED IN THE VINELAND EGG LAYING AND BREEDING CONTEST

As explained in this chapter, fowls of approximately standard weight for the breed lay better than those that are noticeably above or below that weight. This graph shows the average monthly weight of the Leghorns, Rhode Island Reds, Wyandottes, and Plymouth Rocks entered in the New Jersey Contest. Courtesy of the New Jersey Experiment Station.

The Rest Period in Relation to Egg Production

There Is a Distinct Correlation Between the Length of the Average Hen's Summer Rest Period and the Number of Eggs Produced by Her During Year—Body Weight and Broodiness Also Are Important Factors

BY PROFESSOR H. R. LEWIS

WITH the exception of extremely high producers, practically all layers have periods of nonproductiveness of greater or less length, commonly called the "rest period". The average bird molts a part or all of her feathers during these periods. The frequency and the duration of these vary greatly with individual fowls, and in order to determine whether there is any correlation between the length of the rest period and egg production, a careful study was made of the short-time periods in the Vineland Egg Laying and Breeding Contest with reference to this character. A particular object in doing this was to determine just what would be the loss as regards total egg production, if the birds that took a summer vacation were disposed of on the basis of that test but that, if retained in the flock, would have come back into laying again later in the season. In other words, this study was with special reference to the probable losses due to early culling.

The correlation table shown on this page indicates quite clearly that there is a positive and clear-cut correlation between the shortness of the rest period and the number of eggs laid. Leghorns only are represented in this table (Fig. 108), but data at hand show the same correlation existing in the production of heavy breeds.

In studying the table, it will be noted that out of a total population of 532 birds, 347 laid over 150 eggs and rested only from 1 to 70 days, while out of 120 birds which rested longer than 70 days only 30 laid over 150 eggs. Out of 422 birds which rested from 1 to 70 days (a comparatively short rest) there were only 75 which did not lay over 150 eggs. A curve drawn over the correlation table would show that as the days of rest decrease the number of eggs increases. It will be noted that every bird which rested more than 130 days, with the exception of only one individual, did not lay over 150 eggs. So it may be said that the number of eggs laid by a hen in a year is in definite direct proportion to the length of her rest period during the summer. It is also an assured fact that the earlier a hen starts to rest in summer the longer will be her rest period. Hence, by culling the hens which rest early in the summer, say from June to the middle of August, we are automatically eliminating the poor hens or those which rest a long time and which lay less than 150 eggs. Again, by keeping those hens which lay late and which do not rest until about the first of September, we keep those hens which lay a relatively large number of eggs.

At the bottom of the correlation table will be seen figures which show the number of hens coming back into laying following a summer rest period taken before November 1st. It will be seen that out of 56 hens resting from 1 to 10 days, only one came into laying again. But what is of even greater significance and importance is the fact, as shown by these figures, that out of the 532 birds which took a rest period from June 1st to November 1st, only 45 came back into laying again by November 1st and these 45 succeeded in laying only 135 eggs, or an average of 3 eggs per bird.

The horizontal column at the bottom of each table, marked "Weighted Average", gives the average egg production of the number of birds falling in each particular group. For instance, in the table showing the correla-

CORRELATION OF EGG PRODUCTION WITH LENGTH OF SUMMER REST PERIOD
Leghorns

EGG PRODUCTION-PULLET YEAR	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-110	111-120	121-130	Cy.F 131	Total
300-271	2														2
270-241	9	5		1											15
240-211	25	9	13	5	5	8	1					1			68
210-181	17	13	20	3	15	36	15	6	3	2					120
180-151	2	7	9	5	18	56	47	8	4	5				1	162
150-121			4	6	3	26	14	6	13	6	4	2		2	86
120-91		1			3	8	8	4	4	6	6	1			41
90-61						1		1	2	2				7	13
60-31							1	1						2	4
30-1														4	4
Total	56	35	46	20	44	135	86	26	26	21	10	4	2	21	532
Wt'd. Av.	224	206	194	180	176	168	158	146	136	136	115	138	1	93	

FIG. 108—CORRELATION OF EGG PRODUCTION WITH REST PERIOD

This table shows clearly the rapid decrease in the number of productive fowls as the length of the rest period increases. "Rest period" means the time during which the hens were not laying, regardless of whether they were broody or not. Courtesy of the New Jersey Experiment Station.

tion of egg production with length of summer rest period, we find that the weighted average production for the 56 birds taking a rest period of from one to ten days was 224 eggs. Likewise, in the second group, there were 35 birds taking a rest period of from eleven to twenty days. The weighted average production of these 35 birds was 206 eggs.

CORRELATION OF PRODUCTION WITH BODY WEIGHT
HEAVY BREEDS
Weight In Pounds

EGG PRODUCTION-PULLET YEAR	8.0	7.5	7.0	6.5	6.0	5.5	5.0	4.5	4.0	3.5	3.0	2.5	2.0	Total
300-271			1	1	2									4
270-241				1	1	2	1							5
240-211			1	2	10	3	2	2		1				21
210-181		2	6	4	18	18	14	5	1	1				69
180-151	1	3	12	16	24	16	8	7	2	1				90
150-121		2	6	5	14	18	12	9	6	1				73
120-91	2	1	4	10	6	15	6	8	4					56
90-61			3	1	5	2	1	4	2	1				19
60-31			1				2	1		1				5
30-1			1				2							3
Total	3	8	35	40	80	74	48	36	15	6				345
Wt'd. Av.	133	155	145	153	164	153	151	141	124	138				

FIG. 109—CORRELATION OF PRODUCTION WITH BODY WEIGHTS—HEAVY BREEDS

This table is prepared to illustrate the statement made elsewhere in this chapter to the effect that hens approximating standard weight are more productive than those that are much over or under weight. Breeds represented are Plymouth Rocks, Wyandottes, and Rhode Island Reds. Courtesy of the New Jersey Experiment Station.

We note that as the days of rest periods increase, due to molting in the late summer, the weighted average production for the birds in each succeeding group DECREASES until we find that 21 birds resting over 131 days have a weighted average per bird of only 83 eggs.

It seems to be an assured fact that the culling of hens that stop laying and take a rest period in the early summer is a safe practice, for by so doing the low-producing hens naturally are sold and the expense of caring for these fowls is eliminated. Futhermore, it is entirely possible to detect hens that have stopped laying and have gone into their rest period, by studying certain external characters. The culling of hens by external characters is bound to take a more and more important place in poultry management. It is one of the surest and quickest means of reducing cost of production.

Correlation of Production With Body Weights

According to the records at the Vineland Egg Laying and Breeding Contest, there is a rather distinct correlation between body weight and production. It was found there that among the light breeds, chiefly Leghorns, the best producers were fowls whose weight ranged from three to four pounds. Fowls weighing less than three pounds or over four and one-half were comparatively inferior producers.

With reference to the larger breeds it was found that the best producers were within the weights of five and seven and one-half pounds, the latter weight applying particularly to .Plymouth Rocks. In other words, the standard size for such breeds as Plymouth Rocks, Wyandottes, R. I. Reds, etc., are approximately the weights within which the best production within the breed is secured. Using the records of the Vineland Egg Laying and Breeding Contest as a basis, Professor Lewis of the New Jersey Experiment Station has had prepared two tables showing the correlation between the weights of the light and heavy breeds (see Figs. 109 and 110) and their production during their first and second years. He states that "We find that the Leghorns averaging 3 1-2 to 4 pounds are the best producers; that smaller birds than this are less productive. In our heavy breeds the same thing is true—namely, that the nearer the required standard weight they can be bred, apparently the better producers on the average they will be."

Relation of Broodiness to Egg Production

Poultry keepers who have fowls that become broody find that, in addition to the annoyance of having to care for them and break them up, the time spent in broodiness often represents a definite loss in production. A number of attempts have been made to show the loss of time or of production due to the fowls becoming broody. This subject has been quite thoroughly studied at the New Jersey Experiment Station, using the records secured at the Vineland Egg Laying and Breeding Contest, and the charts prepared (see Figs. 111 and 112) show the apparent loss of time due to broodiness in Plymouth Rocks, Wyandottes, and R. I. Reds, as compared with Leghorns.

It should be borne in mind, however, that in actual practice there may not be quite as much difference between the heavy and light breeds in this respect as appears on the surface. Leghorns spend about as much time resting during the laying season as do the larger breeds but, because they do not become broody or rarely so, the fact is not so apparent. A great deal depends upon the care that the poultry keeper gives to his fowls and the promptness with which broodiness is broken up. If the hens are promptly removed from the nests as soon as they show signs of becoming broody, and are placed in suitable coops or similar quarters where they will have no opportunity to sit, they will soon change their minds, and in a comparatively short time will resume laying again. If neglected, however, and allowed to sit on the nest week after week, there is no question about the fact that their average production for the year will be seriously cut down.

To show that the time spent in broodiness does not necessarily represent a definite loss in production, with proper management, but rather a simple rest period such as is taken also by the nonsitting Leghorns, the follow-

CORRELATION OF PRODUCTION WITH BODY WEIGHT
LIGHT BREEDS
Weight In Pounds

EGG PRODUCTION-PULLET YEAR	8.0	7.5	7.0	6.5	6.0	5.5	5.0	4.5	4.0	3.5	3.0	2.5	2.0	Total
300-271									2					2
270-241								1	10	8	1			20
240-211						2	1	5	16	36	13	2		75
210-181							3	14	32	46	34	2		131
180-151				1		2	10	16	47	44	33	11	1	165
150-121						3	6	9	21	19	32	5	1	96
120-91						1	1	6	9	14	6	7	1	45
90-61									3	5	2	3	1	14
60-31									1	2	1			4
30-1									3			1		4
Total				1		8	21	51	144	174	122	31	4	556
Wt'd. Av.				170		164	164	170	173	178	168	137	123	

FIG. 110—CORRELATION OF PRODUCTION WITH BODY WEIGHTS—LIGHT BREEDS

Fowls represented in the above table are chiefly Leghorns. It is quite clear from this table that the most productive birds in the light breeds are those whose weight is around 3 1-2 to 4 lbs. Courtesy of the New Jersey Experiment Station.

ing table has been prepared from data secured in the Sixth National Egg Laying Contest at Mountain Grove, Missouri. Commenting on these data, Director Noland states: "I do not think broodiness has very much to do with egg production. A hen may be an extra-good layer and although she may go broody a number of times in the season, yet she will finish with a good egg record. Usually a high-laying hen, when broody, will begin laying again in a week or ten days after being broken up, if properly cared for, and this period represents nothing more than a reasonable rest period—no more than is taken by the nonsitting breeds, as a rule. I think the length of the brooding period, however, is determined quite largely by the individual rather than the breed. It appears to be a matter of strain rather than of breed."

TABLE SHOWING CORRELATION BETWEEN BROODINESS AND EGG PRODUCTION

Variety	No. Hens	Per Cent Broodiness	Average Eggs	Per Cent of 200-Egg Hens
Plymouth Rocks	55	198	176	29.1
Rhode Island Reds	40	278	182.4	37.5
Wyandottes	25	164	184	31
Leghorns	70	19.5	178.3	28.6

The data in above table were secured during the Sixth Annual National Egg Laying Contest at Mountain Grove, Missouri. It will be seen by comparing the average egg production of different breeds represented that, in spite of the much greater percentage of broodiness among the heavy breeds, they still averaged to lay fully as well as the Leghorns, and even exceeded them a little in percentage of 200-egg layers.

As a matter of convenience and of efficiency in the poultry yard, the breeder naturally will aim to eliminate the most persistently broody hens in his flock and those that become broody at frequent intervals, though care should be taken that in so doing he does not also throw out some of his best layers.

At What Age Do Fowls Cease To Be Profitably Productive?

In the average flock there is a distinct correlation between the percentages of pullets and hens comprising it and the net income realized by the owner. This is due to the fact that, while a certain proportion of hens must be kept for breeding, the pullets are much more productive.

While there are many hens that reach their highest annual production in their second or even their third laying year, there is, on the average, a marked falling off in the number of eggs produced each year after the first. At the Utah Experiment Station the average production of unselected Leghorn flocks was found to be as follows:

Year	1	2	3	4	5	6	7	8
No. of Eggs	124	119	106	82	74	66	51	52

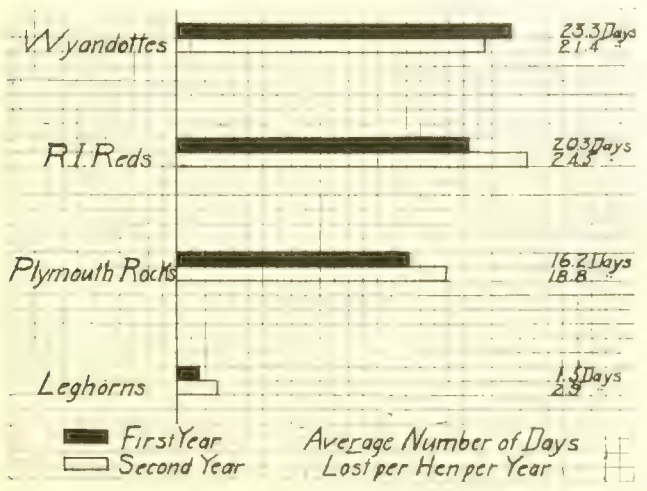


FIG. 111—DIAGRAM SHOWING NUMBER OF DAYS LOST BY BROODY HENS DURING A YEAR

Note in this diagram that while the per cent of broodiness is less the second year than the first (see Fig. 112), the number of days lost per hen is greater in the second year. In other words, one-year-old hens are harder to "break up" than pullets. Courtesy of the New Jersey Experiment Station.

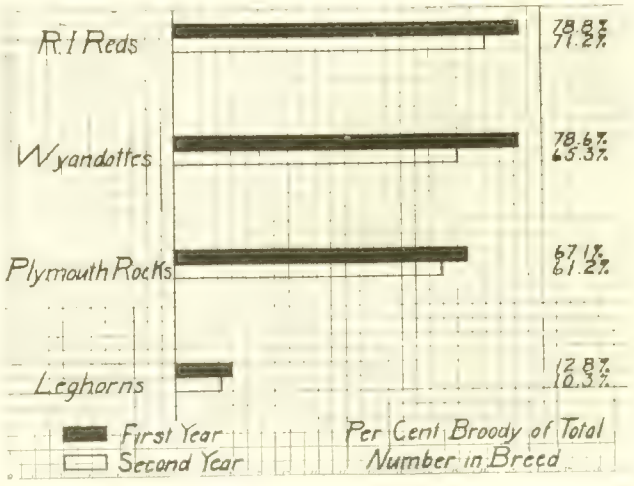


FIG. 112—DIAGRAM SHOWING RELATIVE PERCENTAGE OF BROODY HENS IN DIFFERENT BREEDS

Contrary to what would naturally be expected, the per cent of broody hens to total number is smaller in the second year than in the first. The data represented in this diagram, also in the diagram shown in Fig. 111, were secured at the Vineland Egg Laying Contest. Courtesy of the New Jersey Experiment Station.

The percentage of decrease from year to year appears to be much greater in heavy-laying flocks. The bulletin from which the foregoing figures are taken (Utah Bulletin 148) states that the average production of selected Leghorn flocks (including data from various laying contests) was 180 the first year, 146 the second, and 119 the third. Among fowls of the larger breeds the annual decrease in production is considerably greater than in Leghorn flocks. In the bulletin just referred to, the production of selected flocks of general-purpose breeds is given as 177 for the first year, 116 for the second, and 93 for the third

A study of these figures will make plain why the commercial poultry keeper seldom keeps hens beyond the end of their second laying season, unless they are to be used in breeding pens. It is true that individual fowls often prove to be better layers in their second and even in their third year than in their first, due to their being hatched late or to other conditions that were not favorable to maximum production the first year. The hen shown in Fig. 113, for example, has the remarkable trapnest record given in footnote. It clearly would have been a mistake to have disposed of her as a poor layer at the end of her first year. It is very doubtful, however, whether the number of such hens is large enough to make it worth while for the practical poultry keeper to take them into consideration, especially since few have any means of identifying such individuals. Another reason for disposing of hens at a comparatively early age, that is even more important than the falling off in total number of eggs produced, is the fact that the profit realized from yearling or older hens rarely equals that secured in their pullet year, since, even though such hens may lay a fair number of eggs, these are produced mainly during the low-price season.

Selecting Fowls by the "Patterson Index"

Relative Accuracy of Different Methods of Testing Hens for Productiveness Compared—This Article Also Presents a Method of Determining a Hen's Probable Egg Record Where Her Productiveness for a Short Period is Definitely Known

By DR. C. T. PATTERSON

ONE of the most important subjects connected with the poultry business is the subject of selection, and the ability of the poultryman properly to select for a definite purpose usually determines the degree of his success. The continuous process of selection practiced by nature on both plants and animals, which results in the "survival of the fittest", is not a good practice for the farmer or poultryman, for weeds will survive and corn be destroyed if natural selection is followed; and if a large

FIG. 113—A HEN WITH A REMARKABLE EGG LAYING RECORD

Some hens do not have an opportunity to do their best work the first year, due to late hatching or unfavorable environment. The hen illustrated above (Cornell No. D1437) has the following trap-nest records: 1915-16, 114 eggs; 1916-17, 193; 1917-18, 186; 1918-19, 158. Photo from Cornell University.

number of chicks are crowded together till nature selects the stronger and destroys the weaker, the birds of high production suffer most.

In the development of poultry many ideals have been fixed, each calling for a different method of selection. Some of the characters for which poultrymen select and breed are:—The production of eggs, meat, color, size, shape, vitality, etc., and some characters of less importance, such as broodiness, disposition, etc. Each of these characters requires special attention. In this article selection for productiveness alone is considered.

Every one who has observed the performance of hens recognizes the fact that there is a great variation in the production of different hens in the same flock. The problem which concerns most poultrymen is how to select the high and low producers, the former to be used as breeders and the latter to be removed from the flock.

Methods of selection for productiveness may be divided into two general classes. The first class includes methods employed where the bird itself is examined and the characters used as a guide in selection, while for the other class trap nests are used for longer or shorter periods.

Accuracy of Physical Tests

The first method we will notice is where the number of hens is reduced simply by catching the number to be sold without any definite plan in mind, except to have fewer hens. This is purely a guess and probably would be 50 per cent accurate, i. e., 50 per cent of whatever number was sold would be good hens and 50 per cent would be poor producers.

The Hogan System deals principally with the pelvic bones on each side of the vent, the ability of the hen to perform being measured by the shape, thinness, and rigidity of these bones. The value of this system was determined in a special test in the All-Northwest Egg Laying Contest, where Mr. Hogan handled the hens and estimated the number of eggs each bird would lay. The accuracy of the estimates was determined in the following manner: The number of eggs produced by each hen, as recorded by the trap nest during the year, was taken as 100 per cent and any variation from this number was considered an error in Mr. Hogan's estimates. To illustrate,—if a hen produced 150 eggs and the estimate was 200 eggs, the estimate was 50 eggs in error which is 33 1-3 per cent of the 150, therefore this estimate was 66 2-3 per cent accurate. After the per cent of accuracy for each hen was thus determined they were all averaged which gave an average of 64 per cent accuracy.

The time when hens molt is sometimes used as a guide in selecting the high and low producers. The basis used in determining the value of this method is that the later the hens molt the higher the production, and the earlier they molt the lower the production. In a concrete test of this method we allowed the last two weeks of October for the normal molt so that hens which molted, or rather stopped laying on account of the molt, during the last two weeks of October, were considered average with a production of 150 eggs each, which was the average for the 2,000 hens tested. For each day the hen continued to lay after November 1st, three eggs were added to the 150, and for each day the hen missed before October 15th on account of the molt, three eggs were taken from the 150. In this test selection by molt proved to be 68 per cent accurate. It should be noted that broodiness, feed, houses, health, etc., affect the molt so that in making a comparative test, hens should be kept under the same conditions.

Another method often used is to select the winter layers as the high producers. In one test the average production per hen in a flock of 2,000 hens was 25 eggs for November, December, January, and February, and the average for the year was 150. It was found that for each egg laid during these months the hen would lay six eggs during the year, hence by multiplying each hen's production during November, December, January, and February by six, her total year's production can be approximated. In a careful test this method was found to be 69 per cent accurate.

The shank-color test is often used with hens which have yellow shanks. The fowls whose shanks bleached out first were considered the highest producers, and the ones which retained the yellow color the longest were

considered the lowest, etc. This method proved to be 70 per cent accurate.

The shank-color test when applied on the 15th of March, April, and May proved to be the most satisfactory of any of the tests where the trap nests were not used. The test was applied as follows: On the 15th of March all hens in the flock which had yellow shanks were banded, then on April 15th all hens with yellow shanks were banded, and again on May 15th the same process was followed. All hens with three bands on were of course the lowest producers, the ones with two bands on were the next higher, the ones with one band were the next, while the ones with no bands on were the highest. The test applied in this way is about 82 per cent accurate. All fowls were kept under the same conditions and started with good, rich yellow shanks.

Another method often practiced is selecting by weight. In applying this test, fowls having the weights fixed by the "American Standard of Perfection" were taken as the highest producers, and one-fourth pound was used as a scale for recording variations. The farther the weight varied from the standard, up or down, the lower the production was considered. The hens were weighed only three times during the year which is not a good basis for averaging the weights. The results given however, indicate that to select by weight alone is about 60 per cent accurate.

Another test often used is to select the earliest maturing pullets as the highest producers, taking November first as the beginning date. This method proved to be 65 per cent accurate. A difficulty in using this test is the different ages of pullets.

Short Period Trap-nest Records

The second class or group of methods of selection is the interpretation of trap-nest records. Through use or custom the year has become the standard measure of a hen's production. Every one familiar with trap-nest records recognizes the fact that one year is not a true measure of a hen's performance. The value of one year's record as a basis for selection is estimated by comparing each hen's record for one year with her record for four years. The results indicate that the first year's trap-nest record is only 72 per cent accurate, the second year's trap-nest record is 79 per cent accurate, while the third year's trap-nest record is 81 per cent accurate. It will be seen from this that in trap nesting for one year, only 73 per cent of the good hens are located. In other words, of the number selected as high producers in a term of four years 28 in every 100 prove poor producers, and in every 100 discarded as poor producers there are 28 that will prove good layers in the following year or years.

Cycle and rhythm is a practical method of selecting high and low producers from trap-nest records. The cycle is the number of eggs a hen lays without missing a day, while the rhythm is the continuation or repetition of these cycles. The hen which lays as many as three or more eggs in a cycle, and after missing only one day produces another cycle of equal length and continues at this rate for at least sixty days, is a high-producing hen. She has proven that she has ability to produce eggs at a rapid rate and has a constitution which is strong enough to hold up under heavy production. The sixty days cover a period long enough to demonstrate whether the hen will be affected by broodiness, the increase or decrease of fat, or any change in climatic or weather conditions. Through a careful study of the cycle and rhythm of egg production the Patterson Index Method of Selection was developed. This method when compared with either one or four-year records of hens proved to be 87 per cent accurate, which is the best showing made by any method tested.

The Patterson Index Explained

Nature has fixed a maximum producing standard of an egg each day. The hen which produces an egg each day for thirty days has a perfect rate, and if she continues to produce at this rate for the next thirty days she has a perfect persistency, endurance, or ability to continue. Then multiply the rate by persistency and we get the life's production. Thus, a thirty-egg rate multiplied by a thirty-egg persistency equals 900 eggs which is the hen's estimated life production and, as the first year's production as an average is one-third of the life's production, the perfect year would be 300 eggs. Now we have the perfect rate of thirty eggs in thirty days, the perfect persistency of thirty eggs during the next thirty days, the perfect life's production of 900 eggs, and the perfect first year's production of 300 eggs.

If a hen produces 24 eggs during thirty days and 25 eggs during the next thirty days, her life's production would be 600 eggs and her first year's record should be 200 eggs. The hen which produces 21 eggs during thirty days and twenty during the next thirty days has a life index of 420 eggs or a year's index of 140 eggs.

The time to make this test is during the spring season of the first laying year, because it is when the hen is given every possible advantage that it becomes possible to measure her ability to perform. If her performance is measured under adverse conditions such as poor houses,

TABLE ILLUSTRATING PATTERSON INDEX METHOD OF ESTABLISHING LAYING VALUE OF HENS

No	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	1 yr	In-dex	4 yr	In-dex
1	10	0	0	7	18	21	29	27	17	[illegible]	[illegible]	19	201	261	778	793
2	0	7	3	[illegible]	27	24	25	22	[illegible]	[illegible]	[illegible]	21	230	230	671	670
3	0	16	19	17	22	25	20	19	13	[illegible]	[illegible]	8	199	193	[illegible]	550
4	0	15	0	7	22	24	21	21	19	21	[illegible]	17	191	176	[illegible]	28
5	0	9	22	19	25	23	12	19	15	[illegible]	[illegible]	6	196	193	[illegible]	[illegible]
6	0	6	9	9	19	20	22	20	16	14	0	0	137	147	[illegible]	[illegible]
7	0	0	9	16	23	24	21	16	11	11	17	12	160	[illegible]	[illegible]	196
8	0	4	16	16	17	20	20	24	12	11	24	0	180	160	[illegible]	[illegible]
9	7	13	0	0	3	12	12	18	0	0	0	0	[illegible]	77	[illegible]	214
10	0	0	0	0	9	21	7	16	0	0	0	0	53	53	198	189
Averages													168	164	475	[illegible]

Table showing record of 10 hens—number of eggs produced each month, the number for one year and the number for four years. The index value is shown for one year, also for life. For practical work multiply the two highest consecutive months together for the life's index and take one-third of this for one year.

bad feed, and changeable weather, the records would mean that the hen's ability was equal to her performance plus the handicaps; and if the handicaps form an unknown quantity her performing ability cannot be determined from such records. But where all advantages are given to the hen a true measure can be secured of her performing ability.

There is no arbitrary time for making this test but the most practical time is to trap nest through March, April, May, and June, selecting the highest sixty consecutive days during this time.

Selecting Heavy Layers By the Weight of Their Eggs

This Article Suggests a Means of Detecting High and Low-producing Hens, Doing so by Comparing the Weights of the Eggs Laid by Them at Different Seasons

BY DR. PHILIP HADLEY

IN connection with a study of the manner of inheritance of egg-weight in the domestic fowl, conducted for several years at the Rhode Island Agricultural Experiment Station, there has been evolved a new method for the detection of those birds in a flock that are characterized by higher producing ability. The method is not based upon data involving observed numerical production in any way, but upon the tendency on the part of normal hens to manifest, at certain periods of the year, a gradual increase or a gradual decline in the size and weight of the eggs which they lay.

It has been found that when the numerical production curve of a flock of hens of the same approximate age and condition, and characterized by mediocre producing ability, is plotted on monthly ordinates (aside from the mode of December production of the pullet year, which is sometimes manifested if the hens were hatched very early in the season or are high producers), two modes appear, one in April and one in September. These modes, or maxima, represent the peaks of production for the pullet year.

It has also been found that when the curve of mean egg-weight is plotted on similar monthly ordinates, two modal points appear, one in April and the other in September. These weight modes, or weight maxima, are approximately coincident with the production maxima.

When, however, one analyzes the performance of individual birds at the period of these maxima, one finds that, while the majority show an egg-weight which has markedly increased over the mean weight of the first ten eggs laid at the beginning of the laying year, some have not shown such an increase, and some have shown an actual decrease. When the increase or decrease in mean egg-weight is measured as a percentage-increase or as a percentage-decrease, some birds may show an increase of 10 per cent or more while others show a decrease of equal amount.

The question naturally arose whether the hens which showed the greater increase in mean egg-weight for April and for September also manifested the higher productions for the first laying year. Such correlations were computed and it was learned that in the majority of cases the hens which gave the higher percentage-increase in egg-weight during these months also showed the higher productions for the year. The flock could easily be separated into production-groups based upon the percentage of increase (or decrease) in mean egg-weight. As a rule the correlation was more perfect in September than in April.

Correlations between the percentage of increase in mean egg-weight and numerical production were also attempted when the former were based upon the mean weight of ONLY TEN EGGS laid as nearly as possible at the absolute weight made for April and for September respectively. It was learned from these computations that the correlation was even more perfect when the smaller number of eggs was employed in the computations. The following tables give the results for the spring and autumnal weight maximum, based on the "10-weight maxima", based on the "10-egg test."

Percentage class: Birds selected for change in egg-weight as indicated below.	Number of individuals making the record.	Mean production for first laying year.
10 per cent (increase)	3	142 eggs
8 per cent (increase)	7	141 eggs
7 per cent (increase)	9	140 eggs
6 per cent (increase)	13	138 eggs
5 per cent (increase)	19	127 eggs
4 per cent (increase)	22	126 eggs
3 per cent (increase)	23	125 eggs
2 per cent (increase)	27	123 eggs
1 per cent (increase)	29	122 eggs
0 per cent (increase)	31	122 eggs
0 per cent (decrease)	6	106 eggs
6 per cent (including decrease)	24	109 eggs
Total flock	37	120 eggs

Table I

Showing the mean annual production for the first laying year of groups of hens selected for varying percentages of increase or decrease in mean egg-weight of ten eggs or less laid at the period of the spring weight maximum.

It may assist readers in quickly getting the meaning of this table to explain that each number in the second column includes ALL hens in the flock, whose eggs showed a given increase in weight or over. For example, there were 3 hens whose eggs showed an increase of 10 per cent or over; there were 7 (including the preceding 3) whose eggs showed an increase of 8 per cent or over; 9 (including the preceding 7) whose eggs showed an increase of 7 per cent or over, and so on. In the "0 per cent (decrease)" class are included all whose eggs showed any decrease, while in the "6 per cent (including decrease)" class are included all hens in the flock whose eggs showed a decrease, or an increase that did not exceed 6 per cent.

By way of further explanation it may be stated that the line "0-26-124" in Table II, and all preceding lines in this table, mean that the eggs laid by fowls whose records are there presented, show an increase in weight, and that the increase in percentage was above the amount stated. The line "0-5-108" means that five hens showed a decrease in mean egg-weight. The line "6-19-112" indicates that there were nineteen hens that failed to show a percentage of increase of 6 per cent or higher. This group contains (a) hens that showed increases of less than 6 per cent and (b) hens that showed an actual decrease. The "6-19-112" class therefore includes the "0-5-108" class.

Dividing the flock on the basis of a 6 per cent increase in egg-weight, we get the following results:

	Hens	Eggs
Increase of 6 per cent and over	12	139
Increase from 0 to 6 per cent	19	112
Decrease	5	108

The same explanations (with suitable changes in the figures) also apply to the data given in Table I.

As to the serviceability of the percentage of increase in mean egg-weight of September eggs for estimating the SECOND-YEAR production, no sign of correlation is discoverable between the increase in weight of either April or September eggs of the first laying year, and this second year's production. There is, however, a correlation

Percentage class: Birds selected for change in egg-weight as indicated below.		Number of individuals making the record.	Mean production for the first laying year.
13 per cent	(increase)	3	147 eggs
11 per cent	(increase)	6	145 eggs
10 per cent	(increase)	7	143 eggs
9 per cent	(increase)	8	144 eggs
8 per cent	(increase)	10	144 eggs
7 per cent	(increase)	12	139 eggs
6 per cent	(increase)	12	139 eggs
5 per cent	(increase)	14	135 eggs
4 per cent	(increase)	16	134 eggs
3 per cent	(increase)	19	131 eggs
2 per cent	(increase)	21	125 eggs
1 per cent	(increase)	23	125 eggs
0 per cent	(increase)	26	124 eggs
0 per cent	(decrease)	5	108 eggs
6 per cent	(including decrease)	19	112 eggs
Total flock		31	120 eggs

Table II

Showing the mean annual production for the first laying year of groups of hens selected for varying percentages of increase or decrease in mean egg-weight of ten eggs or less laid at the period of the autumnal weight maximum. (See explanatory footnote to Table I.)

between the increase shown in April eggs of the second year and the total second-year production, and a very marked correlation between the weight increase in September (second year) eggs and the total second-year production. The correlation in both years is best shown in September, and it appears to be shown better on the recorded weight of only ten September eggs as compared with a full month's production.

From the data presented in these tables it appears that higher production is correlated very definitely with higher percentages of increase in egg-weight. The maximum group-production (147) occurred in those hens whose mean increase in egg-weight was above 13 per cent in the "10-egg test." Selecting above 10 per cent gave seven birds whose mean production was 143 eggs. Selecting above 6 per cent gave 12 hens whose mean production was 139 eggs. On the other hand, selecting the hens which gave a decrease in egg-weight (see Table II) gave five hens with a mean production of only 108.

The superiority of the "10-egg test" in establishing the correlation with numerical production in this instance clearly brings the testing of egg production of hens into the same class with testing milk production of dairy cows, in which case Gavin and also Wilson have pointed out that under suitable conditions the one-day test is of greater value than the seven-day, the 30-day, or the year test.

With these points openly in mind, and only with the purpose of stimulating further investigation and discussion, the author presents the following brief summary of his results with a single flock as expressing a biological fact which, if later proved to be of general application, may take its place as a fundamental law of production in the domestic fowl:

The innate egg producing ability of a hen is manifested, not only by the number of eggs laid within a year, or within some longer or shorter period of time, but also by the degree of increase or decrease in the mean weight of her eggs, when this increase or decrease (calculated as a percentage-increase or percentage-decrease) is measured at those periods of laying (the vernal and autumnal maxima) characterized by the markedly increased laying of the flocks; and on this basis, groups of hens characterized by higher producing ability can be differentiated as accurately as, and more easily than by any other known means.

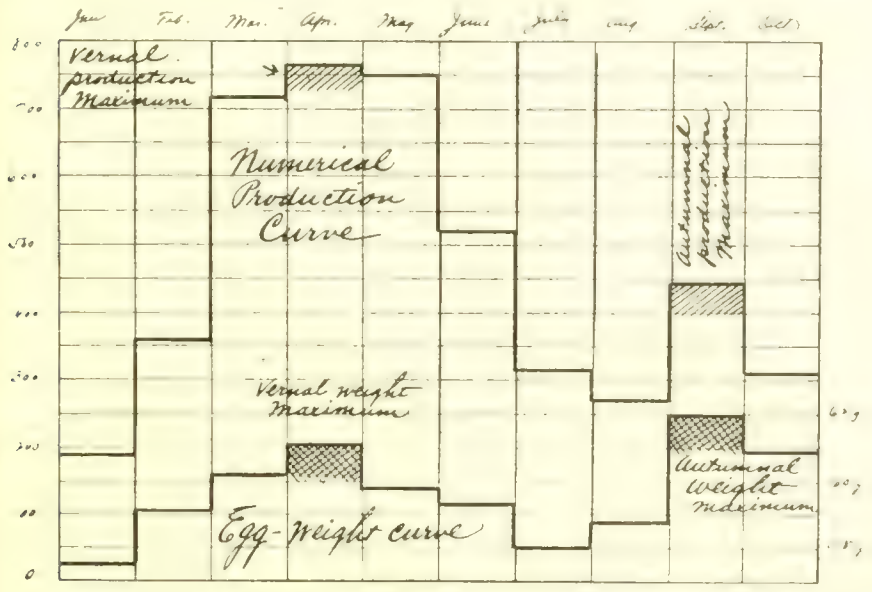


FIG. 114—DIAGRAM SHOWING HOW INCREASED WEIGHT OF EGGS ACCOMPANIES INCREASED PRODUCTION

This chart shows in graphic manner the way in which egg weight increases during the spring and autumn periods of maximum production, and the relation existing between such increases and the productiveness of the flock. The figures on the left give the total monthly egg yield of the flock employed in the test. The upper black line is the production line; the lower indicates the monthly average egg weight; and the shaded "peaks" indicate the periods when comparisons between the two are made for the purpose of determining the probable productiveness of the flock. Reproduced from Journal of the American Association of Instructors and Investigators in Poultry Husbandry.

Summary

There is a distinct correlation between cycle and rhythm and productiveness.

Season, feeding, management, broodiness, etc., may interfere with normal cycle and rhythm.

Practically all layers have seasons of nonproductiveness, or rest periods.

The number of eggs laid by a hen in a year is in definite proportion to the length of her summer rest period.

By culling early in summer, the hens with a long rest period are eliminated.

By keeping those hens which lay late and which do not rest until the first of September or after, the best layers are automatically selected.

There is a distinct correlation between body weights and production.

Among the larger breeds it is believed that the best producers are found within the weights of 5 and 7½ pounds.

Careful observers have found that Leghorns averaging from 3½ to 4 pounds are the best producers.

Broodiness often causes a serious loss in production.

The loss due to this cause is much less where the fowls are properly cared for, and broodiness promptly broken up.

The tendency to broodiness does not necessarily prevent high egg production.

A thorough test of the Hogan System of selecting layers, made at the Wash. Exp. Station, proved about 64 per cent accurate.

The Patterson Index Method of selecting layers proved 87 per cent accurate.

Hens whose eggs show an increase in weight over 6 per cent at the period of maximum production in spring and fall are more productive than those, the weight of whose eggs show a decrease or a gain of less than 6 per cent.

CHAPTER X

How to Select Prospective Good Layers

There Are a Number of Characters That Indicate Prospective Good Layers—The Poultry Keeper Who Learns How to Select His Best Pullets at the Beginning of the Laying Year Has a Great Advantage Over Others—Method Employed in Selecting Pullets at the New Jersey Experiment Station

WHAT has been said in previous chapters in regard to culling has applied particularly to the identification of good layers after they have been productive for some time—after they have gone through the first laying season or the greater portion of it and, unfortunately, after they have in many cases boarded at the expense of the owner for many months of idleness or relatively poor production. It is unfortunate that, to date, comparatively little is known in regard to selection for prospective good layers. There are, however, various characters, such as comb, shape and position of eye, abdominal capacity, general evidences of low or high constitutional vigor, etc., to go by, and close observation of these will enable the operator to form a fair estimate of the probable record that either pullets or hens will make in succeeding months.

Especial attention has been given to the subject of selecting prospective good layers at the Michigan Agricultural College. In a recent bulletin from that institution (No. 21, Extension Series) the following statements on this subject are made:

"Egg type in poultry is more reliably indicated by the head than by any other single part of the body. The head reveals health, constitutional vigor, age, refinement, coarseness, and masculinity. Lady Activity (record 263 eggs in 365 days) was selected as the record hen in the college flock in 1916 just as she began to lay, selection being based chiefly on refinement of head. Care and judgment must be exercised however, or refinement of head will lead to the selection of individuals that are not sufficiently robust to stand up under the continuous strain of heavy egg production. Small heads and extreme fineness of features generally indicate a propensity for broodiness.

"Early maturity also is correlated with heavy egg production. The pullet that feathers earliest over the back has, in nearly every case, made the highest yearly records. Early feathering over the back is an indication of both early maturity and constitutional vigor. Chicks always feather in the following definite order: wings, tail, neck, breast, fluff, and back. Chicks of the heavy breeds should be feathered over the back at seven weeks of age. Leghorns or lighter breeds, a week earlier. Preference should also be given to close, tight feathers, along with early feathering."

It is of the first importance that methods of selecting pullets be developed to the greatest possible accuracy, and many competent investigators are at work upon the subject. The need for practical tests of this sort was forcibly brought out during the course of a visit which one of the authors of this book, in company with Professor H. R. Lewis, paid to the Vineland District where commercial egg production has become a highly important local industry.

The owner and manager of a 2,500-hen commercial egg plant said, in discussing the general subject of culling: "I can tell readily enough which hens are laying well, also those that have laid well and stopped; but what we practical poultrymen want to know is how to tell which pullets are going to make the good layers, doing this before we waste houseroom, feed, and time on them during the fall and winter. For example, one of the White Leghorn pullets that I entered in the Vineland Contest has not laid an egg—not one. Can't you tell us how to come nearer selecting the good layers before the time for them to begin laying?"

The reader will be interested in learning that this nonlaying pullet was given a post-mortem examination which developed the fact that she apparently had been laying internally through some malformation of the oviduct. It is not probable that it will ever be possible to elaborate methods of selection to a point where such fowls can be detected before production begins but, without doubt, much greater accuracy in the selection of prospective layers can be attained than has yet been generally done.

The following helpful suggestions in regard to the selection of pullets contributed by Prof. H. R. Lewis of the New Jersey Experiment Station, are of great practical value. The information here presented was obtained in a personal interview which is here reproduced in connected form, simply omitting the questions to which Professor Lewis' statements are direct replies.

Prospective Good Layers

Suggestions for the Selection of Pullets on Basis of Probable Productiveness—Observations Made at Vineland Laying and Breeding Contest—How Regular Culling Methods May Be Applied to Pullets Just Coming Into Laying

By PROF. H. R. LEWIS.

IT is evident, judging by tests easily made by any practical poultryman, that exterior characteristics and appearances can be relied on to a large extent in telling which hens are laying, or have laid to a liberal extent; now how about picking out the good prospects in handling pullets that have not yet begun to lay?

Our knowledge regarding the culling of fowls has advanced wonderfully during the last two years. The poultry fraternity has available very accurate information pertaining to the selection of hens on a basis of their past and present performances. The application of these tests enables the poultry keeper to weed out cull birds and select the better, more productive hens for breeding. Our exact knowledge pertaining to the selection of pullets on the basis of their future production is much less complete and the results less accurate. We have been studying this problem pretty carefully in connection with work at the Vineland Egg Laying Contest and I have personally handled and observed hundreds of pullets and made estimates as to their probable future production. We expect to publish something on this shortly. Until this work is

published, our most complete information to date and the methods and factors which we most commonly use in picking pullets are as follows:

Early Maturity

Other things being equal, the early maturing pullets are by far the best producers. I have observed hundreds of pedigree pullets in the summer and fall, and the rule is, almost without exception, that those pullets which mature normally, with well-developed bodies, in from 4½ to 6 months, depending on the breed, are by far the best producers; while those which linger in their maturing and require from 4 to 8 weeks longer than they normally should, are always the poor producers. We find this test true in full sisters. Early maturity means continued and sustained production. With the average American breeds (Plymouth Rocks, Wyandottes, and Reds) we expect them to mature in from six to seven months; that is, birds hatched in March will mature in October. For this reason, New Jersey poultrymen like to bring their Rocks, Reds, and Wyandottes out in middle or late March. It requires, on the average, five months to mature well-grown April-hatched Leghorn pullets, hence April-hatched pullets should mature in October. The time of hatching is, of course, governed largely by the danger of the fall molt. April-hatched Leghorn pullets will rarely molt until they are a year and a half old. That is, they will go through the fall and winter of their first laying year without molting, whereas, pullets hatched in March or earlier will usually molt in November and December. There is, however, an advantage in bringing off a certain number of the pullets in February, especially with Leghorns. This advantage is an important one to the commercial egg producer, notwithstanding the fact that these February pullets will molt in the winter. (See Chapter XVII for more on this subject.—Ed.)

Natural Figure

The second point which we use in selecting the pullets for future production is the natural figure of the bird. They must have every evidence of vitality and stamina as expressed by well-developed, good-sized bodies, vigorous head development, round, prominent eyes set well back in large, open eyelids. They must have ample body capacity; that is, their bodies must be relatively long, broad, and deep for the breed or variety. By body capacity is meant breadth, depth, and length of the bird, which means capacity for the greatly enlarged egg organs and intestines which are characteristic of heavy-producing hens. In other words, we do not want to select pullets which have small, short, narrow bodies, and are tucked up or pinched behind.

Cycle And Rhythm

A third factor which we always consider can be detected after the birds have been laying two or three weeks is the cycle and rhythm with which they begin to produce. Pullets placed in the laying pens and trap nested from the time they lay their first egg, will show individual traits of production. Some will lay two eggs and skip a day, others will lay every other day, some will lay three eggs and skip a day, others will lay long periods without a skip, and then take long rests. The way in which the birds lay their eggs is termed their rhythm and cycle. The birds with a long cycle of steady production with short skips, which cycles are regularly repeated, prove by far the best producers.

Type

I am fully convinced that there is such a thing as egg type in all of our strains of poultry, and nowhere is its practical importance greater than in judging the probable production of maturing pullets. In discussing type, the mistake must not be made of disregarding the breed shape or type, for it can readily be seen that there cannot be one egg type for all breeds, owing to the differences in body shape. The egg breeds, however, bear a close similarity to each other in their breed type, and it may thus be assumed that this general conformation represents the desired form.

Tail Carriage

As regards tail carriage, the average Leghorn pullet coming into maturity has a moderately low, well-formed tail, generally fairly well spread. As she continues to lay, the tail becomes changed and is carried at a much higher angle. This, I believe, is due in large part to the development of the egg organs, and the pressure which they exercise on the muscles of the back and tail causes

New Jersey Agricultural Experiment Station
DEPARTMENT OF POULTRY HUSBANDRY

EGG PRODUCTION vs. CERTAIN EXTERNAL CHARACTERS
CORRELATION FACTORS BY COMPARISON

Pen 44 Breed S.C.W. Leg. Band No. 448 Sex ♀
Date January 8, 1917 Age pullet Weight 3.1

Head	Length	long		short	
	Depth	deep		shallow	
	Width	wide		narrow	
Ear Lobe	Color		tint	white	
Eye	Color	good		watch eye	
	Lustre	bright		dull	
	Bulge	prominent		depressed	
Comb	Size	large		small	
	Texture	soft		coarse	
	Lustre	bright		dull	
Beak	Length	long		short	
	Color		tint	white	
Neck	Length	long		short	
Back	Length	long		short	
	Width	wide		narrow	
	Depth	deep		shallow	
Breast	L. Keel	long	medium	short	
	Span	wide		short	close
	Bone		sl. crooked	dec. crooked	
Girth	in inches	13 1/4 inches.			
Tail	Carriage	high		low	
	Shape	spread		pinched	
Lay Bones	Thickness	thick		thin	very thin
	Width	wide		narrow	
	Pliability		medium	soft	
Vent	Color		tint	white	
Legs	Length	long		short	
	Color		tint	white	
Toe Nails	Length	long		short	

Miscellaneous Plumage Old.
Disposition Wild.

H.R. Lewis.

Predicted Production (100) Actual Production 105

FIG. 115—CHARACTERS OF AN INFERIOR LAYER CHARTED AT BEGINNING OF LAYING PERIOD

the muscles controlling the tail to be drawn upward, carrying the tail higher. Likewise, in the male bird as the breeding season approaches, we find the tail assuming a higher carriage. I am strongly opposed to squirrel tails, and do not believe they are necessary to maximum egg production. On the other hand, I am equally opposed to low, drooping tails which in the majority of cases are due to a lack of stamina and inherent vigor and vitality. I do not believe that tail carriage within normal limits, avoiding either extreme, has any influence upon egg production, or can be used as a measure of it.

I do not regard pigmentation tests as of much value in selecting for prospective laying ability. It is true that pigmentation signs of production appear immediately after pullets start to produce, but it is a question in my mind as to whether we should practice culling to eliminate slackers at that time. Pullets that have been grown to maturity and which have been kept until December or thereabout will then only have to be held at the longest a month or two before practically all will come into the natural spring laying season and will continue to lay more or less heavily for two to four months. I believe these late starters and poor winter layers should be held through the winter and into this heavy laying spring period. These birds will be the earliest ones to quit in June and July however, and they can and should be culled out at that time.

New Jersey Agricultural Experiment Station

DEPARTMENT OF POULTRY HUSBANDRY

EGG PRODUCTION vs. CERTAIN EXTERNAL CHARACTERS

CORRELATION FACTORS BY COMPARISON

Pen 42 Breed S.C.W. Leg. Band No. 424 Sex ♀

January -8-1917 Age Pullet Weight 3.5 lbs.

Head	Length	long		short	
	Depth		medium	shallow	
	Width		medium	narrow	
Ear Lobe	Color	yellow	tint		
Eye	Color		poor	watch eye	
	Lustre		dull		
	Bulge		flat	depressed	
Comb	Size	large		small	
	Texture	soft		coarse	
	Lustre	bright		dry	
Beak	Length	long	medium		
	Color	yellow		white	
Neck	Length		medium	short	
Back	Length		medium	short	
	Width	wide		narrow	
	Depth		medium	shallow	
Breast	L. Keel		medium	short	
	Span	wide		short	close
	Bone		sl crooked	dec crooked	
Girth	in inches	14½ inches.			
Tail	Carriage		medium	low	
	Shape	spread	medium		
Lay Bones	Thickness	thick		thin	very thin
	Width	wide		narrow	
	Pliability	hard		soft	
Vent	Color	yellow	tint		
Legs	Length		medium	short	
	Color		tint	white	
Toe Nails	Length	long	medium		

Miscellaneous Plumage Old. Disposition Vicious.

Observer, H. R. Lewis.

Predicted Production (Over 200) Actual Production 263

FIG. 116—CHARACTERS OF AN EXTRA-GOOD PULLET CHARTED AT BEGINNING OF LAYING PERIOD

Charts for Prospective Layers

In order to have a permanent record of observations on the characters of pullets, the chart shown in Figs. 115 and 116 is used at the N. J. Exp. Station. This chart was designed for use in studying fowls at this station and is not regarded as having any special value to commercial poultry keepers. However, those who are applying culling tests to prospective layers will find such "scores" quite helpful in checking up on predictions.

The two pullets whose score cards are reproduced were both S. C. W. Leghorns, entered at the Vineland Contest during the fall of 1916. This study was made on January 8, 1917. All of the thousand birds at the Vineland Contest were gone over three times during their pullet year and studied on the basis of the characters listed on the card. One hundred birds, or ten pens, were gone over in the same way in two-week periods.

These cards are laid out with the character to be studied at the left and standard descriptions of each character listed at the right. When handling a bird, all that is necessary in order to designate her condition with reference to any character is to draw a line through that term describing the condition which she shows. If the size of the comb, for instance, is between medium and small, we would extend the line through medium over toward small. If the comb is dry to dull we extend the line through dry over toward dull. In this way the chart enables us to describe in great detail and very quickly many characters in a large number of birds. From these records we can plot our correlations and make our observations.

At the time these two particular observations were made, on January 8th, I predicted the production of bird No. 448 would be about 100 eggs. She actually laid 105 eggs during the year. At the same time I predicted the performance of bird No. 424 to be over 200. She actually laid 263 eggs. It was not my intention, in these predictions, to attempt to get an exact prediction but rather to throw the birds into certain groups of poor producers, medium producers, good producers, and very good producers. It was with considerable interest that we followed these results and found that, in the main, our predictions were remarkably accurate.

Summary

The selection of pullets with reference to their probable future production is of vital importance but is poorly understood. Present information on the subject may be summed up as follows:

Grow the pullets well, weeding out during the summer growing period any which do not develop properly or which show evidence of slow growth or lack of vitality.

Pick the pullets to put into the laying pens in the fall on a basis of good size, pronounced vigor, and ample body capacity.

Bear in mind that it is the early-maturing pullets which lay the most eggs, for they not only have more stamina and productive ability, but they get an earlier start.

If possible, pullets should be trap nested for a few weeks, in order that their cycle and rythm of production may be determined.

Pigmentation tests are not of much practical value in determining future production.

Tail carriage within normal limits does not appear to have any direct significance as to productiveness.

CHAPTER XI

Importance of Selective Flock Breeding

To Realize the Full Benefits of Culling, Only the Best Layers Should Be Used in the Breeding Pen—By Following This Practice Average Production Can Be Greatly Increased, and at Practically No Added Cost—How to Select the Highest Producers In the Flock and the Ones That Are Best Able to Transmit Their Characters

IN preceding chapters the subject of culling has been discussed chiefly with reference to the direct effect of this practice upon average egg yield, and the economic importance of applying culling methods to all laying flocks, regardless of their size or the conditions under which they are kept. It has there been shown that culling is a highly valuable aid in increasing average production; that it enables the poultry keeper to detect with a good degree of certainty the nonlayers and the poor layers as well, thus cutting down his feed bill by getting rid of all hens that do not lay a profitable number of eggs, and doing so without noticeably reducing the total number of eggs produced by his flock.

Without minimizing the importance of these advantages, it should be clearly understood that the greatest advantage in culling is not in the immediate benefits received from eliminating low producers, but in the opportunity which it affords for bringing about permanent improvement in the flock through the use of only the best layers in the breeding pen. Getting rid of inferior producers as they stop laying in the summer means much to the practical poultry keeper, but it means still more, so to conduct breeding operations that eventually such fowls can be completely eliminated from the flock, at the same time gradually getting better records from the best individual members of it, year by year. As a means of effecting such improvement, breeding only from fowls that have demonstrated their ability to produce great numbers of eggs, or from fowls descended from such, is of unquestioned value. Evidence has been piled up to show that the productive capacity of fowls can be greatly improved through proper breeding, and this book could be filled with authentic records showing how, in practically all popular breeds, strains have been developed in which the average of production has been so increased.

How Fecundity Is Transmitted

It is admitted that our knowledge of the laws governing the inheritance of fecundity is not complete. There are yet important differences of opinion among well-posted authorities, which have not been harmonized, and there are observed facts in the experience of practical poultry keepers that are not readily accounted for. But after conceding all this, the fact remains that fecundity is transmissible, that great numbers of breeders have brought about marked improvement in the production of their flocks by systematic breeding, and that such improvement can be secured in any flock, regardless of breed, by following similar methods.

According to Dr. Raymond Pearl, who for years was in charge of the poultry breeding work at the Maine Experiment Station, inheritance of fecundity is chiefly or solely through the male line. Not all practical poultry keepers nor all investigators in poultry breeding problems accept Dr. Pearl's conclusions in regard to inheritance of fecundity. While it is generally conceded that the male does have a most important influence on inheritance of this character, there is not lacking evidence pointing to the fact that the mating of heavy-laying hens with such males is an important factor in securing desired improvement in production. The general practice among poultry keepers is, while breeding from males descended from high producers, to use along with them the best producing females obtainable.

The ability of high-producing females to transmit this character to their offspring undoubtedly varies in individuals. To date no one has discovered a certain method of determining degree of ability to transmit fecundity, though it is believed that high constitutional vigor is an important and possibly the most important factor involved.

Pedigree Breeding and Use of Trap Nests

No one will dispute the statement that the most exact and most satisfactory method of breeding for improved quality, whether it be high egg production or any other, is pedigree hatching. The breeder who makes individual matings rather than flock matings, and who adopts a system that enables him to keep an accurate record of results secured from individuals, is in a position to make more rapid progress than can be achieved in any other way. This method of breeding, however, involving as it does

FIG. 117—A PREPOTENT BARRED PLYMOUTH ROCK MALE

This bird mated to grade females and others of standard quality, produced ten granddaughters, laying 1956 eggs (an average of 196.6 each) in the Vineland Contest, 1916-1917. One of the ten laid 272 eggs and another 258

the use of trap nests during a whole or a large part of the year, is a relatively expensive practice. To the professional breeder this expense may not be a serious factor, but it makes the method quite impractical for the average person. For this reason trap nesting is not, and probably never will become, generally popular. What the everyday poultry keeper wants, and fortunately now can have, is a simple method by which he may breed his best producers, selecting these without the use of trap nests or elaborate records.

Selective Flock Breeding

Selective flock breeding means simply the annual selection of the best layers by the application of well-known and reasonably accurate methods of identifying them by external characters, and the exclusive use of such females in the breeding pen, mating them with males of known heavy-laying ancestry if possible. This simple and inexpensive plan may be adopted by anyone and, as has been abundantly shown in practice, it results in prompt and marked improvement in production. As an instance of the way in which improvement may be secured by this method of breeding, the following statement in regard to the development of the farm flock of G. W. Buck, of New Jersey, may be mentioned. Mr. Buck is a farmer owning and operating 140 acres of highly fertile soil, chiefly devoted to the production of potatoes, corn, alfalfa, and timothy hay. His poultry flock is more or less of a side issue, though he frankly states that in recent years it has been "the best paying crop on the farm".

FIG. 118—PREPOTENT MALE OF A HEAVY-LAYING STRAIN

This cock produced 10 daughters that in their pullet year (Nov. 1, 1918, to Aug. 13, 1919) averaged to lay 159 eggs each. Compare this record with that of the male shown in Fig. 119. Good breeding pays. Photo from Cornell University.

At the solicitation of the New Jersey Station poultry authorities Mr. Buck entered a pen of ten pullets in the Vineland Egg Laying Contest, which pen made a remarkable record. In the following interview (reproduced from Reliable Poultry Journal, June, 1919) with V. G. Aubry, Extension Poultry Specialist, who has been in close touch with Mr. Buck in regard to his poultry work for a number of years, the following facts were brought out in regard to Mr. Buck's flock and the results secured from his contest pen:

"In the spring of 1914 I was working in Monmouth County as Extension Poultryman, sent there on that errand by Professor Lewis. I did not then know that Mr. Buck had Barred Plymouth Rocks, but was with the county agricultural agent who wanted to see Mr. Buck about the potato crop. As we drove into the place he told me I would see here a good flock of farm-range Barred Rocks —and I did. Their color did not impress me especially, but I at once noted their size, health, and apparent vigor. That day Mr. Buck told me how well they laid, just as a farm flock, and said he would like to know where to buy one hundred hatching eggs; that he wanted some new blood and would like to have something 'a little better', as he expressed it. At the College Farm we had some good-quality Barred Rocks, carrying standard blood of the Dan Lambert strain, also of the M. S. Arey strain, Benton Harbor, Mass. Judge Lambert had bred for high egg production as well as for standard type and color, and Mr. Arey also helped out in type and color. The combination gave us well-bred, average-quality, standard stock. These birds had been line bred for egg production on the College Farm for two or three years, where they were trap nested and selected also for type and color. Mr. Buck bought one hundred eggs from this flock, paying ten dollars for them, and since then he has used no other outside blood. The ten dollars therefore, represented his entire new investment.

"In the spring of 1915, on one of my visits to Mr. Buck's farm, a male bird was selected from this hatch for a special mating, and this cockerel, as a yearling, was used as a breeding male in the spring of 1916, and sons of his were used that same spring on the old flock—meaning the original Buck grade stock—and with other pullets raised from the hundred eggs. The ten birds entered by Mr. Buck in the Vineland Contest, fall of 1916, were daughters and granddaughters (through his sons) of the original male shown in Fig. 117. These ten birds at Vineland laid 1,956 eggs in twelve months, an average of 195.6 eggs each, one of them laying 272 eggs and another 278 eggs—which were remarkable performances indeed.

"This Vineland Contest is not a one-year egg laying contest, but is a three-year laying and breeding contest, as set forth in the rules and regulations. In the spring of 1918, therefore, a cockerel was sent by Mr. Buck to Vineland, to mate to the pen that had laid the 1,956 eggs in twelve consecutive months. This cockerel was the grandson or a great-grandson of the old original 1915 male. The daughters of this cockerel and original pen are at present being trap nested at the contest and now are second high pen (week ending April 17, 1919) in the entire contest, with a production to date of 1,000 eggs, the first high pen being a pen of S. C. White Leghorns with an egg yield to date of 1,102 eggs. The mothers of these Buck Barred Rocks, up to the same date in their year of test (1916-17) had laid only 997 eggs, a difference of 103 eggs in favor of the line-bred pullets to the end of the twenty-fourth week, equivalent to April 17th of this year.

"Furthermore, three daughters of bird No. 19 in the pen entered in the first year of the contest, which hen laid 278 eggs, are laying more eggs to date than did the original bird. Her yield to April 1st of her test was 108 eggs, while these daughters have an average of 119 eggs to the same date, one of the three daughters having laid 85 days in succession with but one skip and having a trap-nest record to April 1st of 139 eggs, or 31 eggs more than her mother laid in the same length of time when she helped produce 1,956 eggs in 365 consecutive days as one of a flock of ten pullet-hens.

"Each year, beginning with the fall of 1915, a member of the department here has helped Mr. Buck in the selection of birds to be kept for laying and breeding purposes. These birds from the first were selected according to pigmentation tests and each summer the flock has been

rigidly culled. In mating the birds, standard values in the form of type and color were also considered as important, and only the best birds on the basis of egg production and standard type and color were kept for breeders. The original male bird undoubtedly had remarkable egg prepotency; also he put the color on them and helped the type. After that it was a matter of selection, in which type, color, and barring were favored."

How to Proceed in Selective Flock Breeding

Anyone who wishes to breed for increased egg production has only to master the selective methods described in the previous chapters of this book, and apply them to his flock, to be able the following season to place in his breeding pens only the best layers of the year before, thus restricting his hatching entirely to eggs from his best producers. In this system of flock mating the breeder necessarily cannot know definitely the ancestry of his male birds, so that while the females may all, or practically all, be high producers, there is the possibility that an inferior male bird may be selected to mate with them, thus to some extent nullifying his efforts. Where only the best layers are used for breeding, however, and male birds selected from the results of these matings, they must all be from high producers, regardless of whether their pedigrees are known or not. In any event this method of breeding is so greatly superior to the method commonly followed, that improvement is assured from the start and may be expected to increase in intensity as the practice is continued through succeeding years.

FIG. 119—A LEGHORN COCK OF POOR LAYING ANCESTRY

This cock produced 17 daughters that in their pullet year (Nov. 1, 1918 to Aug. 13, 1919) averaged to lay only 89 eggs each. Photo from Cornell University

To the breeder who proposes to adopt this practice a word of warning should perhaps be given against a mistake too frequently made. The individual poultry keeper who has familiarized himself with the remarkable results secured through culling is apt to lay too much stress upon selection of adult fowls, depending almost entirely upon late summer or early fall culling, which is the period of the year when the method can most readily be applied, and when most publicity is given to the practice. For the breeder to do so is to result in his overlooking other opportunities for selection which, to those earnestly striving to improve their flocks, are much too important to be omitted. Regardless of what may be accomplished by the application of various culling methods at the end of the first laying year, the poultry breeder should remember that to get best results he should overlook no steps prior to the main summer culling that will enable him to effect improvement in the general average of his flock. This means in practice that culling should begin with the chick.

There is no good reason why any poultry keeper should fall into the costly error of allowing individuals to remain in the flock that at any time in their existence have developed apparent unfitness. Chicks that are weakly when hatched, or that at any stage of their growth and development show a lack of constitutional vigor, such as slow growth, delayed feathering, or the development of any sort of physical defect, should be disposed of the instant these are noted, thus saving the feed that otherwise would be wasted in securing their slow and unprofitable growth.

In the case of growing fowls that show some inferiority, but which are to be kept for a time, most practical poultry keepers adopt a method of marking them by the use of leg bands or even by cutting off the end of a toe, thus insuring that, no matter what development they may make later on, they will by no chance get into the breeding pen where their constitutional weakness, which is not always apparent in adult birds, will be passed on to their offspring.

A good time for culling is during the period when the pullets are coming into maturity at which stage the poultry keeper who knows the age of his pullets is able readily to identify the slow-growing, slow-maturing inviduals which, as a rule, are unprofitable at all times and which he particularly wishes to keep out of the breeding pen, whatever use he may make of these elsewhere.

Use Hens in the Breeding Flock

While there are peculiar conditions under which it sometimes is necessary or desirable to employ pullets as breeders, the use of hens is always preferred, and these should be chiefly depended upon for that purpose. The poultry keeper, who while trying to breed for increased egg production resorts to pullet matings, has to contend with serious difficulties. If he selects his best producers, he will have to take those that have been laying all winter long and that, as a direct result of the general weakening effect of months of heavy production, are not capable of transmitting high vigor to their chicks. If he uses younger pullets that are not open to this objection there will be no way of determining their relative value as producers, and as a result many of the birds selected will prove to be inferior layers and highly undesirable as breeders.

Those who use hens one year old or over find that they come into laying just about at the beginning of the breeding season, and are at their best as regards health and vigor, provided they have been properly handled, and will transmit to their chicks the greatest measure of health and constitutional vigor that they are capable of giving, and they should continue to do this practically throughout the entire hatching period. The eggs laid by hens are always larger than those produced by them as pullets, and as the size of the newly hatched chicks is determined by the size of the eggs from which they are hatched, it is readily seen that the chicks hatched from eggs laid by hens have a distinct advantage.

Prepotency

All fowls possess some degree of ability to transmit racial and individual characters to their offspring. The measure of ability to do this, however, varies greatly in individuals, both male and female. Occasionally a bird is discovered which possesses extraordinary power to

stamp its characters upon its offspring. This is prepotency as the poultry breeder uses the term. Obviously, it is highly desirable to be able to detect such fowls, and many efforts have been made to find some means of doing so. One method that has received a good deal of publicity is based upon skull measurements, but its practical value has never been satisfactorily demonstrated. To date there is no certain way of detecting prepotency except by actual test in the breeding pen. It is known that fowls of the purest blood are most likely to possess this power; hence line breeding is regarded as especially effective in intensifying characters and the ability to transmit them.

To show the influence of a strongly prepotent male upon egg laying ability, the following incident is related: In the first year of the Vineland Laying and Breeding Contest, W. P. Laing entered a pen of Buff Wyandotte pullets. They made a comparatively poor showing, the average production for the pen being only 84.5 eggs. The second year Mr. Laing sent a cockerel to be mated with the pen and, from the chicks produced, a pen of ten pullets was selected for the third year contest. Nothing special was known in regard to the breeding of the cockerel but he proved to be exceptional in ability to transmit heavy egg laying qualities, as shown by the fact that his pullets, up to the middle of July, had already averaged to lay 130.4 eggs. The table here presented gives the individual first year record of the hens in the original pen, and of the pullets descended from them. The hens in this mating appear to have had little influence, as the best-laying pullets were descended from the poorest layers, while the poor-laying pullets were from the birds that made the best records in the first year contest.

FIG. 120—A BRED-TO-LAY FLOCK OF WHITE WYANDOTTES

These laying-strain Wyandottes, bred by John S. Martin of Canada, are descended from "Dorcas" (the hen indicated by an X in the illustration) with a record of 241 eggs in 12 months. This hen has proved to be a highly valuable female, transmitting her superior laying qualities to her daughters with great uniformity.

Similar evidence in regard to the influence of males upon productiveness of offspring has been secured at Cornell University. The cock shown in Fig. 119 (Cornell No. D 1452) had 17 daughters, raised during the season of 1917-1918, whose average production during their pullet year (Nov. 1st to Aug. 13th) was only 82 eggs. The cock shown in Fig. 118 (Cornell No. F 563) had 10 daughters whose average from Nov. 1, 1918 to Aug. 13, 1919 was 159 eggs.

The foregoing may or may not be exceptional cases. There certainly is plenty of evidence to show that hens often do have an important influence upon the production of their pullets, and there are excellent reasons for believing that those who seek to secure increased production will do well to use high-record females, as well as males descended from such.

TABLE SHOWING IMPROVEMENT IN PRODUCTION DUE TO USE OF PREPOTENT MALE

Hen number	1st year record 12 months	Pullet number	3rd year record 36 weeks	Out of Hen No.
1	98	1	169	1
2	72	2	151	2
3	149	3	67	3
4	66	4	148	1
5	109	5	114	5
6	80	6	143	6
7	52	7	125	7
8	171	8	111	8
9	0	9	142	1
10	48	10	134	6

The Breeding Flock and Its Management

The poultry keeper who adopts the suggestions given in foregoing chapters in regard to selection will find that in the fall, after the regular end-of-the-season culling, the question of selecting fowls for his next season's breeding pens has been greatly simplified, since he will have left in his flock few inferior individuals. He will, however, if a true breeder, want to mate his pens in conformity with the established principles of standard poultry breeding. The importance of keeping standard fowls and of breeding for such qualities along with high egg production are presented elsewhere in this book and need not be referred to here further than to repeat, by way of emphasis, that THERE IS NO PERMANENTLY SUCCESSFUL POULTRY INDUSTRY WHERE STANDARD QUALITIES ARE IGNORED.

The fowls that remain after the flock has been culled in the fall must again be culled with reference to standard qualities before final selection as breeders. As a rule, this final culling will take place near the beginning of the breeding season, when the fowls are in full feather and in their best physical condition, and when their general conformity to standard requirements can most readily be determined. It may involve something of a struggle to reject a hen that is an exceptionally good producer because of her unfitness as a breeder when judged from the Standard viewpoint, but certainly such fowls should not be admitted to the breeding pen.

Fall and Winter Treatment of Breeding Fowls

It hardly need be said that fowls intended for breeders the following season should not be fed for egg production prior to that time. Unfortunately the knowledge that the birds should not and, as a rule, will not be productive in fall and early winter, no matter how they are fed, often results in their being grossly neglected. Just because they are not going to be productive for two or three months, however, is no reason why they should be mistreated and kept in uncomfortable or unsanitary quarters, or underfed. That is the poorest kind of economy. On the contrary, they should, if possible, be placed in permanent quarters before winter sets in and thereafter should be fed on a well-selected nutritious ration that will

keep them in best physical condition but will have no tendency to force production. At this time the birds should have a comfortable house and ample yards or range to which they should be given access even in winter, except in extremely cold or stormy weather, and should be fed chiefly on scratch grains.

Litter should be provided freely, and all grain should be buried in it. Nothing will do so much to keep hens in good physical condition and insure high fertility and high vitality in the embryos as an abundance of exercise not only during the breeding season but during the fall and winter months leading up to it. Dry mash should be supplied in hoppers, but its composition should be such that the fowls will not be tempted to consume it too freely. A good grain mixture for the prospective breeding pen is: two parts of cracked corn, one part of wheat, and one part of barley if available. For the mash: two parts by weight of bran and one part of middlings, to which should be added not over ten per cent of meat scrap. The proportion of corn in the scratch grains can safely be increased to one-half or two-thirds in severely cold weather, if cracked and fed in plenty of litter. No oats need be provided in the scratch grain if a daily feed of sprouted, boiled, or soaked oats is given. If this is not done then oats should be added to the grain mixture, in which case a better formula will be three parts of cracked corn, one to two parts of oats (depending upon quality), and one part of wheat. Do not make the mistake of omitting meat scrap entirely from the mash mixture simply because the fowls are not expected to lay. A reasonable amount of meat is needed in the ration of fowls at all times, though the percentage in the case of nonlayers should not be as high as in the ration for laying flocks.

As the breeding season approaches the fowls should be carefully examined and final selection made, and if not already in their permanent quarters they should be placed there not later than January 1st, as a general average for the larger breeds, such as Plymouth Rocks, from which eggs for hatching probably will be required by about the 1st of February. If the modern method of balancing the flock by providing some extra-early pullets is adopted (see Chapter XVII), Leghorns also should be in permanent quarters by about the same date.

The breeding pens should have comfortable, sanitary quarters not differing from those usually provided for the laying flocks, aside from the fact that it is desirable to give the former more floor space per hen. Where winters are extra severe, a somewhat warmer house may be required, in order to avoid any danger of frosted combs. Whether the breeding pen shall consist of a single male mated with a suitable number of females ranging from eight upwards,—this number to be determined by season, breeding, age of male birds, etc.—or a much larger flock with several males (flock mating), will be determined largely by individual conditions. As a rule, better results are secured with small pens mated to a single individual, but flock matings are better suited to the dimensions of the average poultry-keeper's houses. This method also calls for less labor and, when properly managed, gives excellent results.

The ration for the breeding pen should be changed gradually as the hatching season approaches, placing the hens on substantially the same ration as that fed to the laying pen. However, if eggs are to be produced through a long hatching season, any tendency to force production must be avoided. High production early in the season means that the fowls will use up their vigor and their vitality, and the eggs produced by them later on will prove unsatisfactory as regards incubation.

A good grain ration at this time is equal parts by weight of cracked corn, wheat, and oats. Provide sprouted or soaked oats as a regular daily feed. This grain is regarded as a most valuable one for all kinds of breeding stock, and should never be omitted from the ration of breeding fowls. If the oats are plump and heavy they can be added to the scratch-grain mixture to good advantage, but if light in weight their use in this way is apt to result in serious waste, and the fowls will not get as much of this grain as they should have. Heavy feeding of light, dry oats often causes serious intestinal disorders due to the excess of crude fibre. Where oats are freely fed, it is always safer to give them sprouted, soaked, or boiled.

The mash mixture during the breeding season may consist of equal parts by weight of bran, middlings, corn meal, and rolled oats, and twenty per cent of meat scrap. If the fowls will not eat this mash mixture freely in the dry state, it should be fed as a moist mash once a day. At this time the mash part of the ration should amount to approximately fifty per cent of the total day's feed consumption. Supply milk to drink whenever possible, and where this is available the proportion of meat scrap in the mash mixture may be proportionately reduced. Continue to supply litter liberally and give special attention to the exercise of the fowls. Green feed, of course, must be provided. Many experienced breeders prefer cabbage to any other form of green stuff for the breeding pen. Where this is not available, probably there is no better source of supply than sprouted oats. Provide grit and oyster shell as for the laying flock, and see to it that the fowls have fresh, pure water at all times. Since health and vigor are of primary importance in the breeding pens, it is advisable to supply as large yards as practicable and give the fowls access to them at all times, regardless of weather conditions.

How to Mate the Breeding Pens

The number of females that can be mated with one male cannot be arbitrarily fixed, as much depends upon the season, age and individuality of the males, and the breed to which the fowls belong. In cold weather fowls do not mate as readily as in warmer weather, neither do they mate as readily in confinement as on open range. In a general way it may be said that with the larger breeds such as Plymouth Rocks, Wyandottes, etc., the number of females should be limited to not more than eight if a cock is used, or ten to twelve if mated with a cockerel. Later in the season, particularly if on free range or practically so, the number in each case may be increased 25 per cent or more. With Leghorns in confinement the minimum number need not be below ten, and may be increased to twenty with vigorous young birds. With fowls on open range and in the height of the breeding season these numbers may be further increased.

In Leghorn flock matings males usually are provided in proportion of from four to six for each one hundred females. In the case of larger breeds the number of males should be increased to six or eight. Where this method is practiced, it is necessary to use care in handling the

male birds so as to reduce to the minimum the injuries that are liable to result from fighting. If the birds are well acquainted with each other before they are put into the breeding pen, serious trouble is not apt to occur, though they should be kept under close observation for a time. Especially pugnacious individuals should either be removed and used in single pens, or their beaks and spurs should be trimmed in order to reduce the danger of injury from fighting.

FIG. 121—HIGH-VITALITY MALE

Contrast the alert, vigorous, snappy appearance of this bird with the low-vitality specimen in Fig. 122. It is from such birds as the above that the poultry keeper can expect the high constitutional vigor that is one of the most important characteristics of the heavy producer, particularly of those that have the vitality not only to produce large numbers of eggs but to transmit this ability to their offspring. Photo from New Jersey Experiment Station.

Constitutional Vigor and Its Relation to Production and Growth

The Importance of Using Only Highly Vigorous Fowls in the Breeding Pen Can Hardly Be Overemphasized—Causes of Constitutional Weakness In Fowls, How Detected and Prevented

By PROF. H. R. LEWIS[8]

EDITORIAL NOTE—Constitutional vigor in breeding fowls is one of the characters that rarely receives the attention it should. Low fertility, poor hatches, weakly chicks, slow growth, and even inferior production in adult flocks may, in a great many instances, be traced back directly to the inferior physical condition of the breeding stock. This subject is of especial importance to those who are breeding for increased egg production. No matter what a given fowl's ancestry may be as regards laying ability, she will not be capable of sustained heavy production without great constitutional vigor. There is reason to believe that the proportion of high-record hens would be much greater than it now is if it were not for the fact that so many having heavy-laying ability are not physically able to digest and assimilate the relatively large quantities of feed essential to such performance. The relation of vigor to productiveness is quite clearly explained in the following article:

BY observing flocks of different ages it will be noted that, from the time they are hatched till death, fowls differ considerably in regard to their constitutional vigor. Chicks at hatching time show inherited differences, some being weak and stunted and slow growers, while others are exceptionally strong and vigorous, and characterized by a rapid, uniform growth. Many others fall into groups midway between these two extremes. Carrying the study still further, we see these same differences in cockerels and pullets during the growing period, and experiments show conclusively that birds which are weak and show lack of vitality during early life will never produce a profitable dozen eggs or a profitable pound of meat. To continue the same study with mature birds, he who will take time to observe one or more flocks will see that marked differences exist between females in reference to vigor as exemplified by size and shape of body, general carriage, prominence and lustre of the eye, shape of head and beak, and angle of tail. It is quite possible for the student to go into almost any flock and weed out many culls or so called drones which, owing to their form and structure and lack of inherited vitality, are producing few if any eggs, and are living at the expense of the better hens. The elimination of these inferior individuals by selection should be one of the first objects of the poultryman.

Selection for vigor and vitality should be continually practiced therefore, not only in mature birds and in the breeding pen, but throughout the entire brooding and growing period. Fowls of any age or sex which show at any time a lack of constitutional vigor will prove unprofitable for any purpose, and should be eliminated. The motto and aim of the poultry farmer should be "fewer birds, but better birds."

Some Signs of High and Low Vitality

Signs of high vitality, or lack of it, are easily distinguished. The following are a few:

The actions and movements of fowls probably best indicate their physical condition. The physically weak are inactive and dull, and are more likely to sit than to stand. They do not range to any extent in search of forage, nor do they scratch in search of feed. They remain longest on the perches, possibly spending the entire day there.

The loudness and frequency of the crow of the male, and the cackle of the female, are indications of physical strength and superiority. Weak fowls seldom crow or sing.

There are certain signs which indicate lack of vigor in a fowl as, for instance, long neck, thin beak, narrow head, or a long, slender body, long legs and thighs, or a stilted appearance. The reverse is true of vigorous birds.

In the young growing chick, common signs of low vitality are stunted growth, slow feathering, pronounced crow-like beak, drooping wings and head, and a low squatting walk.

The strong bird, at any age, should have a bright, prominent eye, a well-developed, blocky body, bright plumage, and erect carriage, bright comb and wattles, and should be active and sprightly in movement.

[8]Hints to Poultrymen, Vol. 2, No. 4, New Jersey Experiment Station.

Some Possible Causes for Loss or Lack of Vigor

Increased Productiveness. The modern hen is expected by good care and management to lay from 120 to 160 eggs a year, and, at the same time, these eggs, or some of them, must be hatched into chicks with as much strength and vigor as the parent. It is evident that any increase in the production of eggs must be accomplished by a proportionate increase in the physical strength of the bird, to enable her to assimilate the increased amount of food required for this increased production.

In-and-In Breeding. Inbreeding is often resorted to in order that the high producing qualities may be better and more quickly fixed. But where due consideration is not at the same time given to vigor, loss of vitality is bound to follow.

Pullets Instead of Hens for Breeding. Vigor will certainly be lowered by producing progeny from immature parents. Pullets lay small eggs, which hatch small chicks, which in turn result in small adults at maturity. The greatest size and vigor in pullets and cockerels can doubtless be obtained by using yearling or two-year-old hens in the breeding pen, mating them to large, vigorous, early-hatched cockerels.

Fall and Winter Egg Production. Under normal conditions the fowl is allowed a part of the year in which to rest and store up energy for future seasons of heavy production, and it will be found that forced feeding and heavy production are antagonistic to the highest fertility and greatest degree of vigor in the offspring. It is well therefore, at as early a date as possible, to pick out all the adults which are desirable for use as breeders, and give them time to rest during the winter and store up energy and physical strength during the natural resting season.

Excessive Crowding of Breeding Stock. The modern intensive system of handling poultry is responsible for much of the present low vitality in fowls. Where it is desirable to raise future producers, it should be the policy to handle the breeding fowls on extensive rather than on intensive producing plants. Both young stock and breeders have more vigor when raised on land used for other purposes, such as fruit growing, grass, and grain crops.

Lack of Exercise for Breeding Stock. This is another direct cause of low fertility and consequent low vitality. The breeders during the winter should be kept in an open, dry house, and practically all of their feed should be fed in deep litter where they will be compelled to work for it. Exercise keeps the blood in rapid circulation which maintains health.

Improper Methods of Hatching and Rearing. Rather early hatching induces better growth, as the chicks get well started before hot weather. Plenty of moisture in artificial incubation insures better hatches of larger chicks, which seem to possess higher vitality as exemplified by a lower mortality. Extreme variations in brooder temperature accompanied by sloppy sour feed are often responsible for heavy mortality and loss of vitality in the chicks that manage to survive such treatment.

Breeding Stock Low in Vigor. If the desire is to increase or even maintain a high degree of vitality, selection of breeders of superior vigor is of paramount importance. Vitality and stamina are directly affected by two conditions: inherited factors and environmental conditions. If we are to succeed permanently, we must practice systematic and rigid selection, first in our breeding flocks, and second in our laying flocks, and in addition to these we must surround our birds with a congenial environment which is most conducive to health. GOOD HEALTH IN THE FLOCK IS THE FOUNDATION OF SUCCESSFUL POULTRY FARMING.

The truly great importance of culling and of selective flock breeding as a practical means of improving poultry flocks generally, is fully appreciated by the Poultry Department at Cornell University, which has adopted plans for giving practical assistance along these lines, that promise to be of the greatest importance in the development of the poultry industry in the state of New York. What these plans are, is fully set forth in the following article which, it is hoped, will prove helpful in interesting the poultry departments of other state colleges in taking similar steps.

Practical State-Wide Poultry Project

An Excellent Summary of the Money-making Benefits of Down-to-date "Culling"—Also Rules Governing the New York State Method of Certifying Breeders

By EDITOR OF R. P. J.*

THE logical growth and consistent development of the various lines of activity of the Poultry Department of the New York State College of Agriculture, at Cornell University, Ithaca, N. Y., read almost like a romance. The Cornell plan represents what R. P. J. considers to be one of the best poultry projects—if not the best—that to date has been worked out and "put across" in the interests of poultry culture as a science and for the welfare of the poultry industry in this great agricultural country of ours. All due credit to Prof. James E. Rice and his capable, hard-working, loyal assistants. Following is the story—and it is one of genuine impor-

*Reprinted from Reliable Poultry Journal, October, 1919.

FIG. 122—LOW-VITALITY MALE
Photo from New Jersey Experiment Station.

tance to many R. P. J. readers. Fact is, every state in the Union, meaning in particular the states in which agriculture (including live stock) is the foundation of general business and the bulwark of prosperity, SHOULD ADOPT this same method or a quite similar one without unnecessary delay, the work to be done by the state agricultural colleges, respectively.

First, we have this lately discovered and expertly elaborated method of practical culling, with the object of eliminating the nonproducers, poor producers, and early quitters, thus to protect the feed bin and the bank account of the owner of the fowls, few or many.

But that is not enough—is only one step in the right direction. The next step, in logical order, is "certified breeders." Of what real permanent use would it be, if the field-extension men of the Poultry Department at Cornell were to continue to visit the farm flocks of New York State every late summer and fall to "cull out" the poor producers, the early quitters, etc., IF NO REAL PROGRESS WAS TO BE MADE by the owners of these flocks along the line of better breeding and better stock, both as regards standard qualities and high egg production?

And after the plan of selecting out good breeders from every culled flock and styling them "certified breeders" had been followed to a practical stopping place, what then? Was this ALL that needed to be done—all that COULD be done—in the best interests of earnest poultrymen and poultrywomen in New York State who look to their flocks for profitable returns?

No, there was another logical step to be taken—and now it is to be taken. Briefly it is this: the powers that be have made a special appropriation of funds for the Poultry Department of the New York State College of Agriculture, by the use of which a "Breed Proving Station" is now being established. New buildings that will contain twenty to twenty-five breeding pens of moderate size are to be erected this fall as the nucleus—as the starting point of a proving station for breed or strain testing that before long is expected to be a big establishment, a large and vitally important part of the well-equipped and expertly managed Poultry Department at Cornell University.

After this Breed Proving Station has been put into operation, the course of procedure in the Empire State, as regards this line of work or "project" of the Poultry Department of the State Agricultural College will be substantially as follows: first, expert culling of good-sized flocks throughout the state to be done by field-extension men of the Department, these men to instruct the owners of the flocks respectively how to do the work themselves; second, these same experts, at this time or later, will select from the best birds of each owner's flock, those that should be used for breeding purposes, these specimens to be "certified", to be given leg-band numbers, to be kept track of, etc.; third, and later, after the owner of "certified" specimens has shown fully his or her active and intelligent interest in better poultry and more of it, two or more such flock owners in each county of the state will be invited to send a pen of these "certified breeders" to Cornell University, where they will be placed in the Breed Proving Station, kept under trap nest, and line bred, pedigreed, etc., for a considerable length of time, at state expense.

The foregoing is the order of procedure, and we submit to the interested reader that it is a remarkably fine project—AND FOR SOUND REASONS. Its chief virtue, perhaps, exists in the fact that all these flocks belong to the people who are to be relied on to take care of them, help improve them, and be responsible for feeding, housing, management, etc. The flocks also will be widely separated and until a limited number from each flock is sent to the Breed Proving Station ALL responsibility, or practically so, is to rest with the owners of the birds.

A second valuable element in the plan is that numerous earnest, intelligent, and progressive poultrymen and poultrywomen of New York State will be getting the full benefit, if they so desire, of all knowledge, experience, and down-to-date advice that the Poultry Department at Cornell University, with its ten capable workers, headed by Prof. Rice, can give them, and this extraordinary help will be brought right to their farm or poultry plant. Such visits should be worth a great deal to every poultry keeper in that state who carries several dozen, several hundred, or several thousand head of fowl for productive purposes. Also it will help these field-extension men who are working to improve not only the breeding stock and layers, but also the methods of management in caring for them to obtain really profitable results.

Finally, this plan will allow a limited number of poultry keepers—taking New York State as a whole—to adopt and follow up intelligent, down-to-the-minute breeding methods, so that they can get the benefits of line breeding, of pedigree work, etc.—and they will be getting this invaluable help at public or state expense. It is help that perhaps they could not get otherwise. Line breeding, trap nesting, and pedigreeing represent expensive work. Only poultrymen regularly in the business can afford to do this and do it right, as a general rule. But the Poultry Department at Cornell can do such work and do it with thoroughness,—doing it with public funds, and not a tax payer in New York State will ever know the difference. In that immensely rich commonwealth if a "mathematical" tax payer were to try to figure out how much this work is to cost him, on the dollar basis, on a hundred dollar basis, or even on a thousand dollar basis, he would not be able to find the item—it would be that small!

On the other hand, this work is destined to be of immense benefit to poultry culture, on practical lines, in New York State. As time goes on every one of these strains of line-bred stock, based first on selective flock mating, second on the use of "certified breeders", third on the benefits of "proved strains", as tested and demonstrated at the Breed Proving Station at the State College of Agriculture, will be just that many sources or near-by "fountains" where the ninety and nine interested poultry keepers of New York State can obtain surplus breeding males, small pens of breeders, eggs for hatching, and day-old chicks, this stock and the products therefrom to be of decidedly superior value to the average run of present-day farm poultry, even in New York State.

Summary

The greatest practical value in culling is in the opportunity it affords for selecting the best layers for the breeding pens.

Fecundity is transmitted through both male and female lines.

Trap nesting is too laborious and expensive for the average commercial producer.

Selective flock breeding insures gradual improvement at slight expense and with little trouble.

Fall culling alone is not sufficient in selection of breeders.

Fowls intended for the breeding pen should be under observation from the time they are hatched.

Hens are much better than pullets for the breeding pen.

Breeding stock must not be neglected and mistreated when nonproductive.

Exercise for breeders is highly important both in and out of the hatching season.

The breeding pen should not be fed for heavy egg production at any time.

Wide differences exist in fowls as regards constitutional vigor, and these are accentuated by the artificial conditions under which they are kept.

The hen is the most efficient transformer of raw material into finished product on the farm; and exceptional constitutional vigor is required to keep her in good condition.

Selection for vigor and vitality should be continually practiced from the brooder to maturity.

Low constitutional vigor may be caused by heavy production, inbreeding, use of pullets instead of hens, too heavy feeding, lack of exercise, improper methods of hatching and brooding, etc.

Good health in the flock is the foundation of successful poultry farming.

CHAPTER XII

Culling Methods Particularly Adapted to the Farm Flock

Poultry Keeping Is an Important and Profitable Branch of the Farm Live Stock Industry and Is Capable of Yielding Still Greater Returns When Properly Developed—The Efficiency of the Farm Flock Is Increased By Systematic Culling—How To Do This in the Most Convenient Manner

THE farms of this country have always been by far the most important source of supply for table eggs and poultry, and the annual market value of their poultry products amounts to a truly enormous sum. In spite of this fact, however, the possibilities of the farm flock as a source of income are not half appreciated. In too many cases the fowls are largely left to shift for themselves—in fact, are tolerated only because of their ability to do this. By utilizing otherwise waste food materials, cost of maintenance is reduced to so low a level that even though they fall far short of the commercial poultry keeper's standards of production a substantial profit is still assured.

The ability of fowls partially to support themselves should always be fully utilized on the farm. But to get the best returns from them the resources of the range should be regularly and adequately supplemented. Fowls are entitled to rank with other classes of farm animals as a practical medium for turning the raw products of the field into human food. As a matter of fact, they do this with an efficiency unequalled in any other branch of live-stock production; and as this becomes better understood a great increase in this branch of farm production may safely be predicted.

What Breeds to Keep on the Farm

Where eggs only are wanted, there is no question about the fact that small fowls will produce them at less cost than will large ones, while there are many economies in the way of labor, houseroom, and equipment, which are practical with such fowls as Leghorns, that are out of the question with the larger breeds. Notwithstanding this fact, Plymouth Rocks, Wyandottes, and R. I. Reds undoubtedly are most popular with farmers, and probably will remain so for many years to come. Under the conditions found on the average farm the cost of producing table poultry is comparatively low, and it is doubtful whether there would be any advantage in giving up this important source of added revenue for such advantages in low cost of egg production and economy in labor as are realized where Leghorns are kept. It is fortunate therefore, that good egg production can be secured with fowls of large breeds as well as with small ones, and that it does not matter greatly which of the different breeds is kept, provided only that stock from a heavy-producing strain is secured.

The illustrations of high producers of various breeds given in Chapters IV and V, are sufficient proof that no breed or variety has a monopoly of high egg records, and there is opportunity to satisfy a wide range of preference as to size, shape, and color without in any manner sacrificing egg production. As a rule, farmers in the northern part of the country where the summers are short, particularly if they are going to depend upon natural methods of incubation and brooding, should select Wyandottes or R. I. Reds for the simple reason that fowls of these breeds should mature about one month earlier than Plymouth Rocks hatched on the same date. Thus the time required to bring pullets into maturity before cold weather is decidedly reduced. Where artificial methods of incubating and brooding are followed however, this consideration ceases to have much practical significance.

Importance of Culling on the Farm

Culling is a matter of special importance in farm flocks, as the fowls often are of mixed breeding and usually contain many more old hens than is the case in commercial flocks. For these reasons it is common experience in culling demonstrations to find that, with one-third or one-half of the flock thrown out as culls, the fowls that are kept actually produce more eggs than the entire number did before.

In all culling operations it is important to bear in mind that many fowls are thrown out as unprofitable producers because they have been neglected, underfed, or otherwise prevented from doing their best. One of the

FIG. 123—A GOOD NEW JERSEY FARM FLOCK

Scene on the farm of G. W. Buck. The breeding of this flock is described elsewhere (see Chapter XI). A pen of Mr. Buck's Barred Plymouth Rock pullets made an average of 195.6 eggs each, at the First Vineland Laying Contest. Courtesy of New Jersey Experiment Station.

essential conditions of accurate culling, therefore, is to see that the fowls have had good care and feeding. When an owner reports as many eggs daily from his culled flock, as he previously secured from the entire number, that may not mean that the hens taken out were worthless as layers, but rather that the housing or the feeding was inadequate for the original flock or that the culled birds received better care due to the awakened interest of the owner.

FIG. 124—A SCENE IN THE MISSOURI CULLING CAMPAIGN

In this illustration, H. E. Cosby, Extension Poultry Husbandman of the United States Department of Agriculture, is shown explaining before his hearers just how to tell a good layer from a poor one.

It often is not realized to what extent the production of hens is affected by their treatment or by the rations supplied. Often the farmer who knows that neglect, mistreatment, or underfeeding will result immediately in a decrease in the amount of milk produced by his cows, fails to appreciate the fact that exactly the same results accompany similar mishandling of his hens, though the consequences may not be as plainly seen.

To illustrate the economical saving that culling effects in farm flocks we reproduce here an article which appeared in the Reliable Poultry Journal, January, 1919, giving the results secured in a culling campaign in Missouri during the previous season.

Remarkable Success of a Farm Flock Culling Campaign

How Missouri's Slacker Hens Were Culled Out and Disposed of in a State-wide Culling Campaign—Eighteen Carloads of Culls Sent to Market From Only Four Counties

By T. S. TOWNSLEY

EIGHTEEN carloads of slacker hens have been sent to market from four counties and a trainload of feed saved as a result of a Poultry Culling Campaign in Missouri. And the sale of these hens has made no noticeable reduction in the number of eggs produced.

In the Poultry Booth at the University of Missouri Exhibit at the State Fair at Sedalia, August 10-16, 1918, were two White Leghorn and two Barred Rock hens which attracted a great deal of attention. One of the Leghorns and one of the Rocks were fine looking, clean-feathered, yellow-shanked birds, while the other specimen of each breed wore dirty, ragged plumage, and had pale, faded shanks and beak. A sign over the coops containing these birds bore the legend, "Good Layers and Poor Layers." On a small card at the front of each coop was given the laying record of each hen.

Two women who were fond of chickens stopped before the exhibit and began discussing the birds.

"That first Leghorn is a fine-looking hen," remarked one lady. "She must be the good layer."

"I wouldn't have that pale-shanked Rock in my flock," exclaimed the other. "She doesn't look very healthy."

Then they looked at the egg records and found that the fine looking Leghorn had laid only 52 eggs, and that the shabby one had 168 to her credit. They also found that the yellow-shanked Rock was a poor producer, while her faded companion had a businesslike record.

Just at this point the man in charge of the exhibit politely inquired if the ladies could pick out the high producers in their own flocks. He proceeded to explain that the color of the shanks in the fall, and the time the hen molted, were two good indications of the number of eggs laid. He pointed out as slackers the hens that had yellow shanks and had molted early.

"Most of my hens are slackers then, said one of the women, "because I always keep the early molters."

"And I always sell the pale-shanked ones," added the other lady.

During the fair week thousands of farmers and their wives who visited the fair saw the four hens, and a large per cent of them were surprised to find which hens were the good layers and which were the poor.

The County Campaigns

The State Fair exhibit was the first move employed by the Poultry Division of the University of Missouri Agricultural Extension Service in the campaign against slacker hens. Following this a vigorous campaign was carried on through the Farm Bureaus in the various counties. Missouri Farm Bureaus are organized with the community as the unit through which most of the work is done. A community is determined by the natural groupings of the people rather than by geographical lines. A community usually centers around a village, a church, or store, or some other point of common interest. The number of communities in representative counties varies from about twelve to as many as twenty. A community usually embraces from four to eight school districts. In each community the Farm Bureau has a committeeman to represent each line of work carried on by the organization.

To start the culling work in a county an Extension Poultry Specialist from the College of Agriculture at Columbia, with the assistance of the County Agent or Home Demonstration Agent, conducted a one-day culling school at some central point in the county. At this county school the poultry committeemen and poultry leaders from each community in the county were taught the methods of detecting the low-producing hens.

After the county culling school the community com-

mitteemen arranged a similar school in each community. A poultry leader from each school district in the community was asked to attend this local school. These schools were usually conducted by the County Agent or the Home Demonstration Agent, with the assistance of the community committeeman. At these schools the representative of each school district learned how to detect the slackers. After the community school the poultry leaders from each school district were asked to hold local demonstrations and teach the culling methods to their neighbors. In this way a culling campaign was quickly organized which brought the information on culling within the reach of every person in the county who cared to secure it.

To most people this method of separating the good layer from the poor producer was entirely new and the campaign created a great deal of interest and enthusiasm. Many people were skeptical at first and these had to be "shown." The large number of tests, when the hens were kept separated and it was found that the hens chosen as culls laid no eggs, soon convinced the doubters that the method was good and culling enthusiasm ran high. Hundreds of farmers who had never before shown any interest in poultry caught the spirit and examined every hen on the farm to see whether she was worth keeping.

How to Cull

Farmers who have a sufficient number of fowls to make it worth their while to do so, can largely adopt the methods followed by commercial poultry keepers, and with equally good results, but on the average farm, where the poultry flock is comparatively small, it is not to be expected that the more or less continuous and extra-thorough culling practiced by the commercial poultry keeper will be carried out in full. The common tendency to depend exclusively upon a single summer or fall culling, however, is unfortunate. It is impossible to realize the full advantage of present knowledge on this subject where this practice is followed. As has already been stated, culling tests can be successfully applied to extremely poor layers at almost any season and it is true economy to remove these without delay.

Culling tests can and should be applied always in the selection of fowls for table use and, where many fowls are thus used, or retail sales made from time to time, the culling that the flock will receive in this way may in itself be sufficient to keep the percentage of egg production up to a high standard throughout the whole laying season. Continuous culling in the manner just suggested, is undoubtedly the most efficient way of handling the small flock. Failing in this, there should be one or, better still, two regular cullings each summer, as well as one in the fall.

The first one should be about midsummer. At this time the inferior layers will be dropping out for the molt and, if they are disposed of promptly, several months of expensive feeding will be saved. This culling should not be too severe, as many good hens may not be laying at the precise time the test is made, having stopped temporarily on account of broodiness or for a short rest. Such hens will resume laying later on and often prove extra-good producers of fall eggs, when prices are almost double what they were in early summer. The fall culling, in September or early October, can be much more thorough, as the inferior hens may be detected then by several tests and those that are still laying can scarcely be overlooked on the most superficial examination. It is taken for granted that the pullets also will be thoroughly inspected when placed in winter quarters, or after they have been laying for a short time. If this is done, applying the tests described in Chapter X, it is possible to reduce quite largely the percentage of poor layers that will have to be carried through the winter.

Yellow Legs Need Not Be Sacrificed to Productiveness

There is a tendency among many to show a preference for yellow-legged fowls at the annual fall round-up, when surplus stock is disposed of and the flock culled down to winter strength. Selecting fowls for this character in the fall is just about certain to result in retaining the poorest layers, while the best hens in the flock—the bleached-out, ragged looking individuals—are sent to market. So long as the consuming public demands yellow-skinned fowls, clearly the practical thing to do is to cater to this preference. And it should be generally understood that there is no necessary conflict between this market requirement and the bleached-out shanks of the heavy-laying hen. Bear in mind that such hens may have just as yellow legs as any, in the nonlaying season; also that shanks bleached out as the result of laying have no influence on color of the legs of chicks, which are just as likely to have yellow legs as if descended from highly pigmented hens.

There is a marked difference, however, in the degree of yellow normally present in shanks of different fowls, and presumably such differences are inherited. The poultry breeder, therefore, must discriminate between fowls whose shanks are naturally pale in color and those in which the pigmentation normally present is temporarily bleached out as a result of heavy and long-continued production. It is not difficult to avoid confusion on this point if the birds are examined at the proper time. They should be culled for laying qualities at the end of the laying season, and culled again for yellow shanks at the beginning of the next laying or breeding season. If this

FIG. 125—FOWLS SHOULD KEEP IN GOOD HEALTH AND BE HIGHLY PROFITABLE AMIDST SUCH SURROUNDINGS

practice is followed there should be no difficulty in having the desired yellow legs on the market stock, along with constant improvement in egg production.

Selective Flock Breeding on the Farm

Trap nesting, pedigree breeding, and extreme methods generally are out of the question on the farm where the poultry work must not, as a rule, be allowed to make serious demands upon either time or attention. Selective

FIG. 126—A FARM CULLING SCHOOL IN MISSOURI

flock breeding, however, is a simple, practical method readily adopted by any person who takes any interest at all in the improvement of his flock and in increasing his net profits. Selective flock breeding can be applied to any flock, regardless of the breed or quality of the fowls mated, but it would be a great waste of opportunity to try thus to improve a flock of mixed or mongrel breeding, when standard-bred stock of excellent quality can be so cheaply secured.

It is not necessary to use fowls of exhibition quality if the owner is not interested in this branch of the business and has no disposition to profit from the sale of eggs for hatching and breeding stock. The experience of every one who has given standard-bred utility stock a fair trial however, has been that, with such fowls, better egg yields can be secured, also larger and more rapid growth, and greater uniformity in the product as to size, color, and quality. Moreover, the greatly increased attractiveness of the well-bred flock is something that appeals to practically every one.

Those who now have flocks of mixed breeding need not feel that it is necessary for them either to continue with their present low-grade stock or to dispose of it entirely and start over again. There are two ways in which these mixed flocks can be improved, and at comparatively slight expense. One way, and probably the best way in the long run, is to continue to keep and to breed the stock on hand, culling carefully, however, in order to use only the best producers. At the same time, provide some standard-bred stock of good quality by the purchase of a small breeding pen or, if that is too expensive, by the purchase of a single sitting of eggs or a few day-old chicks of the preferred breed. Give these blue-blooded chicks the best possible chance, but do not try to keep them separate from the remainder of the flock. Let them have the advantage of free range and farm conditions generally while growing. At the beginning of the breeding season examine them carefully to see whether or not they will meet the general tests prescribed for good layers, then put them in a separate pen where they will have plenty of room, give them the best of care and attention, and save every desirable egg for hatching.

Another plan of improving flocks of mixed breeding, which is simpler and which, therefore, commends itself to many, is to grade them up by the use of standard-bred males. It is astonishing what results can be secured in a season or two by mating a high-class breeding male with common stock. In starting to grade up the flock in this way, the farmer should determine definitely what breed he prefers and then adhere rigidly to this decision, avoiding the common tendency to change from one breed to another, thus sacrificing each year what was gained the year before, and leaving the flock no better than it was originally.

The experimental work done at the Kansas Exp. Station shows what can be accomplished along this line at slight cost. Flocks of mixed breeding, such as are ordinarily found on average Kansas farms, after only three years of grading up, presented the appearance of good standard-bred stock, and at the same time average production was increased almost 100 per cent.

In securing new males, whether for grading or for use in standard-bred flocks, it is important to be sure that they are from strains distinguished for heavy production. Even in the same breed there are great differences in the productiveness of various strains and, as the males are believed to be highly important in the transmission of egg laying ability, it is of the greatest importance always to select those that are descended from high-producing hens. The more generations of heavy-laying ancestry back of them, the more likely they are to possess, in a high degree, the ability to transmit this character to their offspring. Do not be afraid to pay a good price for such males. Let all matings be truly constructive in the sense that they are intended to secure not only increased production but, along with it, the other highly desirable qualities of truly standard-bred fowls.

Summary

Fowls probably excel all other classes of live stock in the efficiency with which they are able to turn grain into human food.

The larger breeds are most popular with farmers and, under average conditions, probably are more profitable on farms than the so-called egg breeds.

Accurate culling of fowls is only possible where they have been reasonably well fed and cared for.

In a culling campaign in Missouri, eighteen carloads of slacker hens were sent to market from four counties, which illustrates the high percentage of such hens in the average unculled flock.

Where continuous culling is not practiced, there should be at least two regular cullings each season—the first about midsummer, and the second in early fall.

Pullets should be culled about the time they are placed in winter quarters or shortly after they have begun to lay.

Yellow legs need not be sacrificed to productiveness if the breeders are properly selected.

The bleached-out shanks of a heavy layer have no influence upon the color of the legs of chicks.

Selective flock breeding is of special importance to the farm poultry keeper. This method can be applied to any flock regardless of breed.

Those who have mixed flocks often find it most practical to improve them by securing a small pen of standard-quality breeding stock, gradually replacing their mixed fowls with the superior chicks raised from this pen.

Many prefer to improve their flocks by grading, mating the best hens each year with standard-bred males of bred-to-lay ancestry.

CHAPTER XIII

Systematic Culling for the Commercial Flock

The Commercial Poultry Keeper's Special Problems and How He Can Meet Them Most Successfully—To Realize the Largest Profit From the Commercial Flock, Thorough and Persistent Culling Must Be Practiced—How the Summer Egg Yield Can Be Kept up to Fifty Per Cent and the Feed Bill Greatly Reduced

THE last few years have seen a great increase in the number of commercial flocks kept in different sections of the country and, as a rule, these have been operated with a higher degree of success and profit than ever before. More thorough knowledge of the principles of productive poultry keeping, improved facilities for doing the work economically, and better methods for increasing the efficiency both of the poultry keeper and his flock have been largely responsible for this development.

When it comes to a question of low-cost production, few if any commercial poultry keepers can compete with farm flocks, with their free range, cheap feed, and almost unnoticed expense for labor. However, the commercial poultry keeper finds that with good management he is more than able to overcome this handicap of increased cost by the greater production which he realizes from his fowls, and by the higher prices which he is able to obtain as a result of the superior quality of his products and the better opportunity he usually has for marketing them to good advantage.

The commercial poultry keeper finds that in a number of respects his methods must be distinctly different from those of the farmer. Because feed costs are greater, he must learn to buy to as good advantage as possible, and must scrupulously avoid waste; the capital invested usually much exceeds the amount needed for a corresponding number of farm fowls, hence both land and buildings must be more heavily stocked—often to the practical limit; since labor must be figured at the regular rate, methods of management must be as efficient as possible, and maximum growth and production must be secured at all times.

The commercial poultry keeper must give special attention to the marketing of his products. Failure to do this means the loss of a large part of his possible profit and may, in fact, make his venture a losing one instead of a financial success. Those who live close to market have some advantages over those who operate at a distance, and to this fact many attribute the extraordinary development of commercial poultry keeping in the vicinity of Boston, Philadelphia, and New York—the greatest poultry markets in the United States. Just to what extent this localization of the industry is due to superior marketing facilities, and how much to other causes not directly associated with such advantages, has not been clearly established.

Developments in intensive poultry keeping have been especially marked in New Jersey and the Petaluma District (Calif.) where many conditions are favorable to this method. There is no reason to believe, however, that either New Jersey or any other especially popular center of production has a monopoly on opportunities for engaging in commercial poultry keeping. When the producers of the Petaluma District can ship eggs clear across the continent, as they now are doing, realizing prices only slightly below quotations on strictly near-by eggs, there is the best reason for believing that producing centers could readily be developed in many sections at a distance from market but where other conditions are scarcely less favorable than in these two widely known localities. As a matter of fact, this has already been done, for example, in the Morristown District in eastern Tennessee, where a poultry industry of decided magnitude has sprung up in recent years, without any special advantages except a fairly mild climate, good railroad connections, and (which appears to have been by far the most important) the presence in the community of a few public-spirited men who have made it their business to encourage and promote the development of the industry. Without doubt, equal or greater successes could be realized in many other sections of the country.

Why Culling Is Especially Important to the Specialist

Most commercial plants are devoted chiefly to the production of market eggs. While the surplus fowls are salable at good prices, the net sum that can be realized from them is not regarded as important, nor does the production of table fowls as a specialty appeal to the average person who wishes to engage extensively in poultry keeping. Because of the fact, therefore, that his in-

FIG. 127—SCENE ON NEW JERSEY LEGHORN FARM

In the mild climate of New Jersey, houses of low-cost construction with muslin-covered front and no glass are successfully used. Glass is recommended, however, for best results.

come is derived almost exclusively from eggs, there is no one to whom culling is of greater importance than to the commercial poultry keeper. Every day that he keeps a nonproducing hen in his flock he is losing money on her.

Poultry surveys in New Jersey have shown that, in that section at least, it is necessary to secure an average production of 100 to 110 eggs per fowl, or 110 to 120 when feed is extremely high, in order to realize a satisfactory income. While this is much above average production, taking the country as a whole, it is not a difficult standard to reach with any of the popular breeds. It is doubtful, as a matter of fact, whether any properly culled flock will fall below an average of 100 eggs per hen, no matter what breed is represented, and well-bred fowls, properly cared for, should do much better.

FIG. 128—VIEW ON EGG FARM NEAR MORRISTOWN, TENNESSEE

Morristown, in eastern Tennessee, is the center of a prosperous commercial poultry farming section. White Leghorns are kept on most of these farms. Through refrigerator car service to New York City is maintained, and producers get good prices for eggs the year around

The commercial poultry keeper, with his high cost of feed, and his high labor cost and "overhead", cannot afford to follow the practice of the average farmer in culling only once or twice in a season. He must, in order to keep his flock at a high state of efficiency, begin culling almost with the baby chicks, watching them through the season and promptly marketing any pullets that develop undesirable characters or those that are indicative of low constitutional vigor or inferior egg laying capacity.

In the fall when the pullets are to be placed in winter quarters, he will cull them with special care and, without fail, will market those that do not respond favorably to the tests applied. Few poultry keepers find it necessary or desirable to do any special culling during late winter and spring, aside from promptly removing from the flock any birds that develop marked indications of poor health, low constitutional vigor or inability to lay. After carrying the birds up to this time, it is wiser to keep them through the regular laying season when even the poorest producers usually will make at least some return for their winter's feeding. By June, however, summer culling begins in earnest on the up-to-date poultry plant and, from this time on until practically all the birds have stopped for the molt in the fall, culling will be repeated at frequent intervals in order to eliminate the quitters as they develop.

The methods of culling described in the foregoing chapters make it possible to pick out the nonlayers with a good degree of accuracy within a very few days after they have stopped. A week's idleness produces a marked change in pigmentation about the vent, and within a few days more its presence may be detected in the ear lobes and at the base of the beak. At this time, also, the birds which are only indifferent layers may be detected and removed, their inferiority being betrayed by imperfectly bleached shanks, poor head points, lack of abdominal capacity, etc. ALL of the methods of culling that have been described in previous chapters should be applied to these birds—do not make the mistake of relying upon only a single character.

The appearance of the vent will show unmistakably whether the hen is laying at the time she is examined, while the eye ring, ear lobe, beak, and shanks in succession give their clues as to the length of the period during which she has laid. The egg farmers of New Jersey depend quite largely upon the appearance of the comb in detecting the hens that have stopped laying (see Chapter VI). The beak is helpful in determining whether or not the hen is a constant heavy layer or takes long rest periods. The spread of the pelvic bones and the keel show capacity, while the condition of the abdomen is an almost infallible indication of high and low productivity. By applying all the tests as herein described, the observer may rest assured that he can readily detect the best layers and can eliminate the unprofitable ones with a great degree of accuracy.

How to Secure Fifty Per Cent Production

By the foregoing term is meant a daily egg yield equal to one-half the total number of fowls in the flock. For example, fifty per cent production in a flock of one hundred hens means an average of fifty eggs a day. During the natural laying season, or from the first of March to the first of September, as a general average, it is not only

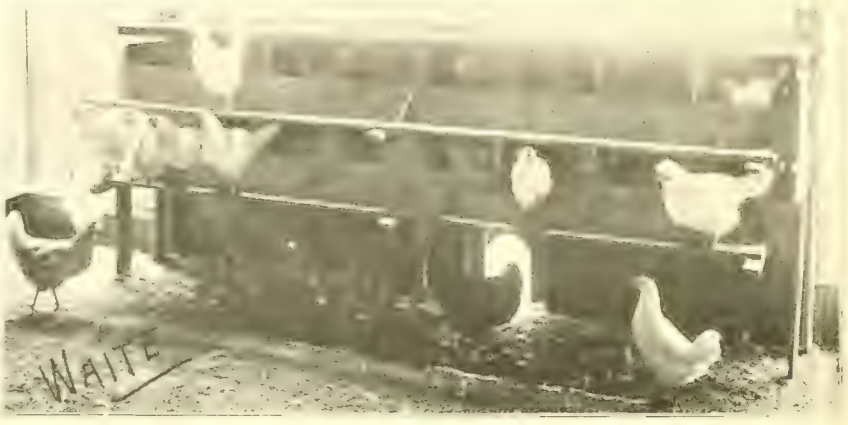


FIG. 129—EVERY NEST OCCUPIED AND A GOOD WAITING LIST

The owner of this commercial flock was dissatisfied with his summer production, and culled his hens. Above photo was taken in the house containing the selected layers showing every nest occupied. At the time this photo was taken all the nests were EMPTY in the house containing the CULLS.

possible to secure such production, but the commercial poultry keeper cannot afford to fall much short of this standard. This subject is considered more in detail in Chapter XVII, but the importance of systematic culling as a means to this end is so great as to warrant calling particular attention to it here.

It is safe to assume that when production falls below fifty per cent during the period just mentioned, there are some hens in the flock that are not laying. According to Professor Lewis of the New Jersey Experiment Station (see page 33), the number of layers in any flock can be estimated approximately by doubling the percentage of production. That is, forty per cent production indicates eighty layers in a flock of one hundred hens; in other words, there are twenty in the flock that are nonproductive. To secure a fifty per cent egg yield therefore, these twenty idle hens must be detected and removed.

The farmer with his low production costs may safely adopt a lower standard for his flock if he wishes to do so; the breeder who generally keeps a much larger percentage of old hens, and who desires maximum production during the breeding season, may not want heavy summer production; but the commercial poultry keeper cannot retain in his flock a large percentage of nonproducers without serious and unnecessary loss.

Selective Flock Breeding

The commercial poultry keeper has an exceptionally good opportunity to apply methods of selective flock breeding to his flock. He usually is better equipped with facilities for separately housing his breeding birds, and for giving special care to the chicks hatched from such stock; he also has more to gain by giving this subject his particular attention. The importance of securing high average production has already been described, and the only way in which this can be brought about permanently is by persistently breeding from such producers. With good breeding methods applied to his flock the poultry keeper will find not only that his average egg yield will increase, but also that he will have to meet a rapidly increasing demand for eggs for hatching and day-old chicks. And, as this trade can be cared for without interfering with commercial production and represents a much better per cent of profit, it affords a source of additional revenue that few can afford to ignore. This is another reason for seeing to it that commercial flocks are of good standard quality, within practical limits, and that the breeding fowls receive the additional care and attention required in order to produce hatching eggs of the highest quality.

It cannot be too plainly stated that selective flock breeding followed year after year means permanent improvement in production averages. In seasons of low prices for eggs or high prices for feed, when the average poultry keeper's margin of profit is greatly reduced or perhaps entirely wiped out, those who have brought their flocks up to a high average of production find that their profits are still good, possibly even greater than under what would generally be termed more favorable conditions. For example, almost without exception, those whose flocks had reached a high average of productiveness reported that their profits during the years 1916-17, and 1917-18, which proved so disastrous to many, were fully as great as in any former year, or even more so, due to the fact that while the price of feed was high, the price of their products was higher still. The poultry keeper, therefore, who makes high average production his goal, is not only certain of greater profits under normal conditions but, as just shown, has a safe margin of profit under conditions which may mean actual loss to those whose flocks are on a low level of productiveness.

Summary

More exact knowledge and the development of better methods have resulted in a marked increase in number of commercial poultry flocks in recent years.

Poultry specialists cannot compete with farmers in low cost of production, but have a number of important advantages that may more than overcome this handicap.

The commercial poultry keeper must give especial attention to cost figures and to marketing his product.

No one locality has a monopoly of opportunity for engaging in successful poultry keeping.

The poultry specialist must get an average of 100 to 120 eggs per hen to realize a fair income. To do this he must cull persistently.

Fifty per cent production in summer is largely a matter of systematic culling.

Selective flock breeding means permanent improvement in production averages in any laying flock.

The best protection against low prices of eggs or abnormally high prices for feed is high average production.

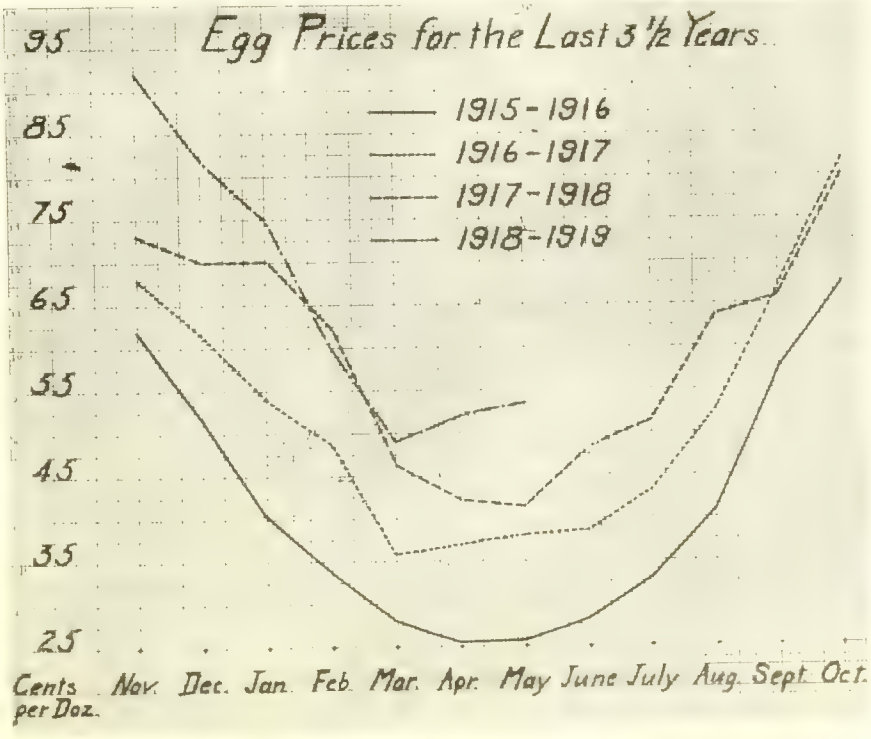


FIG. 130—GRAPH SHOWING WHOLESALE EGG PRICES IN NEW YORK CITY MARKET NOV. 1, 1915, TO MAY 1, 1919

This illustration makes it plain that a large part of the commercial egg farmer's profit depends upon the percentage of production he secures during the high-price months. He can well afford to provide comfortable houses for his early-hatched pullets, and to do everything else in his power, including the use of artificial illumination, to bring his winter production up to a high point—or 50 to 60 per cent, as a safe average.

CHAPTER XIV

Practical Culling Methods for Back-Yard Flocks

Advantages in Keeping Back-yard Flocks, and Methods Best Adapted to Their Requirements How Culling Keeps Down the Cost of Feeding the Flock Without Decreasing Production—Keep the Home Table Supplied by Killing Off the Slacker Hens—How to Turn the Nonproducers into Special-quality Table Fowls

IN THE last few years there has been a great increase in the number of back-yard flocks kept, and undoubtedly this has been to the distinct advantage of their owners. Back-yard egg production is a practical economy that few can afford to ignore. A flock of 10 to 15 fowls, consuming the table scraps and waste from the kitchen garden, helped out by necessary feed from the poultry supply store, will provide enough eggs to meet all the requirements of the average family, and at a fraction of their cost if bought at regular market prices.

What is of even greater importance to the average household is that a good home flock insures having eggs when wanted, particularly during the high-price season when they otherwise would be practically unobtainable. Observation has shown too, that, with strictly fresh eggs of unquestionable quality, consumption quickly increases so that many more eggs are regularly consumed than would ever be called for under other conditions. Many who have back-yard flocks of good size find that they can reduce their meat bill by one half, not only effecting a decided saving in the cost of living but often with marked improvement in health. Of all the animal foods available, none is more readily digested or more healthful than eggs. It is for this reason that they invariably are prescribed for invalids and children, and they are just as healthful and nourishing for the able-bodied.

FIG. 131—THE BACK-YARD POULTRY KEEPER HAS THE BEST CHANCE TO SECURE MAXIMUM PRODUCTION PER HEN

The J. W. Parks' strain Rocks in the small pen illustrated above practically all exceeded 200 eggs in the twelve months of their pullet year. One of them has a record of 313 eggs in that time. Whatever breed is selected, the foundation stock should be of some good bred-to-lay strain. Photo from Prof. E. F. Grundhoefter, State College, Pa.

Where there are growing children in the family, the liberal use of eggs is especially important. Recent researches have established the fact that eggs and milk are the best and cheapest sources of a group of important nutritive elements known as vitamines. These are regarded as essential to normal growth and development. Unfortunately, in the average home the free use of eggs is out of the question during a large part of the year on account of cost. It is true that eggs can successfully be put down in water glass in the summer and kept for winter use at an important saving, but such eggs are not fresh. The same is true as regards storage eggs. These are used in enormous quantities each winter but no one expects to find in them the delicate, appetizing flavor that characterizes newly laid eggs, and in the absence of which maximum consumption can never be secured. With a home flock all this is changed, and eggs at once take the important place in the diet to which their qualities clearly entitle them. The difficulty sometimes encountered at the home table, of having persons get tired of eggs when freely used, is readily met by more variety in serving them. There are many highly palatable ways in which eggs may be prepared for the table, hence the number consumed is largely under the control of the housewife.

Methods Simplified

Methods of poultry keeping have become greatly simplified and results are much more satisfactory and success more certain than was the case a few years ago. The method now commonly followed, of keeping the back-yard flock confined to the house practically the year around, removes one of the objectionable features, that of dirty, foul-smelling yards which are almost unavoidable where

Where the fowls are provided with convenient, comfortable, and attractive houses, such as the one shown in Fig. 133, and kept confined to it constantly, sanitary conditions may be of the best, and with proper care and feeding the fowls will lay almost as well as if on open range. So managed, poultry keeping becomes a pleasure as well as a source of profit, and there is ample room to keep a flock in even the smallest of back yards. It is always wise to build the house on runners for easy moving, but by all means build it substantially and neatly. It only costs a little more to have a house that is attractive from the outside, comfortable for the hens, and convenient for the caretaker, as compared with the makeshift structures so often provided with mistaken economy. The right kind of a house will aid in getting much better returns from the flock, it can be cared for with half the labor and annoyance, and if it becomes necessary to dispose of it through any change of plans it can be sold to some one else, provided it is built so that it can readily be moved.

Special Need for Culling

The back-yard poultry keeper, even though he may have only a small flock, will find that culling is relatively as important to him as to those who number their fowls by the hundred. Just because only a few birds are kept is no reason why one should be satisfied to keep any that are making no adequate return for the feed and care bestowed upon them. Moreover, the average back-yard flock is almost always overcrowded and in practically all such cases the removal of one or two or more of the poor producers not only cuts down the feed bill, but the remaining birds, with more room and perhaps better feeding, will lay more eggs than before. This is one of the reasons

why so many culling reports show better production after culling than was secured from the larger number in the original flock.

Many back-yard poultry keepers cannot or do not wish to raise their own stock, but plan to buy a new adult flock each fall, killing off the fowls in the summer as they stop laying, thus to avoid feeding them through the nonproductive period of fall and early winter, and incidentally providing a supply of Sunday chicken dinners through the summer. The flock then is replaced in the early fall with another lot. Starting in the fall is especially popular since reasonably quick returns may be expected. If early-hatched pullets can be secured at fair prices they may be brought into laying with only slight delay. Later-hatched pullets and yearling hens must be fed for a considerably longer period before they become profitably productive.

Perhaps one of the errors that the back-yard poultry keeper is most apt to fall into is in being too impatient with his new flock, expecting the fowls to lay almost as soon as he acquires possession of them, and being greatly concerned when he sees no returns coming in for the feed given daily. There are good reasons why the new flock is not apt to begin laying at once, and some delay is always to be expected. Any change in quarters may interfere with the productiveness of fowls, either pullets or hens, and if they are not in good condition when bought several weeks' feeding may be required before many eggs will be secured. If the owner gets impatient or discouraged and neglects them or, as is too often done, tries to economize by reducing the feed, he may never get the returns that he should and could have secured. It is important to bear in mind that there is nothing especially difficult about securing good egg production when the fowls are in condition to lay, but enough time must be allowed to bring this about. Even though there may be weeks of delay in getting started, they can confidently be counted on to return a substantial profit for the year if properly cared for.

With either late pullets or molting hens, the waiting period can be greatly reduced by the use of artificial illumination which has been proved beyond question to be of great value in bringing fowls quickly into laying in fall and early winter. It is growing increasingly difficult to secure first-class early-hatched pullets at prices within the reach of the average buyer's pocketbook, and it is worth while to understand that with the help of artificial illumination the long period of heavy feeding that used to be necessary in order to bring late-hatched pullets and yearling hens into laying condition can be noticeably shortened. Experiments have shown that with artificial lighting late pullets can be brought quickly into laying and even made to exceed the production of "unlighted" pullets hatched much earlier. For example, at Sunny Crest Farm, East Aurora, New York, 2,100 pullets were sorted over in the fall, and 1,600 of the best and earliest were placed in one flock and the remaining 500 in another. These pullets were described by the owner as being "the weakest, smallest, and most unpromising of our entire flock (naturally including the latest hatches.—Ed.). We greatly regretted that two pens, or 200 of these birds, we had not sold to market". During October and November this "poor" flock was noticeably far behind the other in percentage of production, but within ten days after artificial illumination was introduced it had passed the earlier-hatched and better pullets (which were without "lights"), and within about a month was producing 40 to 65 per cent, while the better pullets were ranging from only 25 to 35 per cent. Similar results have been secured at Cornell University and elsewhere, thus showing that the back-yard poultry keeper who cannot secure early-hatched pullets need not, therefore, be disappointed in having a productive winter flock.

Always Cull New Stock

Obviously, it is necessary in buying undersized and inferior pullets culled from some other flock thoroughly to understand the practice of culling so that the least productive individuals can be thrown out. Notice particularly the head points, and cull rigidly for fowls of low constitutional vigor.

The beginner, in purchasing his stock, is apt to select inferior specimens unless he has given careful study to the subject. This is particularly the case in purchasing in the open market, since so many of the fowls offered him are likely to be nonlayers culled from some well-posted poultry keeper's flock. Whether buying pullets in the fall or laying hens in the spring, it is quite important to become familiar with the characters of good and poor producers. If pullets are to be purchased, carefully apply the tests herein suggested. To do this will enable the buyer to discard the most inferior ones offered, with a marked increase in the total number of eggs secured during the year—probably at no greater initial expense for the stock.

Age and season must be taken into consideration in close culling. If any of the fowls are laying when handled

FIG. 132—A PRACTICAL BACK-YARD POULTRY PLANT

House here shown has been in use for several years by Prof. H. R. Lewis of New Jersey Exp. Station. It is doubtful whether the back-yard space occupied by this house and small run could be put to any more profitable use.

it is comparatively easy to pick them out. In the fall, good, well-matured pullets can be scored before laying has begun, doing so with a good degree of accuracy by following the suggestions given in Chapter X. In buying either hens or pullets in the spring, a good many are apt to be included that will lay only under the most favorable conditions. Where only a few are purchased this may not be important, as the inferior ones can be culled out and used on the table as their unfitness develops.

In early-summer culling some judgment must be exercised, particularly as regards broody hens. Often these will "come back" after a rest and prove to be the best late summer and fall layers in the flock. Whether they are likely to do this or to molt and remain idle all fall can usually be determined by careful examination, applying the various tests elsewhere described. Begin culling just as soon as the egg yield falls below 50 per cent--which may be in June. Any percentage below that means that there are some idle hens in the flock, and many of them will not be profitably productive at any time thereafter. Because of the small size of his flock, and the close observation that he is able to bring to bear upon it, the back-yard poultry keeper need have no difficulty in detecting his unproductive fowls at any season.

Owing to the heavy feeding that the average back-yard flock receives, along with close confinement and limited exercise, overfattening is of common occurrence. In almost any flock some hens will get overfat on rations that are well adapted to the needs of the rest. Such hens often are naturally good layers but to do well require a different ration from the others, or at least different feeding methods. It usually is not practical to give them special care, however, and as in this condition they are especially susceptible to disease, they should be culled out, no matter what showing they may make under regular culling tests. It is much better to use them on the table than to lose them through disease as is almost certain to happen sooner or later, if they are retained in the flock.

How To Select Layers When Buying

By no means all of the pullets and hens that are found on the market have been culled out as nonproducers. The application of culling tests is now so general, however, that the wise buyer will assume that this has been done in the case of any fowls offered him, and will accordingly use due caution in making his selections.

Buying in the fall, where selection is to be made from early-hatched pullets, it is advisable always to choose those that are best matured, plump, and well developed, giving special attention to their head points (see Chapter VI). If choice is limited to later-hached, more or less immature pullets, size, condition of plumage, head points, and general indications of thrift will be helpful in selecting those that are likely to mature earliest. Pullets that are in poor flesh, but apparently in good health, indicating that the lack of flesh is due simply to scant feeding, often will make remarkable improvement in appearance with a few weeks' feeding.

In buying yearling hens in the fall notice with particular care their physical condition. If they have been underfed, ordinary culling tests will be misleading if too strictly applied. If the birds are in good health, if they have fairly good span between pubic bones and keel, and if their abdomens are reasonably soft, they may prove to be good layers with proper care, even though they may be poor in flesh, and too highly pigmented, and their pubic bones too close together and too thick as judged by ordinary standards of comparison. Avoid all hens that have noticeable physical defects, particularly those that "bag down" or that have abdomens containing a hard lump, indicating a tumor or some other abnormal condition.

FIG. 133—A GOOD BACK-YARD POULTRY HOUSE—CAPACITY, AS ILLUSTRATED, 18-25 FOWLS

This practical and comfortable house, used with complete success in the Vineland Egg Laying and Breeding Contest, is well adapted to back-yard use. It is 8x10 feet, 8 feet high at highest point, 5 feet, 5 inches at rear. As here shown it has a sand floor, but for general use a double-board floor should be provided unless house is to be permanent, in which case a concrete floor is desirable.

Summary

Back-yard poultry keeping is a practical economy that few persons can afford to ignore.

Modern methods of back-yard poultry keeping are simple, and success practically certain.

Providing a comfortable and convenient house is half the battle.

Do not be too impatient with the new flock, however. Pullets or hens moved to a new location need a little time to get started.

Where early-hatched pullets are not obtainable, good winter production can be secured in later pullets and yearling hens by the use of "lights".

The back-yard poultry keeper must know the marks of good and poor layers in order to avoid getting culls when buying in the open market.

In early-summer culling be careful to avoid throwing out good producers that are simply taking a short "brooding" rest.

In buying pullets select for early maturity and general thrift.

Do not apply culling tests too strictly to hens that have evidently been underfed or mismanaged.

CHAPTER XV

What Culling Means to the Fancier

The Growing Demand for Superior-Quality Breeding Stock With Heavy-Laying Ability Is Developing a New Field for the Fancier—Great Possibilities Open to Those Who Can Supply the Right Kind of Stock—Many Breeders Already Have Successfully Combined High Egg Production With Standard Quality—Doing This Is Essential to the Best Interests of the Poultry Industry

TO THE fancier the chief value of information regarding the characters that indicate egg-laying ability or the lack of it lies in its application to his breeding problems. He is directly interested, of course, in eliminating poor producers from his flock and in keeping only fowls that show a good profit in eggs produced, but he is much more deeply concerned with utilizing his newly acquired knowledge further to improve the productive capacity of his fowls without injury to or neglect of their showroom quality.

That this is not an extremely difficult problem is proved by the records of production at every laying contest in this and other countries where (with the exception of Prof. Dryden's new egg breed, the "Oregons") practically every high producer has been standard-bred. So far as the popular breeds are concerned at least, breeding intensively to meet the requirements of the Standard has in no way injured the productivity of the fowls—has in fact, resulted in development along lines THAT MAKE GREAT EGG RECORDS POSSIBLE. This is all the more creditable to the fancier since, up to a comparatively recent date, neither he nor the utility poultry keeper had any accurate knowledge of how to breed specifically for egg production or how to identify the physical characters indicating it.

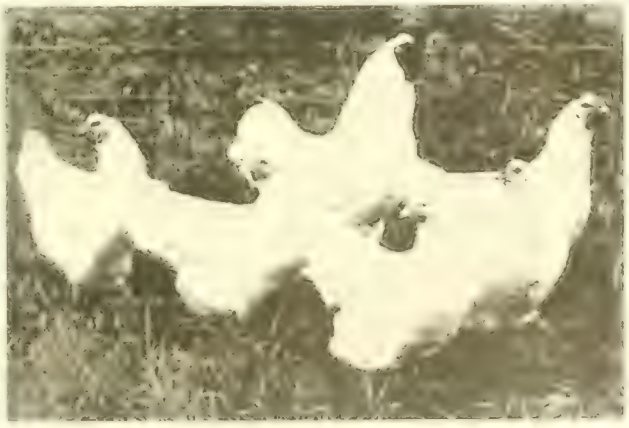


FIG. 134—HEAVY-LAYING PEN OF STANDARD-BRED WHITE PLYMOUTH ROCKS

The hens here shown averaged to lay 188.8 eggs each, in 12 months, at National (Mo.) Laying Contest. They also are good representatives of the breed from the fancier's viewpoint.

It is true that the winners in some contests, while listed under breed names, have not been good representatives of the breed, and much has been made of this fact in some quarters. But it also is true that the particular strains of inferior quality that a few years ago were in the lead now are being distanced by fowls that conform more nearly to standard requirements. By way of illustrating the practical combination of standard qualities and productiveness already achieved by breeders, note the following from Storrs Bulletin 100, regarding the fowls entered in the Seventh Annual International Egg Laying Contest:

"In considering the birds entered in the seventh competition from the viewpoint of showroom quality, the management decided to dispense with the score-card system of judging employed in the previous three years. Accordingly all birds were judged on a comparison basis. This method simplified the judging process considerably and saved a great amount of clerical work, while at the same time each pen could be placed in exactly its proper relationship to all other pens of the same variety. Inasmuch as there has been considerable agitation on the question of whether or not show qualities and egg-laying ability can be combined in the same individual, it is interesting to see what the contest records have to show on this problem. The average production per pen of ten birds in the seventh competition was 1690, 1394, 1683, 1530, 1480, and 1628 eggs respectively for Barred Rocks, White Rocks, White Wyandottes, Buff Wyandottes, Rhode Island Reds, and White Leghorns. The corresponding figures for those pens comprising the best 25 per cent of each variety when considered from a showroom standpoint were 1739, 1346, 1834, 1582, 1390, and 1672 respectively. In the case of White Plymouth Rocks the number of pens was only four, and consequently the figures are less suggestive than in the case of White Leghorns, where forty-three pens were entered. Taken as a whole, this material certainly constitutes an argument for the contention that showroom and utility qualities can be combined in the same strain of birds."

More evidence of the same sort is presented in Fig. 137 which indicates the correlation existing between standard qualities and egg production as observed in the Plymouth Rocks entered in the Vineland Egg Laying and Breeding Contest. In studying this table it should be remembered that the birds were scored as they entered the contest, and were by no means in showroom condition. It was stated that "On the ground of condition alone these birds could have been made to score four or five points higher, on the average, than they actually did," which indicates that they were of even better than ordinary exhibition quality. In this table it will be seen that the majority of the best layers (averaging 180 to 210 eggs) scored around 86-88 points. There were almost no low-scoring birds among the high producers, and but few high-scoring fowls among the inferior layers. Similar correlation tables for Reds, Wyandottes, and Leghorns in this contest (see Figs. 138, 139, and 140) all illustrate the same combination of good exhibition quality with productiveness.

Egg Type in Standard Fowls

There is no reason for questioning the fact that all the essentials of egg type (or to speak more accurately—egg-laying capacity), so far as this subject now is under-

stood, can be secured in any of our popular breeds without any important change in standard type. At the Second Annual Poultry Judging and Breeding School at Cornell University, July 1919, where laying capacity was definitely defined (see Chapter VII), it developed that most of the government experts there assembled believed that heavy-laying fowls in certain breeds, particularly

FIG. 135—HOW PRODUCTION MODIFIES TYPE—A GOOD LAYER

The hen here illustrated was a heavy producer and has the large soft abdomen and wide span between pubic bones and keel that give ample capacity for necessary development of digestive and egg organs. Compare with Fig. 136. Photo from Cornell University.

Leghorns and Wyandottes, are longer bodied than representatives of the extreme show type. It is important to remember however, that length of body is a relative term, and in practical breeding may mean little more than the longer appearing, less rounded underline which may be produced without any change in body dimensions other than the spreading of the keel bone. For illustration of this compare Figs. 135 and 136, showing in profile the body of a good and a poor layer. The good layer here is no longer than the other but in full plumage would certainly appear so, owing to the position of the keel. With these two fowls in mind, a study of the Standard's "ideal" Leghorn and Wyandotte will suggest how breeding for a smoothly rounded underline may readily result in a "tucked-up" keel—a highly objectionable character from a practical viewpoint. This clearly is a character that the fancier must avoid even if, to do so, it should become necessary to modify the Standard description on this detail. That the standard Wyandotte type does not necessarily interfere with good egg production is proved by the outlines of the 309-egg hen shown in Fig. 141.

Relation of Size to Productiveness

The results secured at the Vineland Egg Laying and Breeding Contest, as set forth in the correlation tables in Figs. 109 and 110, show clearly that standard requirements as to weight are no handicap in productiveness in the case of any of the breeds represented. White Leghorns ranging in weight from three and a half to four pounds were better layers than those above or below that weight, while best production in R. I. Red, Wyandotte, and Plymouth Rock pens was secured with birds ranging from five to seven pounds, or seven and one-half in the case of Plymouth Rocks.

Pigmentation Not a Serious Problem

Standard requirements in regard to yellow pigment in such breeds as Plymouth Rocks, Wyandottes, etc., are no more difficult of adaptation to reasonable "utility" demand than is breed type. The commercial poultry keeper and the fancier alike want rich yellow skin and shanks in their fowls WHEN NOT LAYING.

The exhibitor well knows that his pullets are at their best just before they begin to lay, and he plans to have them reach this stage of development about showtime, when their beaks and shanks will be as yellow as they ever will be. To demand that a pullet shall show more or less loss of pigment at this time as a proof that she is a good layer would be to handicap all except extra-early-hatched birds and also would, in practice, put a premium upon pale beaks and shanks—a defect fully as objectionable to the commercial poultry keeper as to the fancier. As regards hens, by the time these have progressed sufficiently in the molt to be in winter showroom condition they will have regained their pigment in all sections. It may be practicable to modify the Standard so as to avoid handicapping pullets and hens that have been laying for some time when shown, such as hens at fall shows and extra-early pullets, but is an open question whether for the time being that had not better be left to the discretion of the judges.

About the only time that the fancier is in serious danger of going astray in pigmentation tests is when mating up his breeding pens, and then only when this is done comparatively late in the season. At this time the preference for fowls with bright yellow shanks may result in putting a premium on late-maturing pullets, or on hens that are apt to lay only for a short time in the spring —none of which should ever be admitted to the breeding pen no matter what their exhibition quality may be.

The principle should be accepted by fancier and commercial poultry keeper alike, that shanks that have faded out as a result of production are in no way objectionable in breeding stock, since chicks from such fowls will have just as yellow legs as any. If the breeder will keep in mind that during the laying season bleached shanks are a badge of merit, and will look with suspicion upon any

FIG. 136—HOW PRODUCTION MODIFIES TYPE—A POOR LAYER

This hen was a very inferior producer. Her abdomen is much smaller than that of the one shown in Fig. 135 because her egg organs weigh nearly half a pound less, and her digestive organs also are smaller since she requires much less food. In actual length of body, however, she differs but little, if any, from the good layer shown in Fig. 135. Photo from Cornell University.

hens or pullets having highly pigmented shanks at this time, he will have no difficulty in maintaining the yellowest of legs and skin in his fowls, doing this without putting them at any disadvantage whatever as regards productiveness.

CORRELATION OF EXHIBITION SCORE WITH PRODUCTION
PLYMOUTH ROCKS
Standard Score

EGG PRODUCTION-PULLET YEAR	90	89	88	87	86	85	84	83	82	81	80	79	78	Disqualified	total
300-271				1	1	1		1							4
270-241					1								1		2
240-211			1	4	3		1	1						1	11
210-181		2	3	10	5	4	5	4		1				2	32
180-151	1	5	5	2	8	9	3	2	1	1				5	42
150-121	1	1	6	5	5	4	2	3	1	3		1	1	4	37
120-91	1		7	5	4	1	1	1	1	1			1	5	28
90-61		2	2	2	2	1					1				10
60-31					1	1					1				3
30-1						1									1
Total	3	10	24	29	29	22	10	12	3	6	2	1	3	17	170
Yrl'd. Eg.	136	141	139	164	157	150	166	177	141	144	68	139	164	146	155

FIG. 137—STANDARD QUALITY NO HANDICAP IN LAYING CONTESTS

This correlation table for Plymouth Rocks at Vineland Laying Contest shows that the best production was secured with hens ranking above the general average of exhibition-quality fowls of their breed. Correlation tables of the Wyandottes, Reds, and Leghorns entered at this contest (see Figs. 138, 139, and 140) show similar quality. Courtesy of New Jersey Experiment Station.

Yellow Pigmentation in the Showroom

This Article Suggests Changes In the Standard With Regard to Pigmentation Which the Authors Believe Would Give Heavy Layers a Fair Chance In the Showroom

Condensed from Storrs (Conn.) Experiment Station Bulletin No. 92

POULTRY shows are one of the most valuable agencies for fostering interest in the poultry industry. They afford an opportunity for a ready comparison of a large number of different poultry breeds, strains, products and apparatus that would not be gotten together otherwise. Of equal value probably is the occasion which they offer for the informal interchange of ideas between progressive poultry breeders. The more valuable an institution, the more care should be exercised to insure its improvement in response to the changing ideals of the times.

Plants and animals have been domesticated and cultivated for one or both of two main reasons—for the pleasure which their presence gives us, or for some useful product which they yield in the form chiefly of food, clothing, or labor. The distinction is not absolute, even as the distinction between beauty and utility cannot be absolute, but in general we may distinguish the forms primarily ornamental from those primarily useful. The first are grown as pets, the second for utility. Ornamental things may be useful, and the market value of a product is not diminished by the inherent beauty of the producer. In fact, the perfection of form and color that appeals to the eye may indirectly affect the yield. The pride of the flock or of the field will be most tenderly cared for.

A visible character that has a direct connection with yield may be called a utility point, while one that has no such direct connection may be called a fancy point. Each may be developed without injury to the other, but the man who aims at but a single target is most likely to reach his mark. To the practical breeder the most valuable thing is yield. This the showroom almost entirely leaves out of consideration, either directly or by scoring on a multitude of fancy points that often have at best only a fancied connection with the object for which the breed is supposed to be cultivated. In the score card for dairy cattle no place is left for the quantity or quality of milk which the animal is capable of giving. In the ear of corn attention may be given to the straightness of the rows and the completeness with which the tip of the ear is filled out, but the yield per acre is not recorded. The score card for poultry gives ten points each for comb, wings, and tail, but no credit is given for the number of eggs a bird has laid.

Attempts in many cases have been made to use characters in the score card that may be indicative of yield. In corn, the filling out of the tip, the size of the ear, the size and compactness of the kernels, are all characters that influence the amount of food substance carried by an individual ear, but are not of necessity correlated with the yield per acre. In the experience of the Connecticut Experiment Station, poor scoring strains of corn have been found to outyield better scoring strains in comparative test cultures.

In poultry, probably less attempt is made to use characters in the score card indicative of yield than in most other economic breeds of animals or of plants, and the standards may be fictitious in that they are even directly opposed to the natural development of the animal.

Most fancy points probably are indifferent so far as they directly influence the practice of breeding plants and animals for utility. The danger is that they tend to substitute a fictitious standard for real value, and thereby distract the aim of the breeder. In some cases, however, the standards may be in direct opposition to utility.

The presence of yellow pigment is a case in point. It has been conclusively demonstrated in the present bulletin that visible yellow pigment in the breeds investigated is indicative of poor laying ability. Our investigations have shown however, that the yellower the beak and legs, the longer since the last egg was laid.

The "Standard of Perfection", which controls the judges in the show room, demands yellow in the beak and legs of Leghorns and the American breeds. Other things being equal therefore, in preferring the bird with yellow beak and yellow legs, the poultry judge is preferring the poorer layers. In other words, production is penalized.

As a specific contribution toward improving the "Standard of Perfection", we would suggest changes in the score card relating to pigmentation in breeds in which the amount of pigment is affected by laying. The present color standards are irrational in several respects. Let us consider the White Leghorns for example.

The "Standard of Perfection" calls for white ear lobes and for yellow beak and legs in both sexes. Such a standard is inconsistent. The white in ear lobes is opposed to the yellow in beak and legs. Moreover, while white in the lobes of the females may be indicative of laying, in males it certainly is not. It is a peculiarity of certain strains or is brought about by lack of vigor due to sickness or by other environmental factors.

We suggest that male White Leghorns be required to show yellow in the ear lobes as well as in beak and legs. If males with pale lobes are used as breeders, strains are likely to be favored in which the ear lobes will be of little value in selecting layers. The ear lobes in males therefore, should show a high percentage of yellow. It would be possible to require the color to come up to any desired standard,—say at least 40 per cent

CORRELATION OF EXHIBITION SCORE WITH PRODUCTION
RHODE ISLAND REDS
Standard Score

EGG PRODUCTION-PULLET YEA.	90	89	88	87	86	85	84	83	82	81	80	79	78	Disqualified	total
300-271															
270-241				2											2
240-211				1		1								1	3
210-181		4	1	4	6									1	16
180-151		1	5	3	3				1					4	17
150-121			4	4	2	4	1	1						6	22
120-91		1	5	4	2									2	14
90-61			1	2										2	5
60-31				1											1
30-1														1	1
Total		6	16	21	13	5	1		1	1				17	80
Yrl'd. Eg.		175	136	161	164	156	129	125	175					134	150

FIG. 138—STANDARD-BRED R. I. REDS ARE GOOD LAYERS

Courtesy of New Jersey Experiment Station.

yellow as determined by the color top. It might seem fairer to competitors who have developed strains under the old standards, to place the requirements not too high at first, and raise them later. It is our belief however, that ultimately a high percentage of yellow in the ear lobes of male White Leghorns should be demanded by the score card.

CORRELATION OF EXHIBITION SCORE WITH PRODUCTION
WYANDOTTES
Standard Score

EGG PRODUCTION-PULLET YEAR	90	89	88	87	86	85	84	83	82	81	80	79	78	Disqualified	Total
300-271															
270-241														1	1
240-211			1	1	1	1		1						2	7
210-181		1	8	4	5	2	1							4	25
180-151		5	6	10	5	4		1						6	37
150-121		3	4	9	7	2	3							5	33
120-91	1		7	8	7	1								2	26
90-61		1	2	3	2	1								2	11
60-31			3		1	1								1	6
30-1			2	1	1										4
Total	1	10	33	36	29	12	4	2						23	180
Wt'd. Avg.	113	150	131	137	133	148	154	175						155	144

FIG. 139—BIRDS OF STANDARD QUALITY LEAD IN PRODUCTION AT VINELAND CONTEST

In the female bird, decided yellow pigment is indicative of lack of laying activity within the recent past. A study of the preceding pages indicates that the ear lobes and vent are the first to change color in response to a change in the laying activity, that the beak is next, while the legs are the last of all to be affected. Futhermore, paling in visible yellow pigment may at times be brought about by other influences than laying. The presence of yellow pigment therefore, is more decisive than its absence. These facts should be taken into consideration in the showroom. A good-laying bird might not have lost the yellow from her legs early in the season, although her vent and beak would be pale, while, toward the end of the laying year, yellow legs would be almost a sure sign of a poor layer. In most of the fall fairs and early poultry shows, pullets are exhibited before they normally begin to lay. Such pullets one would expect to be abundantly supplied with yellow pigment. Pullets in early shows therefore, should not be judged in the same manner as the birds in the regular later shows, when a bird certainly should be penalized which is evidently a poor producer.

The suggestion may appear drastic, but it would prove of great service to the poultry industry and ultimately to the poultry shows themselves, we believe, if during the laying season, any hen or pullet were disqualified from the showroom which did not show evidence of being in a laying condition.

The foregoing article is presented for the serious consideration of breeders of Leghorns and all yellow-skinned fowls. If it should prove to be true that yellow skin and white ear lobes in Leghorns are definitely opposed to each other, then the Standard should and no doubt will be amended in this particular. It is just as well however, to bear in mind that the identification of characters that indicate laying ability, or the lack of it, is still a new and obviously incomplete science, and the fancier can scarcely be blamed for feeling that, in view of the remarkable progress already made under the present Standard, changes in it should be made only after the need for them has been clearly demonstrated.

CORRELATION OF EXHIBITION SCORE WITH PRODUCTION
LEGHORNS
Standard Score

EGG PRODUCTION-PULLET YEAR	90	89	88	87	86	85	84	83	82	81	80	79	78	Disqualified	Total
300-271				1		1									2
270-241	1		4	1	11	2	2							1	22
240-211	4	10	12	12	14	12	4							7	75
210-181	4	6	21	24	40	18	7							16	136
180-151	8	11	32	43	35	19	9	5	1					14	177
150-121	3	8	14	30	22	12	3	1			1			14	108
120-91	3	6	7	15	7	5	3							6	52
90-61	1	3	4	1	3	3	1	1							17
60-31		1	2	1										1	5
30-1		1		2	3										6
Total	24	46	96	129	135	72	29	7	1	0	1	0	0	59	600
Wt'd. Avg.	167	157	167	160	175	174	173	156	161	0	139	0	0	168	169

FIG. 140—NO ONE WHO LOOKS AT THIS TABLE CAN QUESTION THE SUPERIORITY OF STANDARD-BRED LEGHORNS AS LAYERS

The Fancier's Opportunity

The wonderfully awakened interest in the poultry industry in this country, and the great importance which is and should be attached to keeping only high-quality, bred-to-lay stock means that there is developing for the fancier a greater market than he has ever known before,—is making prospective purchasers of practically every farmer and commercial poultry keeper in the country. One of the bugbears of the fancier has been the disposal of his medium-grade stock. There never is any question of his ability to place his exhibition specimens at good prices, but for the medium birds—those not good enough to win in hot competition or to use in select breeding pens,—he has a limited demand. The commercial poultry keeper and the farmer however, are not, as a rule, interested in exhibition birds, though they do want standard-bred fowls.

No breeder can afford to be indifferent to the requirements of this trade. Instead, he will cater to it and will permit no unnecessary obstacles to be interposed. If his breed or variety does not quite measure up to the reasonable demands of commercial poultry keepers he will quickly see to it that their conditions are met, even if that involves a modification of present Standard values. However, those who consider the present situation carefully will find that they need sacrifice nothing essential and with right breeding methods they certainly have it within their power to realize a volume of sales that in former years was entirely out of the question.

FIG. 141—WHITE WYANDOTTE WITH RECORD OF 309 EGGS

This hen was one of a pen entered in the International Laying Contest. Is a good illustration of the fact that conformity to type in this breed is not necessarily a handicap in egg production. Courtesy of Conn. (Storrs) Experiment Station.

Summary

Standard fowls are the foundation of a permanent poultry industry.

Practically all high egg records have been made by standard-bred fowls.

In the popular breeds, breeding for standard qualities has been in no way a handicap as regards capacity for egg production.

At the Storrs Egg Laying Contest the production of the highest scoring pens regularly exceeded the average for all entries in the respective breeds,—further proof that showroom quality is not necessarily secured at the expense of productiveness.

At the Vineland Contest correlation tables show that the best layers in all the popular breeds average high in exhibition quality.

The requirements of the "Standard" as regards yellow pigment need but little adjustment, if any, to meet all reasonable demands of the commercial poultry keeper.

CHAPTER XVI

The Physiology of Egg Production

Fowls May Have Great Capacity For Egg Production Without Making Exceptional Records Unless Conditions Generally Are Favorable—Persons Who Are Culling Fowls and Poultry Keepers Who Are Trying to Secure Maximum Production Need to Understand Fowl Nutrition and the Physiology of Egg Production—How the Fowl's Egg Organs Function Is Here Briefly Described, Also the Influence of Feed and Care Upon High Egg Production

ATTENTION has been called elsewhere to the fact that a fowl may have excellent egg-laying capacity as determined by body measurements, heredity, etc., and yet prove quite inferior in actual performance unless the conditions under which she is kept, the methods employed in her care, the rations fed, etc., are such as will give her a chance to do her best in this respect. Speaking generally, the number of eggs laid by any hen is simply the measure of her ability to produce UNDER EXISTING CONDITIONS.

For this reason, the poultry keeper who is interested in securing maximum returns from his flock needs to understand pretty thoroughly the physiology of the fowl, at least in so far as it relates to egg production and to the digestion and assimilation of food upon which high egg records in so large measure depend. He needs to know what organs are involved in these operations, the manner in which they work, the circumstances under which they can best fulfill their natural functions and the conditions which the poultry keeper should provide in order to give the fowls the best possible chance to reach maximum production.

The influence of external conditions upon egg yield should receive especial emphasis in presenting the subject of culling to the beginner, who is quite prone to accept rules as hard and fixed, and to apply certain tests without taking other characters into consideration or without investigating the condition under which fowls have been kept. Without in any manner detracting from the practical value of culling methods the beginner should understand that he must take breeding, feeding, and general management into careful consideration if he would escape serious errors in classifying fowls with reference to their laying ability.

Egg Organs of the Hen

The ovary in an inactive state is a comparatively small organ resembling in appearance a dimunitive bunch of grapes. It is attached near the backbone of the fowl, just in front of the kidneys, and contains an indefinite number of undeveloped ova, which when they reach full development are known as yolks. The ova have been counted by different observers who have reported anywhere from 2,500 to 4,000 as visible to the naked eye. In addition to those that may be so counted there probably are many more that can only be counted by the use of a microscope. The number actually visible in the ovary of even the poorest layer however, is much greater than the number of eggs that any hen can possibly lay, hence there is no reason to believe that the number of ova present bears any direct relation to the hen's productiveness.

The oviduct is the organ which receives the yolk when it reaches full size and escapes from its follicle, and in which the albumen and shell are deposited. In the non-laying hen the oviduct is extremely small, being only a few inches in length at most. In the active state it is from 18 to 24 inches long in which condition it occupies a good deal of space—one reason why the abdominal capacity of a heavy layer must be large. The upper end of the oviduct, known as the funnel, is not directly attached to the ovary, but at the time when each yolk bursts from the follicle the funnel rises up so as partly to enclose it, thus to insure its entrance into the oviduct.

Development of the Egg

After the yolk has dropped into the upper end of the oviduct it is gradually forced onward by peristaltic action. As the egg progresses spirally through the oviduct it accumulates successive layers of albumen until it reaches the isthmus where it receives the membraneous coating of soft shell. It then passes on to the uterus where the hard shell is deposited. It also receives in the neighborhood of 40 per cent of its total albumen at this point. According to observers it takes in the neighborhood of 14 days for the yolk to develop from its initial stage to full size, and for the formation of the egg after the yolk has

FIG. 142 WHY SOME HENS DO NOT LAY

Illustration shows condition of egg organs of hen No. 838, details of whose post-mortem are given herewith see page 10

entered the oviduct it is stated that 24 hours or more are required.

The size and shape of eggs vary with individual fowls, and the commercial poultry keeper must give close attention to the character of the eggs produced, particularly with reference to quality. Size of egg and color of shell

FIG. 143—PELVIC ORGANS OF LAYING HEN

1—Ovary and yolks in process of formation; 2—active oviduct with egg ready to be laid at 3; 4—the rectum; 5—the liver; 6—retroperitoneal storehouse for fat. After Kaupp, in second edition of "Poultry Culture, Sanitation, and Hygiene".

are but slightly under the poultryman's control though size is noticeably affected by the rations fed, amount of water consumed, and the supply of shell material. The quality or flavor of the eggs is normally determined by what the fowl eats and drinks.

The color of the egg yolk is affected in a marked measure by the rations fed, and as a bright yellow yolk is always desired, those who are catering to first-class markets must keep this point in mind. The color of the yolk is produced by the same pigment that makes yellow skin, beak, and shanks, and if it is not present in the ration it cannot appear in the yolk.

Abnormal eggs, meaning eggs abnormal in shape, size, and shell usually result from some unfavorable condition in the oviduct or from physical conditions affecting that organ. Fowls that are overfat or that are underexercised, (resulting in the weakening of the abdominal muscles) or that do not have an ample supply underexercised (resulting in the weakening of the abnormal eggs, particularly at the height of the laying season. At this time also blood clots are apt to be found in the eggs and various diseases of the egg organs may develop. The remedy in practically all of such cases is not medicinal treatment, but a correction of the ration and of the conditions under which the fowls are kept, which will set the organs to functioning in a normal manner. When this is done, ordinary derangements will correct themselves if not too acute or of too long standing.

Why Some Hens Do Not Lay

The explanation of the manner in which the complete yolk enters the oviduct suggests how yolks may sometimes escape into the body cavity without entering that organ; also how it is possible for an egg, after being partly formed or perhaps even after receiving its shell, to make its way back up through the oviduct by a reversal of the peristaltic action and drop out at the upper end into the abdominal cavity. The yolks or partially formed eggs, after escaping into the body cavity may be walled off or encysted, and more or less completely reabsorbed, or their presence may cause acute inflammation and death.

Partially formed eggs may also escape into the abdominal cavity through a rupture of the walls of the oviduct, often without any serious consequences so far as the general health of the fowl is concerned. A peculiar condition sometimes met with is illustrated in Fig. 142. The hen shown was entered in the Vineland Laying Contest but had only a single egg to her credit in six months. She was carefully examined by Dr. W. C. Thompson of the Poultry Department, New Jersey Experiment Station, and her condition described as follows:

"S. C. W. Leghorn pullet No. 838 showed every indication of being a good producer, with faded shanks, white ear lobes, whitish beak, and good development of comb, and exhibited other signs of being in full producing condition. Post-mortem examination was ordered and made. A large, round, hard mass of yellowish matter was found, about the size of a large orange and encased within a membraneous sac which was formed in the side-wall of the oviduct. Many yolks had been formed normally in the ovary and then passed into the oviduct where a small amount of albumen had been secreted and the whole mass pushed on into the sac instead of following the regular channel of egg formation. These had accumulated for some time and finally formed this tumor-like mass."

The Digestive Organs of the Fowl

The fowl's ability to produce great numbers of eggs is quite largely conditioned upon her capacity for digesting and assimilating food. When it is remembered that a fowl laying 200 eggs in a year must reproduce her weight in egg substance in the neighborhood of five times during this period, it will be seen that the demand upon her digestive organs is great, and there must not only be room for storing large quantities of food at feeding time, but there must be rapid digestion to enable her quickly to transform the crude nutrients in the ration into the highly complex compounds of which the egg is composed. While the fowl's digestive organs are naturally designed for the rapid assimilation of food, it has been found that where heavy production is sought, assistance must be given by having a large part of the ration finely ground and in that way partly prepared for digestion.

The crop, which is the first organ of digestion, is a comparatively thin-walled sac, capable of great distension and serving as a storehouse for food. It also ex-

cretes a mucus which moistens the food and probably has some digestive action. The food remains in the crop for a period of some hours, during which time it becomes quite soft, and is then passed on to the stomach or proventriculus, a glandular organ secreting the gastric juice. The food then passes to the gizzard where it is reduced to a very fine condition, and is thoroughly acted upon by the digestive juices, after which it passes into the intestine. The first portion of this forms a loop in which lies the whitish-yellow pancreas, a gland which secretes another digestive juice. Bile from the liver also enters the intestine near the gizzard. Its part in the digestive process is more or less mechanical; that is, it emulsifies the fats and neutralizes the acidity of the food in solution as it enters the intestine. The liver itself is largely concerned with the absorption of food, in doing which it transforms certain compounds into more easily assimilated ones. In addition to the digestive juices already mentioned there are several others secreted by glands in the wall of the small intestine, each performing an essential part in the digestion of the food.

This is not the place to go into a complete discussion of poultry feeds and feeding.. That is done in detail in a new book issued by Reliable Poultry Journal Publishing Company, entitled "How to Feed Poultry for Any Purpose With Profit", and to which the interested reader is referred for down-to-date information on this important subject. There are, however, some practical details in regard to the subject that are so important to every one interested in increased egg production that they clearly should receive at least some attention in this chapter. Probably the most effective manner in which this can be done is to present the results of some observations made at the Vineland Egg Laying and Breeding Contest where the rations of laying fowls have been very carefully studied. During the visit of one of the authors of this book to the Experiment Station at New Brunswick and to the contest plant, he interviewed Prof. H. R. Lewis, who kindly furnished the following information regarding the feeding methods in use there, and the results secured.

Nutritive Requirements for Egg Production

Herewith Is Presented a Most Instructive Interview With Prof. H. R. Lewis, Head of Poultry Department, New Jersey Experiment Station, Giving Valuable Data Based on Records of the Vineland Egg Laying and Breeding Contest, 1916-1917—Full Information Is Given Regarding Rations Used, Food Consumed, Cost of Production, Etc., Etc.

Question—What rations were used at the First Vineland Egg Laying Contest?

Special rations were evolved for the feeding work at the contest. The aim in evolving these rations was to secure simplicity and at the same time insure maximum efficiency. The basic grains, corn, wheat, oats, and their by-products were selected as the ingredients for the rations. The mash ration consisted of 100 pounds of wheat bran, 100 pounds of wheat middlings, 100 pounds of ground oats, 100 pounds of corn meal, 100 pounds of meat scrap. This dry mash was kept before the birds in hoppers and was supplemented by a scratch grain ration consisting of equal parts of cracked corn, wheat, and oats. During extremely cold weather in the winter the corn in this scratch ration was doubled, giving to the ration more heating properties. In addition to this mash and scratch ration, the birds were fed a considerable amount of succulence, and grit, shell, and charcoal were kept before them in hoppers constantly. During the spring, summer, and fall they were allowed to run on alfalfa ranges.

Question—Briefly, what was the method of feeding?

The method of feeding was just as simple as it was possible to make it. The mash was kept before the birds constantly in hoppers, and the scratch grain mixture was fed to the flocks three times a day, morning, noon, and night in rather restricted quantities, and in such amounts as to insure the proper consumption of mash. No wet mash was fed, no tonics or panaceas of any kind were given. The object in feeding the grain in small quantities three times daily was to keep the birds active and hungry, and not allow them to fill their crops full at any one time with hard grains. Only a very small amount of scratch feed was fed morning and noon, the bulk of it being given at night.

Question—Do you regard the mash ration as the egg-maker, so to speak?

The nutritive ratio of the mash was 1:2.65 and the nutritive ratio of the grain was 1:7.7. When these are fed in about equal proportions a nutritive ratio for the daily diet of the flock of about 1:4½ to 5 is secured. Of course it is true that the bird uses both the mash and the grain ration in part from which to manufacture eggs, and in part to maintain her body weight and to provide heat and energy; yet when we appreciate the fact that one-third of the dry matter of an egg is protein, one can readily appreciate the importance of protein in the daily diet of a flock of layers, and it will be obvious that the mash mixture, due to the presence of 20 per cent of meat scrap, is essentially the egg-making part of the ration. Experiments conducted at the New Jersey Station show conclusively that maximum egg production cannot be secured unless the flocks are compelled to eat large amounts of a well-balanced mash, containing at least 20 per cent of meat scrap.

Question—In your opinion then, is there a good reason for the claim that the grain ration is used largely for the fowl's maintenance?

This reasoning is largely correct from the fact that the grain ration is primarily composed of carbohydrates and fat, although there is, of course, considerable protein present. Since maintenance requirements call for heat, energy, and reserve food supply, it is more economical and efficient to provide these maintenance requirements from the grain rations.

Question—Were records kept showing what proportion of mash and what proportion of grain was consumed?

Recent feeding tests at the New Jersey Agricultural Experiment Station have brought out interesting results

FIG 144—OVARY AND OVIDUCT OF GOOD AND POOR-LAYING HENS CONTRASTED

This remarkable illustration shows, on the reader's left, the ovary and oviduct of the heavy-laying Rhode Island Red hen illustrated in Fig. 54, and on the right the egg organs from the poor-laying hen in Fig. 55 (see page 43). Both hens were actively laying, but the poor producer's ovary shows a much lower state of activity—shorter cycles with long periods between—and this is confirmed by the noticeably smaller size of the oviduct which suggests also that the hen has not been laying for so long a period as the one on the left. Photo from Conn. (Storrs) Exp. Station.

regarding the proper proportion of mash and grain to feed. Formerly it has been suggested that 2 parts of grain and 1 part of mash were about right. Feeding tests disclose the fact that the best results are secured, especially in late spring and summer, if the birds are restricted in their grain feed and compelled to eat greatly increased amounts of mash. Mash is the cheaper of the two mixtures, and its greater use tends to lower feeding costs. Mash also contains more protein, which is the egg-making material, hence its larger use tends to force greater production. The following table has been worked out showing the proper amount of grain to feed layers during each month. With this amount of grain they will naturally eat the remainder of their requirements in the form of mash which will insure the correct proportions between the two.

Amount of Scratch Grain to Feed Layers Each Month in the Year

Month	Pounds per Day per 100 Birds	Pounds for Each Feeding A. M.	P. M.
November	12	4	8
December	12	4	8
January	12	4	8
February	12	4	8
March	12	4	8
April	12	4	8
May	10	4	6
June	10	4	6
July	8	3	5
August	6	2	4
September	5	2	3
October	5	2	3

The fact that at the Vineland Contest approximately equal parts of mash and grain were consumed throughout the year is of special significance since it has been the general custom heretofore to recommend feeding twice as much grain as mash. Our practice not only insures sufficient protein material for egg production, but it also cheapens the ration, for the mash is generally cheaper than the scratch grain. In addition it may be stated that birds require slightly more grain than mash until they come into full laying condition; equal parts of mash and grain while laying heavily in the late winter and spring; considerably larger amounts of mash than grain during late summer and fall.

Question—Are these proportions the same for hens as for pullets?

Yes, the above proportions are approximately the same for hens as for pullets with the one exception that the feeder must use special care not to feed yearling hens in the fall and early winter as heavily of grain as is done with the pullets, for such practice would result in their taking on too much body weight, and therefore becoming too fat for egg production.

In this connection it may be of interest to learn the relation which existed between grain and mash consumption and feed costs, also comparing the light and heavy breeds. These details are shown in the following table:

Amount of Mash and Grain Consumed per Pen in Heavy and Light Breeds, and Cost of Feeding---Vineland Laying Contest

	No. of Birds per Pen	Mash Cons'd per Pen	Grain Cons'd per Pen	Total Feed per Pen	Cost Feed per Pen	Ratio of Mash to Grain	Cost per100 Birds
Heavy breeds	400	452.2	399.9	852.1	$24.30	1.13:1	$243.
Light breeds	600	387.2	375.9	763.1	21.90	1.1:1	219.

It will be seen here that it cost $2.43 to feed each heavy-breed bird, and $2.19 to feed each light-breed bird of the Leghorn type.

Question—Did the records show that the fowls consumed an increased amount of feed during the period of high egg production?

Table Showing Relation Between Feed Consumption and Egg Production

WEEK	PLYMOUTH ROCKS		WYANDOTTES		RHODE ISLAND REDS		LEGHORNS	
	Feed Consumed	Eggs Laid	Feed Consumed	Eggs Laid	Feed Consumed	Eggs Laid	Feed Consumed	Eggs Laid
1	227.9	165	189.3	171	111.6	73	630.4	1046
2	243.	200	209.6	219	101.2	117	621.9	1532
3	263.4	213	229.3	254	126.4	141	736.7	1557
4	256.9	228	218.9	280	127.2	136	706.4	1491
5	264.4	240	224.8	297	128.6	141	772.1	1545
6	305.5	294	258.8	320	128	149	926.7	1703
7	294.5	318	247.2	307	137.8	147	882.5	1483
8	284.4	288	241.4	292	128.8	157	815.8	1172
9	278.3	338	235.	299	126.3	153	787.7	1188
10	315.1	371	265.5	314	157.5	169	865.1	1246
11	344.8	382	277.4	314	156.	211	920.8	1407
12	341.2	406	269.5	372	152.9	220	942.	1316
13	323.6	494	256.8	405	148.4	247	906.3	1456
14	327.7	528	264.1	418	148.	278	923.6	1585
15	333.7	563	177.9	422	144.6	279	940.1	1528
16	337.0	630	253.2	475	141.5	216	937.6	1787
17	313.2	717	263.6	540	143.9	286	989.1	2266
18	346.1	746	272.1	563	156.1	307	1033.2	2484
19	352.6	791	282.9	598	152.7	318	1056.6	2601
20	348.5	822	272.7	649	151.9	327	1041.5	2777
21	342.5	823	260.9	698	155.4	352	968.7	2842
22	320.2	828	266.2	683	146.1	363	1064.2	2922
23	315.5	809	260.0	674	152.9	373	1057.9	2906
24	330.1	806	254.8	631	150.1	362	1036.7	2919
25	323.5	788	260.7	623	154.7	367	1055.9	2939
26	320.0	724	259.3	609	149.3	338	1005.7	2914
27	309.1	679	242.1	548	135.3	319	1019.8	2794
28	338.2	725	254.2	547	142.0	274	1068.6	2769
29	301.3	730	230.5	535	124.6	283	925.8	2828
30	311.0	784	243.0	603	138.4	324	1054.6	2871
31	289.2	739	236.3	591	138.7	330	943.4	2808
32	296.8	685	235.9	585	132.5	331	981.3	2906
33	277.2	615	204.1	464	110.8	245	964.7	2748
34	253.4	577	180.5	373	109.0	190	900.8	2719
35	224.7	565	158.2	310	95.5	204	801.2	2756
36	228.1	536	170.6	333	103.6	212	886.6	2612
37	248.8	530	193.3	370	113.7	226	960.0	2560
38	258.1	553	199.3	474	108.8	231	914.8	2621
39	239.7	501	192.9	471	99.6	208	850.9	2516
40	194.1	348	175.9	334	98.4	167	862.6	2209
41	233.5	368	199.3	351	120.0	208	879.2	2073
42	261.4	435	216.3	431	109.3	223	870.0	2063
43	241.3	417	200.7	388	113.2	196	860.0	1937
44	243.7	312	190.8	293	117.5	120	777.1	1501
45	233.4	282	178.1	221	108.1	141	713.1	1035
46	259.9	326	183.9	238	117.1	157	653.7	811
47	260.4	369	189.9	256	127.2	183	635.9	828
48	273.2	385	213.8	287	131.0	196	671.8	826
49	274.8	396	223.0	321	128.3	222	689.6	748
50	289.4	336	243.9	303	146.5	205	716.6	647
51	289.6	331	236.8	290	140.6	183	725.5	564
52	380.8	319	299.9	297	194.5	196	941.2	537
Total	15263.4	26355	12051.6	21641	6924.9	12017	45714.3	101832
Aver.	293.5	506.8	231.7	416.2	133.2	231.7	879.1	1958.3

Yes, the records show that feed consumption increased quite materially as egg production increased. In fact, we find a close correlation between the curves of egg production and the curves of feed consumption; the rise and fall in the curve of feed consumption being slightly ahead of the corresponding rise and fall in the curve of production. Birds in heavy-laying condition during the spring months will consume from 80 to 100 per cent more feed than they will during the resting period. The accompanying table shows in a very interesting way this uniform relation which exists between feed consumption and egg production.

Question—How much feed is required to produce a dozen eggs in the case of the four breeds under consideration at the Vineland Contest?

The Leghorns lead in efficiency, requiring 5.4 lbs. to produce one dozen eggs; the Wyandottes next with 6.12 lbs.; Plymouth Rocks next with 6.85 lbs.; and Rhode Island Reds next with 6.9 lbs.

CHAPTER XVII

Balancing the Flock, and Methods of Increasing Fall Production

For Best Results the Laying Flock Should Be Properly Balanced as to Proportion of Pullets and Hens Production in the Average Flock Generally Drops to a Low Level in the Fall—How This Can Be Prevented by Proper Handling of Hens and by Early Hatching of Pullets—With Leghorns a Practical Plan Is to Have a Flock of Extra-early Pullets to Begin Laying in August

A REASONABLY uniform production of eggs the year around is the poultry keeper's ideal, but as a rule he falls far short of achieving it. Beginning in late summer the egg yield of the average flock falls off rapidly and reaches an extremely low level during the fall and early winter months. Greater uniformity in production and better profits can be secured by properly balancing the flock. By this term is meant maintaining the correct proportion between the number of hens and of pullets, also having pullets of different ages.

The production of hens in their second year is always lower than in their first, speaking in averages, and they seldom begin laying until after the first of the year, so that the average price of their eggs is decidedly lower than that of early-hatched pullets. One-year-old hens, however, are much better for breeding purposes than pullets and their chief value to the poultry keeper, therefore, is in producing eggs for hatching. The fact that such hens do not begin laying until after the first of the year is no objection,—indeed, is an advantage, as it insures a supply of eggs for hatching from fowls that are just coming into laying after a long rest period and that are capable of transmitting the highest vigor and vitality of the embryos.

Poultry keepers have long recognized the fact that their only chance for keeping up the production of the flock and securing a goodly number of eggs during the high-price months is to have a large percentage of early-hatched pullets, meaning by this, pullets that will come into laying during October, as a general average. There are practical reasons however, why the proportion of such pullets in the flock usually is comparatively low, and it is something of a problem for the average poultry keeper to determine how many he should try to raise and when these should be hatched, to maintain just the right balance between hens and pullets.

In a survey of 150 poultry farms, reported in Bulletin 329 of the New Jersey Agricultural Experiment Station, the correct proportion of hens and pullets in the flock, as determined by actual experience, has received careful attention and the conclusions reached are set forth in the following extracts from that publication:

"Poultrymen usually recommend that the major portion of the flock be made up of pullets in order to have the most profitable producers. The hen lays a larger number of eggs the first year of her life than the second, and a larger number the second year than the third, decreasing the number each year as she grows older. The poultrymen of the farms included in this survey keep a portion of the flock as yearlings and the remainder as pullets. The best pullets are kept the second year as yearlings and the inferior ones sold. Those sold are selected according to the best judgment of the operator, who tries to pick the poorest layers.

"By dividing these flocks according to the proportion of pullets and yearlings, the advantage or disadvantage of keeping a large proportion of yearlings in the laying flock should be shown. In a number of tables (necessarily omitted from this chapter owing to lack of space—Ed.) it is made plain that the poultrymen whose flocks have 50 to 70 per cent of their number in pullets obtain greater total receipts per flock and per hen than any other class. They also receive the highest number of eggs per hen, except in the class having 80 to 90 per cent of their flock in pullets. A well-balanced flock must carry 30 to 50 per cent of yearlings to produce eggs for hatching, otherwise the poultryman will need to buy his eggs for hatching. This proportion allows the development of a flock with good vitality, and with enough old hens to give it stability. The average proportion of pullets on these farms was 61 per cent. They have just about the right proportion on the average."

Better Fall Production From Hens

With more attention to the subject, even the one and two-year old hens can be handled so as to get more eggs from them during the fall months, doing this by giving them a needed rest in early summer before there is any tendency to molt, and pushing them for eggs till they stop for the molt in the fall. If this is properly done the molt can be delayed for several weeks in the fall and the laying period correspondingly prolonged. We have a good deal yet to learn about the molt, but in the case of persistent layers at least, production apparently governs it to a great extent, so that in the words

FIG. 145—A FEBRUARY-HATCHED LEGHORN PULLET LAYING AT AGE OF 129 DAYS

This pullet was hatched February 25th, and laid her first egg July 4th—just 129 days after hatching. Such pullets should produce a large number of eggs in late summer and early fall before going into molt. Photo from University of Missouri.

of Professor Lewis of the New Jersey Experiment Station, "We used to say that our hens are molting, so they have stopped laying; now we say our hens have stopped laying, and so they are molting."

The idea of a few years ago that the poultry keeper should try to secure an early molt in the hope that it would be followed by good fall and early winter production has given away to the more practical plan of securing the greatest possible production before the birds stop laying for the molt. It is not to be expected that hens will produce eggs throughout the entire season without a rest; only the most persistent layers in the flock will do that. But if the poultry keeper watches the performance of his fowls carefully and at the proper time in early summer allows them to drop off in production for a time, by making judicious changes in the ration, and then after a few weeks brings them back gradually, he will find that he can "carry over" a good many summer eggs into the fall.

It is believed by many that special attention to the exercise of hens in the fall assists greatly in postponing the molt and securing increased production at this time. Mr. R. S. Moseley of Sunny Crest Farm, New York, states: "To retard molting in case it starts earlier in the season than you think is natural or necessary, increase the litter to practically a foot deep and every time you go through the pens sprinkle a little hard grain in the litter. We have found that more exercise on the part of our layers induces a hardening of the feathers and if the birds are treated in this way they will postpone molting, at least in many cases, and go on laying.

Another method that aids greatly in increasing fall production of hens is the use of artificial light. Evidence has been heaped up to show that "lights" do, without question, increase egg production, not only in pullets but also in hens. For example, at Cornell University it was found that where unlighted pens of hens gave a production of only 4 per cent in October, hens under lights reached 27.2 per cent in the same month and on the same rations.

Culling to Keep Up Percentage of Egg Yield

Many progressive poultry keepers are maintaining the percentage production of their hens at a high point by persistent culling. Experience has shown that in the summertime an average production of less than 50 per cent means that some of the hens in the flock are not laying at all. It is the opinion of Prof. Lewis of New Jersey Experiment Station that where the production of the flock is under 50 per cent, the number of idle hens will be found to approximate two per cent for each point below. In other words, if the production of the flock is only 40 per cent, 20 per cent of the hens are nonproductive. Keeping production around 50 per cent, of course, accomplishes nothing in the way of securing uniform production; it simply reduces the size of the flock and keeps down the cost of production—a practical step of much importance to every egg producer.

What Can Be Done With Early-Hatched Pullets

Every poultry keeper realizes the advantage of having early-hatched pullets, meaning those that reach maturity and begin laying during the month of October as a general average. It is such pullets as these that produce by far the greater proportion of eggs secured during the fall and early winter months.

With many it has become something of an art to decide at just what time to hatch their pullets so that they will come to maturity early in the fall and keep laying constantly thereafter, but avoiding the well-known danger of having them come in too early, in which case they are almost certain to go into a molt after laying a month or two, after which they will lay few eggs until the winter is practically over.

Delaying the maturity of early pullets that are coming in a little too late for profitable summer production and too early for continuous winter production, are measures that the careful poultry keeper resorts to when occasion requires. This may be done by shifting the pullets frequently to new quarters, supplying bulky feeds, using only limited amounts of animal matter, grains rich in oil, etc. In doing this, however, avoid extreme measures, which may cause injury to the fowls and result in loss rather than gain.

There is another method of securing increased fall production which in recent years has come rapidly into prominence as a practical measure: This is the plan of bringing out some extra-early pullets which will begin laying in late summer. It is most commonly practiced by Leghorn breeders, since these quick-growing pullets are particularly well adapted to this method. Practically all such pullets will molt in the fall, but if they are hatched early enough so that good production can be secured before they go into the molt they may be utilized to excellent advantage.

FIG. 146—ARTIFICIALLY LIGHTED LAYING HOUSES ON BROAD ACRES FARM

The above illustration shows arrangement of houses at Broad Acres Farm, Connecticut. The 20x30-ft. laying houses are so located that a single fence makes a double yarding system possible. The hens range in one large flock either on the east or the west side of the row of houses. During the season of lighting a single lantern was used in each of these houses, and egg production largely increased. The use of "lights" is an important aid to securing increased fall and winter egg production. Photo from Prof. Roy E. Jones

The value of February-hatched Leghorn pullets is set forth in "Hints to Poultrymen", Vol. IV, No. 4, a monthly publication of the New Jersey Experiment Station, in an article by E. H. Wene. Extracts from this article are given herewith including a table showing the production of a flock of 190 February-hatched Leghorns at the New Jersey Experiment Station, including not only their production, but the profits realized.

"February hatching has not been carried on to a great extent in the past, possibly because of the fact that market eggs sell for such a high price at that time that the poultrymen have not considered early hatching profitable. The fertility is apt to run lower during the winter months, a fact which also would tend to discourage the practice. Although there are, therefore, one or two disadvantages in early hatching there are a number of important ways by which it can be made of great help to the poultryman. It is our firm belief that the farmer can plan to have from one-quarter to one-third of his chicks hatched during February. This would give him plenty of time to care for them before the rush of the spring work. Also, by early hatching it is possible for the poultryman to get a greater supply of hatching eggs during the following spring from his February-hatched birds, for such birds make the best possible breeders by the next April, being yearlings in fact in that they are over one year old and have molted.

"By the middle of July, the February-hatched pullets should be moved to their laying houses, as they will be producing a few eggs by this time, and during the months of September, October, and November, if the pullets have been properly reared and well fed, a good supply of eggs may be expected. Special care should be given to their feeding. In the morning the pullets are fed equal parts of wheat and oats scattered in deep litter, feeding about one pound to twenty birds. Special care should be used to see that the litter is kept dry, deep, and coarse. In the afternoon scratch grains are fed, the mixture consisting of one part of oats, one part of wheat, two parts of cracked corn. About one pound to every ten birds should be fed. In addition to these standard grain rations the regular winter laying mash is fed in large open hoppers. This mash consists of:

2 parts wheat bran, 2 parts wheat middlings, 1 part gluten meal, 1 part corn meal, 1 part ground oats, 1 part alfalfa meal, 2 parts meat scrap.

"In addition to the grain rations mentioned, a constant supply of clean, fresh water should be kept before the birds all of the time. Sour skim milk is also a valuable addition to the feeding ration if it can be bought at a reasonable figure. From 25 to 50 cents for a 40-quart can is a fair price.

"Accompanying table gives results obtained from a pen of 190 Single Comb White Leghorn pullets hatched on February 9, 1914. These pullets were placed in a New Jersey Multiple Unit Laying House the last of July. They began laying soon after being placed in permanent quarters, and continued to lay a good number of eggs except during the molt which took place in November, December, and January. The number of eggs laid during the year, the per cent production, the value of the eggs, the amount of feed consumed, and the profit are shown here as the proof of their work."

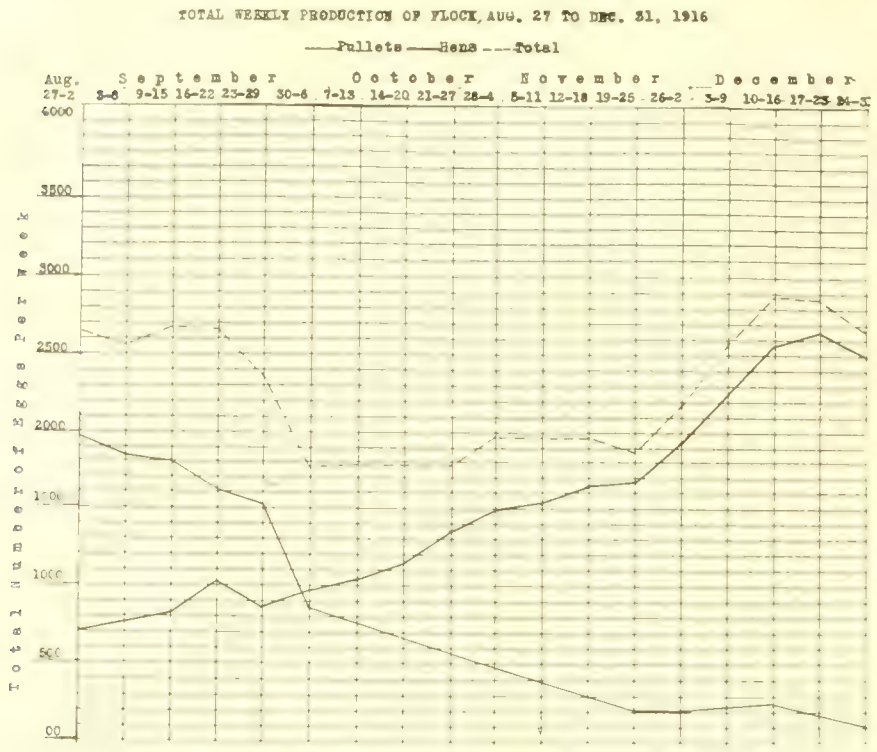


FIG. 147—EGG PRODUCTION AT MASSACHUSETTS AGRICULTURAL COLLEGE POULTRY PLANT—FALL OF 1916

This graph and the one shown in Fig. 148 should be studied in connection with article by Prof. Graham. Above graph shows the production of pullets and hens in the college flock where no effort was made to "balance", thus resulting in the usual low level of production during the early fall months. To show how balancing the flock raises the average of production at this season, see Fig. 148.

The value of a flock of extra-early pullets in helping to secure uniformity in annual production is also explained in the following article:

Keeping Egg Production at a High Level During Fall Months

In Leghorn Flocks It Is Recommended That One-third of the Pullets Raised Each Year Be Hatched the Last of February so as to Have Them Laying in August

By PROF. J. C. GRAHAM*

I WILL not take time to tell how this subject came to our attention as a vital factor in poultry farming, but suffice it to say that observations on our early-hatched pullets (those hatched by the winter-course students the last week in February) proved that they were not only our most profitable ones but that their production filled that great gap between September 15th and November 16th caused by the sudden falling off of the eggs from hens and the lack of maturity on the part of the pullets hatched during the customary period. In other words, the necessity for early-hatched pullets to meet college requirements accidentally demonstrated, in part, how to meet this great need, long felt by specialty poultry farmers. These observations have enabled us to arrange a series of hatching dates, coupled with the number of pullets in each lot, to bring the pullets to production during the two months mentioned above, to within about 70 per cent or 75

Record of Eggs Laid in 12 Months by a Flock of 190 February-hatched Leghorn Pullets, and Cost of Production

Month	Number of Eggs	Per Cent Production	Total Cost of Food	Value of Eggs	Profit or Loss
1914					
August	1245	21.1	$17.43	$39.42	$21.99 profit
September	1756	29.6	17.23	57.07	39.84 profit
October	1934	32.9	14.51	79.78	65.27 profit
November	593	1.1	15.58	29.11	13.53 profit
December	132	0.2	16.75	6.38	10.37 loss
1915					
January	847	1.4	24.51	32.47	7.96 profit
February	2155	40.0	20.99	62.85	41.85 profit
March	4014	68.0	27.50	83.62	56.15 profit
April	3984	68.0	27.84	79.68	51.83 profit
May	3619	61.1	28.50	72.48	43.98 profit
June	2927	51.4	28.75	64.48	39.78 profit
July	3029	52.0	21.94	71.96	50.02 profit
Totals	26280		$257.53	$679.30	$421.83

per cent of the normal production in August. We believe that production under this plan can be raised still higher at that period of the year but the number of early pullets would be abnormally high. To get the maximum results, the hens must be kept laying at as high a rate as possible until well into November or December, so we found that putting this plan into operation on a college and experimental plant required the solution of many intricate problems. We discovered very early in the demonstration that the hens could not be transferred very much later than August 1st without a serious drop in production and a poor come-back; that after the pullets had begun to lay fairly well, a removal or transfer would result in a serious drop, this being especially true with the early-hatched ones. To allow an early transfer of the hens from the regular laying house and to do away with disturbance by a second or third transfer of the pullets, open growing sheds were built in the rear of the yard of the winter quarters, to which the hens were transferred during the month of July. The first year they were transferred to these sheds when broody, and after they were broken up production was resumed with only a normal loss of time due to broodiness. The last two years they have been transferred en masse during June or July. The first of these two years the drop in production was slight, but the past season the reduction due to the transfer was marked, but only for about ten days. Our conclusion in regard to the removal is that, with the broody races, it is better to make the transfer during the broody period unless the birds can be moved without serious disturbance. They continue production in these sheds well into November. Of course, judicious culling does away with a large portion of the hens so that two complete flocks are not kept at the same time. After the transfer the houses are thoroughly cleaned and ready for the pullets about the first of August when the early-hatched ones are brought in, and the medium and later-hatched ones are placed in winter quarters when they begin to show signs of maturity; but we plan to have them all in by the last of October or slightly earlier if possible. As can readily be seen, this plan enables us to have, at this particular season of the year, a double flock, so to speak, which, overlapping in production, holds the egg production near the desired level.

Some flocks of early-hatched pullets molt, but the manner in which they do this varies greatly. Some lots will go through almost a complete molt, and egg production will nearly cease, while other flocks will molt very slowly and give a production of something like 25 per cent or 30 per cent during the molting period. We have found that by hatching out about one-third of the pullets the last of February or the first of March, another third from three to four weeks later, and the last third from three to four weeks following the second lot, the second and third lots will begin production somewhat in advance of the slackening of the first lot and the almost ceasing of the hens. Of course the dates for hatching depend largely upon the age at which the pullets may be expected to come to laying maturity. Again, the rate at which the hens keep up production in the fall is another factor that must be considered. At present writing, our demonstration is closing the third period with most satisfying results. We herewith present two charts (see Figs. 147 and 148), the first showing the production of the entire college and experimental flocks at our poultry plant for the fall of 1916, and the second for that of 1917.

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Summary

Uniform production the year around is desirable but this ideal can only be partially realized in practice.

Early-hatched pullets are essential to good production in fall and early-winter months.

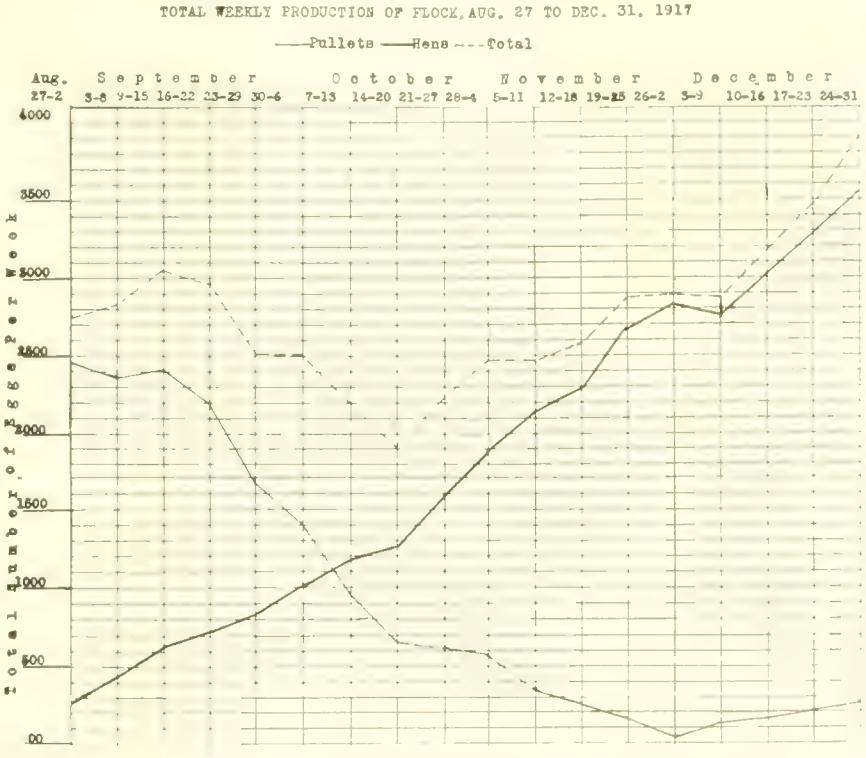

FIG. 148—EGG PRODUCTION AT MASSACHUSETTS AGRICULTURAL COLLEGE POULTRY PLANT, FALL OF 1917, WITH BALANCED FLOCK

The production lines cross during the early part of October, but the total production for hens and pullets is decidedly above that of previous year (see Fig. 147), due to the presence of a flock of February-hatched pullets. These, if properly grown, can be depended upon to bring up the egg production during September and October when hens are falling off. Prof. Graham states that the results during the fall of 1918 were very similar to those of 1916 and 1917.

A well-balanced flock requires 30 to 50 per cent of yearling hens.

The flocks of the New Jersey commercial poultry farmers contain 50 to 70 per cent of pullets on the average.

Too large a proportion of pullets results in increasing cost of production.

Better fall production can be secured with yearling hens, with proper management.

Hens may be made to molt later in the fall by giving special attention to exercise for them.

The use of artificial light produces a marked increase in fall egg production.

The summer egg yield of hens can be kept up to 50 per cent by systematic culling.

Extra-early-hatched pullets may be made a profitable source of supply for summer and fall eggs.

Extra-early pullets may be profitably used to provide eggs for hatching for the following spring.

Extra-early hatching enables the poultry keeper to lengthen his hatching season, thus modifying the usual spring rush and getting double service from the hatching and brooding equipment.

CHAPTER XVIII

A Demonstration in Culling the Poultry Flock

One of the Most Popular Educational Practices Introduced by College Extension Workers Is the Culling Demonstration - Poultry Keepers Everywhere Take Great Interest in Watching the Work—How One Well-known Extension Poultry Specialist Conducts Such a Demonstration and Teaches His Hearers to Apply the Methods to Their Own Flocks

NO OTHER new development in poultry keeping has ever met the immediate popular approval that has been accorded to culling. This has been due in part to the comparative simplicity of the method and the startling results secured, but chiefly, no doubt, to the fact that the methods lend themselves so readily to practical demonstrations. Great numbers of extension workers on agricultural college and experiment station staffs have enthusiastically taken up the work of introducing the practice in their respective states, and almost uniformly with good results. Culling campaigns have profited largely by the fact that in the last few years the educational work in poultry husbandry has been unusually well organized and manned. Almost every state has one, and many have several workers who devote their entire time to poultry extension, and by cooperating with the county farm bureaus these agricultural advisers have been able to interest great numbers and to make their culling demonstrations unusually effective.

Every demonstrator has his own methods of interesting the public, of getting the attention of those who attend the school or demonstration, of enlisting their support, and of getting them enthused to the point where they will go home and apply what they have learned to the culling of their own flocks. Usually demonstrations are arranged through the county agent, who is in a position to determine where they can be held to best advantage, and to arrange the necessary details so that the demonstrator can do the work without loss of time, and thus is able to cover more territory than would otherwise be possible.

While attending the Judging School at Cornell University in July, 1919, the authors of this book arranged with W. G. Krum, extension instructor in the Poultry Department of that institution, to give a demonstration for the express purpose of illustrating the Cornell method of carrying on this work. Cornell University has been a leader in the development of culling methods and in getting these before the public. Mr. Krum, who has been with the department for many years and knows the laying hen as do few other men in this country, has been highly successful in this line of work. Following, Mr. Krum tells in his own words how he organizes a demonstration, how he gets the interest and sympathy of his hearers, how he illustrates methods and shows how to apply them practically. In the course of this demonstration many valuable hints are given in regard to detecting layers and nonlayers, in determining the length of time that the bird may have been laying or resting, also of estimating her probable production. Every person who has occasion to demonstrate culling methods we believe will find much that will be helpful in this interview.

FIG. 149—W. G. KRUM, EXTENSION INSTRUCTOR, CORNELL UNIVERSITY, GIVING A FARM DEMONSTRATION IN CULLING

A Culling Demonstration

Method of Conducting a Culling Demonstration Fully Outlined—Numerous Helpful Comments on Scoring Special Types of Fowls

Demonstration by W. G. Krum, Extension Instructor, Cornell University, Ithaca, N. Y.

DEMONSTRATIONS in selection are arranged through the farm bureau managers who look after publicity, arrangement of the place, provide stock to be used and have it housed previous to the meeting. Demonstrations usually are at some farm and, if the farmer has only one variety, arrangements frequently are made to have the neighbors bring in others.

At the beginning of the demonstration I usually use a chart showing the difference in egg production between a good and a poor pen, and the money value of their product. Then I select from the birds as many different types as I can find,—all the way from hens that have not laid in several months to hens that are laying practically every day. These are passed around to the audience and, without any instruction whatever as to their laying quality, the persons holding them are asked to form in two lines or groups, those who have birds that they consider laying, standing on one side, and those who think their birds are not laying, on the other. Then I pass down the line and pick out a few of the birds that are in the wrong place and explain what the hens

are or are not doing. This usually creates considerable amusement and in that way you get the full attention of the audience. Then I pick out the various types of birds, usually beginning with the poor layer, and point out to the audience all the various points indicating their rank as producers.

Hen No. 1

(At this point Mr. Krum took up a Leghorn hen that had been brought in from the college flock and proceeded to apply culling tests with running comments as made under regular demonstration conditions.—Ed.) This Leghorn is not laying at the present time as indicated by a dry, puckered-up vent that shows a large amount of yellow pigment. This also is noticeable about the edge of the eyelid or eye ring. She has yellow ear lobes, which would indicate that she has not laid for a week or more. Her beak is entirely yellow and as it takes four to six weeks for all of the yellow to come back into the beak after it has been laid out, it is an indication that she has not laid for that length of time. Finally, she has round, plump, bright yellow shanks which indicate that she never laid very many eggs.

With reference to the foregoing statement it should be remembered that this hen is being scored early in July. Plump yellow shanks on a hen scored in September or October would not necessarily mean that she had never laid many eggs but that, though she might have been a good spring layer, she had been idle for a long time. In July, however, a hen with plump yellow shanks could scarcely have been very productive, even in the spring.

This hen is just beginning to molt a few neck feathers but if she was a good layer she should still be laying and growing a few pin feathers at the same time. A good layer usually shows a few pin feathers in the neck about four to six weeks before she goes into the regular molt. The indications are that this hen has always been a poor layer.

Hen No. 2

Hen No. 2 is not laying at the present time although she has laid within a week because only a little color shows at the vent. Pigment coming in around the vent usually shows first right along the edge where the feathers begin to show.

This hen has laid enough eggs to take all the color out of her beak, but she has vacationed long enough to put some of it back. It goes out first at the corner of the mouth because of the high circulation of blood at that point and gradually keeps fading out, leaving the lower mandible first and finally the extreme tip of the upper beak. It comes back in the same order and inasmuch as this hen shows about one-fourth of her beak yellow, it would indicate that she has already had a good vacation. Notice that this hen is very white naturally, having an almost pure white quill. Allowance must be made for this in applying pigmentation tests.

Under some conditions, with birds normally well pigmented, and on farm range where the yellow color comes in much more quickly than in the case of hens kept in confinement, a beak with this amount of yellow might indicate only a two weeks' vacation, or less, whereas this bird's wing molt indicates that she has not laid for probably eight weeks.

The primary wing feathers beginning next to the secondaries are molted usually in pairs, one in each wing, the pairs dropping about two weeks apart. A complete feather grows in in six weeks and in two weeks more another one finishes its growth This hen has two complete primaries and four growing. This would indicate that she has been growing feathers for eight weeks. Her body is full of pin feathers and the old feathers are loose, which means that she is through laying for this season and is going through a complete molt. All these are indications pointing to the fact that this hen probably stopped laying to molt about the middle of May and hence has not likely laid more than 50 to 75 eggs.

The comb is small and cocked up in the rear—the type of comb that usually goes with poor layers. The eye is small and surrounded by a puckered eyelid so that none of the membrane surrounding the eye is visible, in fact some of the eyeball is not visible, being partially covered with the puckered eyelid. Hens with this type of eye usually lay only from 5 to 10 eggs a month at their best

The pelvic bones are quite close together and covered with thick layers of fat. This hen's back and breast lines are not parallel, being much closer together at the rear of the keel than at the front, showing a lack of capacity for digestion of food. The skin of this bird is very coarse.

FIG 15 TESTING A HEN FOR RECENT EGG PRODUCTION

With the fingers spread on either side of vent, a slight pressure will cause the escape of watery fluid if hen has laid within past 24 hours or so

Good layers, like good milch cows, have a thin, pliable skin. This hen's is tough, hard, and leathery.

Hen No. 3

Hen No. 3 is laying at the present time as indicated by her large moist vent. She is in good health and in a laxative condition, so that by pressing lightly on each side of the vent with the first and second fingers a watery discharge comes from the vent—a certain indication that she has laid within the last 24 hours.

This hen's ear lobes are pure white, which indicates that she has been laying more than a week. Absolutely no color in beak, which shows she has been laying for at least two months, and the shanks have lost almost all of their color and are thin and wedge-shaped, the sharp point of the wedge being at the rear. While the hen is plump and full there is no fat left in her shanks, which indicates she has laid very heavily. This hen has the comb that is known as the rocker comb, showing a tendency to follow the neck. The points are tapered, wide at the base, and wedge-shaped.

The comb and face are very bright, indicating that she is not laying very heavily at the present time,—possibly every other day. A bright comb is an indication of good health and laying condition rather than the

number of eggs the hen produces. When a hen is producing heavily, her comb will be full and waxy and almost as shiny as a doorknob. After laying heavily for several weeks however, the comb loses some of its color, as also does the face, and she is pale.

This hen has very good eyes. They are more nearly parallel in the head than in hen No. 2, whose eyes have a tendency to sink in at the corner. The position of the eyes is observed by holding the fowl so as to get a direct front view of the head. The eyelids are drawn back by high nerve tension and show quite a good deal of the membrane in the corner of the eye.

This hen's abdomen is full and soft. The pelvic bones are four fingers wide in a 4½-pound Leghorn. The width between the pelvic bone and the breastbone or the keel is five fingers and the body is wider at the rear than at the front, and the keel is long. A long keel indicates capacity for laying. The pelvic bones have practically no fat on them and are very pliable. This hen, while still laying, has an occasional pin feather started in her neck which would indicate that she, unlike the other hen that has already quit, will probably continue to lay for six weeks or more.

The time at which the rest period begins, with reference to the molt, will vary with different hens. In a good layer, production will stop as soon as she starts shedding wing feathers. This hen has already dropped two pairs of feathers earlier in the season, indicating that she took a month's vacation.

Hen No. 4

Hen No. 4 is laying, as indicated by the same characters that we noted in hen No. 3, but her comb is swollen to the limit and is waxy and shiny, indicating that she is laying practically every day. She has a pale face and slightly pale comb.

Bear in mind that the swollen comb of the heavy layer is not necessarily bright red. The enlarged condition apparently is not due to the comb being engorged with blood but may be due to expansion of the cells. The comb at this time usually feels cold, because the blood is being used for the production of eggs and is drawn toward the reproductive organs rather than to the comb.

This hen's face is quite pale which also indicates that she has been laying heavily for quite a long time. She has all the other marks of a good layer that the previous hen had and the eyes of this hen are about the same. This hen however, has rougher plumage than the other, more broken, and the feathers are dryer, indicating that she has used up more fat from the skin. The oil on the feathers does not come from the oil sac as supposed, but it comes out through the skin and onto the feathers by capillary attraction through the oil ducts.

This plumage is badly broken because it is dry and because of heavy laying. There are no loose wing feathers at all, and no loose feathers or pin feathers in the body. This hen will probably be laying for a long time. She has three-finger capacity, is wider at the rear, and has a longer breastbone, same proportion of abdomen as the other hen but with a longer keel, which would indicate greater capacity than the last hen.

Hen No. 5

This hen laid long enough to take the color all out of her beak. Then she took a good vacation, and the yellow returned to two-thirds of her beak. When she resumed laying again, she took the color out at base of beak, which resulted in leaving a yellow ring over a quarter of an inch wide near the middle. She presents an appearance often observed in farm flocks at this season. Where a number of hens in the flock are like this it usually will be found that the farmer shut his hens up about the middle of May because they were digging up the corn, and that they all stopped laying because of the change of environment. Then, after about a month's vacation, they began laying again.

A Couple of Plymouth Rocks

Here is a Plymouth Rock hen that laid fairly well previous to her vacation as nearly all of the yellow went out of the front of her shanks, but at the present time the front is more yellow than the back, due to the fact that during vacation it comes into the front before it does the back. The thinness of the back of the shank and its medium-yellow color would indicate capacity for laying, but she fell down because of some unfavorable condition, such as being confined in a bare yard, or possibly because of a poor ration. She shows a few pin feathers.

Here is another Plymouth Rock that has taken a long vacation, evidently a month or two, but all of her feathers are tight, and her comb is hot, indicating that she is coming into laying again. My supposition is that this hen was broody and reared chickens, otherwise the feathers would be loose at this time. If she had stopped for the molt the comb would be shriveled and not hot and swelling.

Scoring Nonpigmented Hens

In the case of fowls that do not have yellow skin and shanks we can get some idea of their productiveness by their shape. If a hen is in laying condition it would be shown by the condition of the vent the same as in Leghorns; capacity would be shown by the shape and texture of the body, the muscles being soft, the skin soft, oily, and pliable. The shape of the eye also indicates a hen's ability to lay and her past performance will be indicated very plainly by the condition of the shanks, the poor layer having hard, plump shanks, the good layer having wedge-shaped shanks, very tapering to the rear, the fat having all been removed. Coarse scales are always correlated with heavy, thick skin and therefore are found only on poor layers.

The texture of the comb also is correlated with that of the skin. If the surface of the comb is rough and coarse the skin will also be of the same character and these are found on poor layers. In a good layer, the comb, whether large or small, should be very smooth and waxy on the surface, indicating thin skin.

Comments on Special Points in Culling

When the hen takes a rest and the comb shrivels, a fine, white scale forms. If she starts up again, the comb, in the process of enlarging, cracks this scale which remains in patches on the comb for some time. So when you see a comb with a white surface broken in patches you know that she is coming back into laying again and this comb, of course, always will be warm at this stage.

A short keel usually indicates poor production because a short-keeled bird has not sufficient abdominal capacity to handle large quantities of feed and if she attempts to do it there is a tendency for her abdomen to bag down over the end of the breastbone, often making serious trouble.

A good many of the keels of high producers are crooked, due to a lack of knowledge in feeding hens. The mineral matter is laid out of the bones and they are easily bent. We find many more crooked keels with high producers than with low producers.

I almost never, in judging in the fall, throw out the bird that has taken a vacation unless she has some pin feathers, because it may have been a case of broodiness, or it may be due to improper feeding, or to shutting them up. That would not be the hen's fault, and if there are no pin feathers I do not throw her out but try to bring her back into laying again. I always investigate the feeding, housing, and yarding methods so I know to what extent these are responsible for the performance of the hens.

We begin culling work sometime in July and run up to September and October. Speaking in averages, I feel that on most commercial farms a hen that is laying on September 1st is worth carrying over as a layer but not as a breeder; and all hens still laying on October 1st, if of desirable type, should be marked and set aside for next season's breeding pen.

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