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B214: The Biology of Poultry Keeping

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University of Maine.

Maine Agricultural Experiment Station

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THE BIOLOGY OF POULTRY KEEPING

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BULLETIN No. 214.

THE BIOLOGY OF POULTRY KEEPING.*

RAYMOND PEARL.

There are certain phases or branches of agriculture which are from their very nature specialized and locally restricted either in space or time. The growing of beef cattle is not adapted to the conditions of the city back-lot not could it be considered sound economic policy for the Saskatchewan wheat grower to set out an orange grove. There is, however, one kind of farming, which in one form or another, knows no limitations of space, and only those limitations of climate which forbid any sort of agriculture whatever. This is poultry keeping. No plot of ground is too small to keep a few hens on, or at least to try to keep them on, and no ranch, however large, is complete without a flock of hens to furnish eggs for the table and perhaps a few over to sell. It may be safely said that there is no phase of agriculture which is so universal and wide spread over the whole world as poultry husbandry. The adaptability of the business is marvellous. Poultry raising may be, and probably has been, successfully combined with every other kind of farming known to man. One farm recently visited would seem to have about reached the limit in the way of oddity of the combination. This was a *fox and poultry farm*. Raising foxes was one part of the business, and raising chickens and turkeys the other part. Needless to say the two lines of endeavor were kept strictly apart.

When combined with other things as an integral part of diversified farming poultry keeping is usually one of the most profitable activities of the farm, and can be made so in every

* A lecture given at Columbia University on Jan. 31, 1912, in a course of "Lectures on Economic Agriculture."

Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 49.

case with attention to fundamental principles. If given a chance hens will make money on a farm. Of specialized poultry plants, where the chickens form the main or sole line of endeavor, there are all sizes ranging from the town dweller's one, two or three hens in a box in the back yard, or on the roof, or the fire escape, to the immense poultry ranches or farms where the unit of production is the flock of a thousand birds and there may be many such units. Sad it is but true that not all of these specialty plants are profitable. The back yarder's usually is, but after a certain magnitude of plant and of operation is passed trouble begins and frequently does not end until the available capital is exhausted and the business is brought to an end.

If it is true that some men find poultry keeping profitable while others fail in it, we may well ask what are the *essentials* to success in the business. It would appear that there are three fundamental elements involved in every successful venture in poultry husbandry. These are:

1. Good stock
2. Proper management
3. Good business sense in the conduct of the commercial end, including:
 - a. Buying the supplies.
 - b. Selling the product.
 - c. Economically controlling the labor factor in the business.

Of the third of these categories, namely good business ability, nothing further need be said here. It is something with which the hens have nothing to do. It is not primarily a biological problem as are the other two. Furthermore nearly every normal man feels sure, down deep in his own mind, that while he may not be a financial genius, still after all he possesses a reasonable modicum of business sense, and is quite certainly not keen on being advised as to how to run his business by any itinerant college professor.

GOOD STOCK.

Good stock is in last analysis a question of breeding. Of course it may not be directly such for the man just starting out

in the poultry business. He must purchase his stock in one form or another. But somebody must have bred it. There is no way to get stock of high quality except by breeding. Good stock may be very much hurt by bad management, and on the other hand stock which has been run down by improper management may be very much improved by correcting the evils in this direction. But stock which is inherently poor can only be made inherently good by changing its innate constitution. Such a change can only be wrought by careful breeding along definite lines.

In considering the subject of breeding from the practical standpoint it must always be remembered that the rank and file of successful poultrymen are not in any sense of the word *scientific* breeders. They know little or nothing about the science of breeding and are only interested in it, if at all, in what might be called a somewhat academic manner. Indeed it is fair to say that many of those doctrines which the practical poultry breeder usually holds to with the greatest firmness on the supposition that they are "scientific" principles of breeding are things which modern exact scientific studies of heredity have shown to be either quite erroneous or of exceedingly limited applicability. What the successful practical poultry breeder is an expert at, however, is the *art* of breeding. Possibly some who are interested only in the investigation of the laws of inheritance may be inclined to doubt whether really there is any such thing as an art of breeding, distinct from the science of breeding. The contention might possibly be made that what we call the art of breeding is merely a convenient verbal shroud to cover the nakedness of the empiricism in breeding, which in large part can now be reduced to scientific principles and should ultimately be entirely so. This sounds well in theory, but anyone who is disposed to maintain that there is no such thing as an art or craft of breeding, quite apart from the scientific side of the matter, should attempt once to produce, on scientific principles, a winning male in the Barred Rock class in the Madison Square Garden Poultry Show, for example. Let me hasten to say that no doubt this could be done. But when it is done the person accomplishing it will in the meantime have become something more than a student of the science of inheritance. He will have become an expert practical poultry breeder.

Granting that practical success in the breeding of poultry depends upon the knowledge of something more than the laws of inheritance thus far set down in books, it is none the less important to know the fundamental principles or qualifications upon which success in this field depends. There are three primary factors involved in poultry breeding without any one of which success of the highest type will never come, and with all three of which it is sure to come in time.

THE RECOGNITION OF INDIVIDUALITY.

The first of the factors is what may be characterized as the ability to "see" a bird. This is the most fundamental qualification for a breeder to possess and is the most difficult of all to acquire. Some years ago, at a very enthusiastic meeting of men engaged in the teaching of poultry husbandry in the various colleges and schools of agriculture in this country, a whole day's session of the meeting was devoted to the pedagogy of poultry husbandry. With much vigor and at great length such matters were debated as the text book method versus the lecture method in imparting a knowledge of how to grow chickens; whether the higher theory of caponizing should precede or follow the advanced philosophy of broiler production in general; how the recondite subject of "brooding" might be best presented and so on. After the discussion had proceeded along these lines all day the chair finally called upon a distinguished teacher of poultry husbandry, who had not hitherto taken any part, for an expression of his opinion on these weighty matters. In response this gentleman said that, while he had been much interested in the discussion which had gone on, it seemed to him after all very academic. After considerable experience in trying to teach poultry husbandry he had found that about all he could hope to do in four years was "to teach the students to see a chicken." He felt if he succeeded in doing this that his teaching had been successful, as measured by the highest standards. He admitted, however, that he by no means always succeeded. It is worth noting that this gentleman's summing up of the essential purpose of a college course in poultry husbandry agrees precisely in principle with the statement of James that the function of a college in general was to help you "to know a good man when you see him."

It is in regard to just this point of ability to see a bird that lies the chief difference between the expert poultryman and the rank amateur. By "seeing a chicken" is meant, in brief, the recognition of the individuality of that bird. Every human being is able to recognize the individuality in the appearance of other human beings. At a glance we recognize in looking at a number of people the points of difference which distinguish one individual from another. The distinguishing trait may be only some very unimportant feature. Almost certainly it is something which is nearly, if not quite, impossible of accurate description. The case simply is that our eyes are trained to recognize individuality in appearance amongst men. It is just precisely this ability to recognize instantly, easily and fully individual differences amongst fowls which characterizes the expert poultryman.

To him a flock of chickens is not simply an aggregation of living things all very much like one another. It is, on the contrary, a group of *individuals*, each one of which possesses some distinguishing trait which can be found, if one cares to look for it, and which will mark this bird out from its fellows for all time to the "seeing" eye. The minute differences upon which such distinction of individuals depends may be in form, or color, or size, or pattern. Quite as often there will be differences in behavior, expression, or disposition. Such matters as carriage, the method of holding the head and the body, the expression of the eyes, and so on are characteristic of individual fowls as of individual men. Many of the differences which the expert poultryman will readily recognize are quite as difficult of precise description as are the differences which prevent you from confusing your next-door neighbors when you meet them.

Not only does this ability to "see" a bird mean the ability to recognize it as an individual of the flock, but also it means the ability to form a judgment as to its bodily condition and state of health. We are able to recognize at a glance whether a person appears to be in good health, or whether, on the contrary, he is off condition. Relatively small differences of this kind in human beings are easily recognized. It is not necessary that an individual should be moribund before we are able to say that he is not looking well. In the case of poultry, however, it

usually has to be a very sick chicken before the amateur will realize that there is anything the matter with it. On the contrary the expert, who is accustomed really to see his fowls as individuals, will recognize as slight changes in well-being among them as he will among his fellow men.

The first great underlying principle then, which biology has to give to animal husbandry of any sort, and particularly to poultry husbandry, is the principle of *individuality*. The living organism, whether it be a hen or a dairy cow, is not primarily a fraction of a flock or a herd, but is before anything else an *individual*, endowed with a whole mass of individual peculiarities of structure, physiology and behavior. Furthermore the ultimate foundation for practical success in the conduct of a poultry business depends not only upon a recognition of this principle of individuality, but an ability to put it into actual operation in the daily work. No one can ever be a successful practical poultryman until he acquires, in some degree, the ability to see his fowls as individuals, in the same sense that he sees his fellow men as individuals. Other things being equal the greater his powers of discrimination in this particular, the greater will be his practical success in the business.

CONSTITUTIONAL VIGOR.

Having acquired the ability to see the individual birds as individuals, the next step is to learn to distinguish a good bird from a poor one. Here it is ever to be kept in mind that the primary and most essential characteristic of a good bird must always be a sound constitution and plenty of vitality and vigor. Without these qualities it is impossible to have first class stock. Constitutional vigor and vitality may be put as the second fundamental requisite in the successful practical breeding of poultry. In all kinds of breeding operations whether for utility purposes, or for the fancier's show pen, or for the purpose of experimentation in the field of heredity, the first selection of birds for the breeding pen should be made on the basis of their general constitutional vigor. No bird which shows signs of weakness in this fundamental regard should ever be used as a breeder under any circumstances. If such a bird is used the breeder will eventually have to pay the penalty.

The external, visible evidences of a sound constitution and a possession of abundant vitality and vigor are numerous. In the first place the bird of sound constitution will be in perfect health. Perhaps its most striking characteristic will be an independence of disposition and demeanor. By this is not necessarily meant aggressiveness. The bird, whether male or female, which is forever picking quarrels with its fellows is by no means always the bird of greatest vigor. Strange as it may seem a bird may indeed be very far from a mollycoddle and yet have a peaceable disposition. It may be taken as an unfailing characteristic of birds of high constitutional vigor, however, that they are able to take care of themselves and may not be imposed upon, or bullied by their fellows, with impunity. While they may not pick a quarrel, they are abundantly able to make a forceful presentation of the merits of their end of any debate which another bird may choose to enter upon with them. In other words they have, as has been said, an independence of disposition; an ability, reaching to the limits of gallinaceous capacity, to meet all situations which may arise in the day's work of a fowl, whether food getting, fighting, rearing young, or what not.

The bird of high constitutional vigor will have a thrifty appearance with a bright eye, and clean, well kept plumage. The head will be broad and relatively short, giving in its appearance plain indication of strength. It will show nothing of the long-drawn-out, sickly, crow-like appearance of the head which is all too common amongst the inhabitants of the average poultry yard. The beak will be relatively short and strong, thus correlating with the general conformation of the head. Comb and wattles will be bright in color and present a full-blooded, healthy, vigorous appearance.

The body of the bird of high constitutional vigor will be broad and deep and well meated, with a frame well knit together, strong in the bone but not coarse. In fowls of strong constitution and great vigor all the secondary sexual differences will usually be well marked. In other words the males will be masculine to a degree in appearance and behavior, and the females correspondingly feminine. It must be noted, however, that this last is a general rule to which there are occasional exceptions.

INBREEDING.

The third basic factor which makes for success in practical breeding is *inbreeding*.* This may seem a radical statement, but a careful study of the history of the best improved strains of live stock of all sorts, including poultry, leaves no room for doubt that the attainment of the highest degree of excellence has always been associated with the practice of a very considerable amount of inbreeding, of rather close degree. It is a curious paradox of animal husbandry in general, and of poultry husbandry in particular, that while, as a matter of fact, every successful breeder of high grade stock practices inbreeding to a greater or lesser extent, a great many of these men are violent, even fanatical, opponents to inbreeding in theory. Most of them will deny stoutly that they ever practice inbreeding. They contend that they practice "line breeding," but never, never "inbreeding."

The distinction here is obviously verbal and not biological, being in its essentials precisely similar to that between Tweedledum and Tweedledee. The essential and important biological point is that what is actually done is to *purify* the stock in respect to all characters to as great a degree as possible. What the successful breeder aims to do is to get his stock into such condition that he has only one kind of "blood" in it. Expressed more precisely, though unfortunately more technically, it may be said that the breeder endeavors to get his stock homozygous with reference to all important characters or qualities. The quickest way, indeed the only way, practically to obtain this result is by the practice of some degree of inbreeding. Sometimes a great stride towards the desired end may be made by mating brother and sister or parent and offspring together.

That a mating of such close relatives will surely result in disaster is one of the carefully nursed superstitions of breeding, which has often been exploded, but will doubtless always be with us. It may be said that all the evidence which may be gleaned from the experience of stock breeders indicates that the results which follow inbreeding depend entirely upon the nature of the individuals inbred. If one inbreeds weak animals, lack-

*The following discussion of inbreeding has already appeared, in slightly altered form, in *The Farm and Home Poultry Annual for 1913*.

ing in constitutional vigor, and carrying the determinants of undesirable qualities in their germ cells, the offspring resulting from such a mating will undoubtedly be more nearly worthless than were their parents. If, on the other hand, one inbreeds in the same way strong and vigorous animals, high in vitality, and carrying the germinal determiners of desirable qualities there may be expected a corresponding intensification of these qualities in the offspring. The time has come when a vigorous protest should be made against the indiscriminating condemnation of inbreeding. It should be clearly recognized that if the experience of stock breeders extending throughout the world, and as far back as trustworthy data are available, means anything at all it plainly indicates that some degree of inbreeding* is an *essential* to the attainment of the highest degree of success in the breeding of animals, poultry forming no exception to this rule.

This contention receives full support from the results of modern exact studies in genetics. Such studies show that the personal bodily characters of the parents have no causal relation to the personal characters of the progeny. What the progeny shall be like is determined by the constitution of the germ cells of the parents. When by a proper system of selective breeding the point is reached where these germ cells are pure with reference to a particular character, or degree of a character, then that character will unfailingly appear in the offspring, in the degree of perfection in which it is represented in the germ cells. This is the highest goal of the practical breeder. But in a sexually reproducing organism like the domestic fowl purity of the germ cells with respect to the determiners of any character is only to be obtained, in the hands of a practical breeder without special scientific training, by the practice of inbreeding.

It should not be understood that indiscriminate inbreeding without definite purpose or reason is advised, or advocated as a panacea for all the difficulties which beset the breeder's path. All successful breeding is the working out of carefully made plans. In those plans inbreeding has a place. For the average

* Of course if the term "inbreeding" makes too violent a strain upon anyone's intellectual, moral or merely human prejudices, there is no objection to his using for the practice the term "line-breeding," or some other even milder designation.

poultryman who does not keep individual pedigrees, and could scarcely afford to do so if he wanted to, the safest and wisest plan to follow in breeding is to make matings without any thought whatever of the relation to one another of the individuals mated. In some instances they will be closely related, in others not so, purely as a result of chance. If *only* individuals of high constitutional vigor are used as breeders no thought need be taken as to relationship, and there will be no necessity of going out of the flock to get "new blood" to rejuvenate the stock. Further if "new blood" is not brought in there will be sufficient inbreeding purely from chance to bring about in time (in a flock of not too diverse origin) a considerable degree of purification in respect to selected characters.

Introduction of new blood for purposes of rejuvenation or reinvigoration, which is one of the commonest practices of the poultryman, is, as ordinarily done, one of the surest ways to prevent any real or permanent improvement of his stock by breeding. The difficulty here is that when one introduces new blood he runs the risk of introducing a whole set of characters *inferior* in their degree of perfection to what he already has in his own stock. The real cause which so frequently leads poultrymen who should know better to take this risk is a failure rigorously to select breeding birds for high constitutional vigor. The average poultryman finds it very hard to discard some particularly fine specimen just because it shows a little weakness in one way or another. He is disposed "just this once" to let the bird by, and use it as a breeder. This practice continued will make "new blood" necessary for rejuvenating purposes.

Again the careful breeder often finds himself in this situation. He has by well planned and executed breeding brought his stock up to a particular level of excellence. There the improvement stops. His birds breed true to that particular degree of quality but cannot be made to attain a higher degree. In other words, he has substantially purified his stock relative to the characters which interest him. But he sees that the stock of some other breeder is measurably better than his. If A is to get his stock up to the B level he must introduce some B blood. This has long been the poultryman's procedure, and if done in the right way, it is found to be as successful in practice, as it is justifiable in theory in the light of modern ideas respecting

inheritance. The danger in the matter in such a case as this under discussion all turns on the way in which the thing is done. If one feels it to be desirable, for the reason specified, to introduce "new blood" into his flock of birds let him by all means do it gradually, and not swamp the whole flock with the new germinal combinations all at once. For if he does he may destroy in this way at one blow results which have taken years of careful breeding to build up. The proper procedure in introducing "new blood" is, in most cases, to buy a male bird and mate it the first year with only a small number of females, perhaps three or four. In this way it is possible to find out whether the new "blood" "nicks" with the old, as the breeders express it.* If it does he may then extend its introduction to the whole flock. If it does not "nick" he will not have lost all, but may still continue with his original foundation stock, with all its good qualities.

Having considered in detail the principles involved in the production of good stock in poultry keeping, we may next turn to the conservation of this stock once it has been obtained. While well bred stock of sound constitution is fundamental for all permanent success in the poultry business, yet it is equally true that the best stock in the world may be made very unproductive, and in nearly all respects practically worthless, by improper management. Furthermore in the hands of a skillful poultryman the same stock can be made to yield a great deal more profit, both in egg production and in meat production, than if handled and cared for by an amateur without any understanding of the business.

HOUSING.

In the management of adult fowls there are in the main two things to be considered, housing and feeding. A vast multitude of methods of doing these two things to poultry have been tried during the history of the industry.

There have been published plans for poultry houses of all conceivable shapes and sizes. Long houses, short houses, tall houses

* From the standpoint of modern conceptions of heredity "nicking" possibly means nothing more than that the individuals mated form homozygous combinations of many important characters rather than heterozygous combinations.

low houses; square, hexagonal, octagonal and round houses; heated houses and cold houses; all these and many more have had their advocates and detailed plans for their construction can be found. It would appear that there must be realized here the primary condition of the experimental method, namely the "trying of all things." It only remains to discover that which is "good" in order that we may "hold fast" to it.

This discovery has indeed been made in regard to a few of the basic things in the housing of poultry. It would be strange if something had not come out of all the indignities to which innocent and inoffensive generations of fowls have been submitted in the way of dwelling accommodations. It is now clearly recognized, and generally admitted by all competent poultrymen, that certain things are absolutely essential in any poultry house which is to give good results. These are (1) fresh air, (2) freedom from dampness, (3) freedom from draughts, (4) sun-light, and (5) cleanliness.

If these five things are realized in a poultry house the birds will thrive and be productive in it, provided they are well and regularly fed and watered. It makes no difference particularly to the well-being of the birds how these necessary specifications of their dwelling are attained. To the poultryman, however, it is important that they be attained at the smallest expense, having regard to (a) initial cost, (b) repairs and up-keep and (c) labor necessary to operate the house to get the specified results. The housing problem is to the poultryman, then, both a biological and an economic one. The biological solution is definite. The requisites named above must be met, and there is one additional factor to be taken into account; namely size of house. Experiments made at various times and places indicate clearly that in northern climates, where birds must be shut up in the house during a part of the year in order to give best results, there should be allowed in the house at least three square feet of floor space per bird, and preferably a little more. Four square feet floor space per bird is a liberal allowance.

A factor which it was formerly thought necessary to control in the housing of poultry was the temperature. It was long held that if fowls were to lay well in the winter it was necessary that they should be in a heated house. Later experience has shown conclusively that this was an utterly fallacious idea. As

a matter of fact, even in the coldest climates, fowls will lay better during the winter months in a properly constructed house wide open to the outside air in the day time, so that they are living practically out of doors, than in any heated house which has yet been devised. If a laying house is *dry* the temperature factor may be neglected. If a house has a tendency to dampness, it will give poor results regardless of temperature.

From the economic standpoint there are two systems of housing poultry to be considered. One of these is the system of long continuous houses for the laying birds. The other is the so-called colony house system, in which the birds are housed in small separate houses which may either be set a considerable distance apart over a relatively wide area, or may be placed relatively near one another. Each system has its strenuous advocates. Experience covering a fairly long period of years now has demonstrated that both systems have good points. As to which shall be adopted in a particular instance depends upon a variety of considerations, each in some degree peculiar to the particular case in hand.

In the extreme northern part of the country where the climate is very cold in the winter and there is an abundance of snow there can be no question that the long house is much to be preferred to a colony system. There are two reasons for this. In the first place experience indicates that the birds are somewhat more productive and keep in better condition in a properly constructed and managed long house than in colony houses. Furthermore the labor expense involved in caring for a given number of fowls is much less, under such climatic conditions, than with the colony house system, where the birds are scattered over a wider area and more paths must be broken out in the snow.

The great advantage of the colony house system is its flexibility. Furthermore it gets around the troubles involved in the contamination of the ground by the long continued keeping of poultry on the same small area. In general, local conditions and circumstances must decide in each individual case which system of housing shall be adopted.

Having decided upon the general system to be followed, what particular type of house is best? There is one outstanding type of "long" house which has been very widely used with

great satisfaction. This is the so-called "curtain front house." The particular form of this which was devised and has been used for many years at the Maine Station is probably the most widely used. See Fig. 56 and 57. Description of this house with specifications for its construction may be found in Circular No. 471 of the Maine Agricultural Experiment Station, which will be sent free to any resident of Maine. The essential feature of this type of house is that during the day the front of each pen, which is formed of a cloth curtain, is wide open, so that the pen becomes in effect a shed open on the south side. At night this curtain is closed, but it still permits of some circulation of air so that the house is at all times a strictly "fresh air" house.

In the case of the colony house there cannot be said to be any single type which, by common consent, is of such outstanding merit as the "curtain front" type in the case of the long house. There are two types of colony houses which are at present popular and seem to be of greatest merit. One of these is essentially nothing more than a single unit or pen of a "curtain front" house. That is, it is a "curtain front" colony house built on essentially the same plan as the long house only very much smaller. The other type of colony house is the so-called Tolman house, which is another modification of the open front principle. Another house of this general type which has been advocated is the Woods house.*

FEEDING.

Having housed our fowls they must be fed. Here the same sort of history is to be found as in the case of housing. Substantially all known edible substances must, at some time or other, have been suggested or tried as component parts of the rations of fowls. Not only have many and curious substances been suggested as poultry food, but they have been combined in formulæ as weird as a medieval apothecary's prescription.

* Detailed plans and specifications for the construction of poultry houses of various types may be found in Bulletin 215 of the Wisconsin Agricultural Experiment Station, entitled "Poultry House Construction," by J. G. Halpin and C. A. Ocock; "Poultry Houses and Fixtures" published by the Reliable Poultry Journal Pub. Co., Quincy, Ill., and many other standard poultry books give house plans.

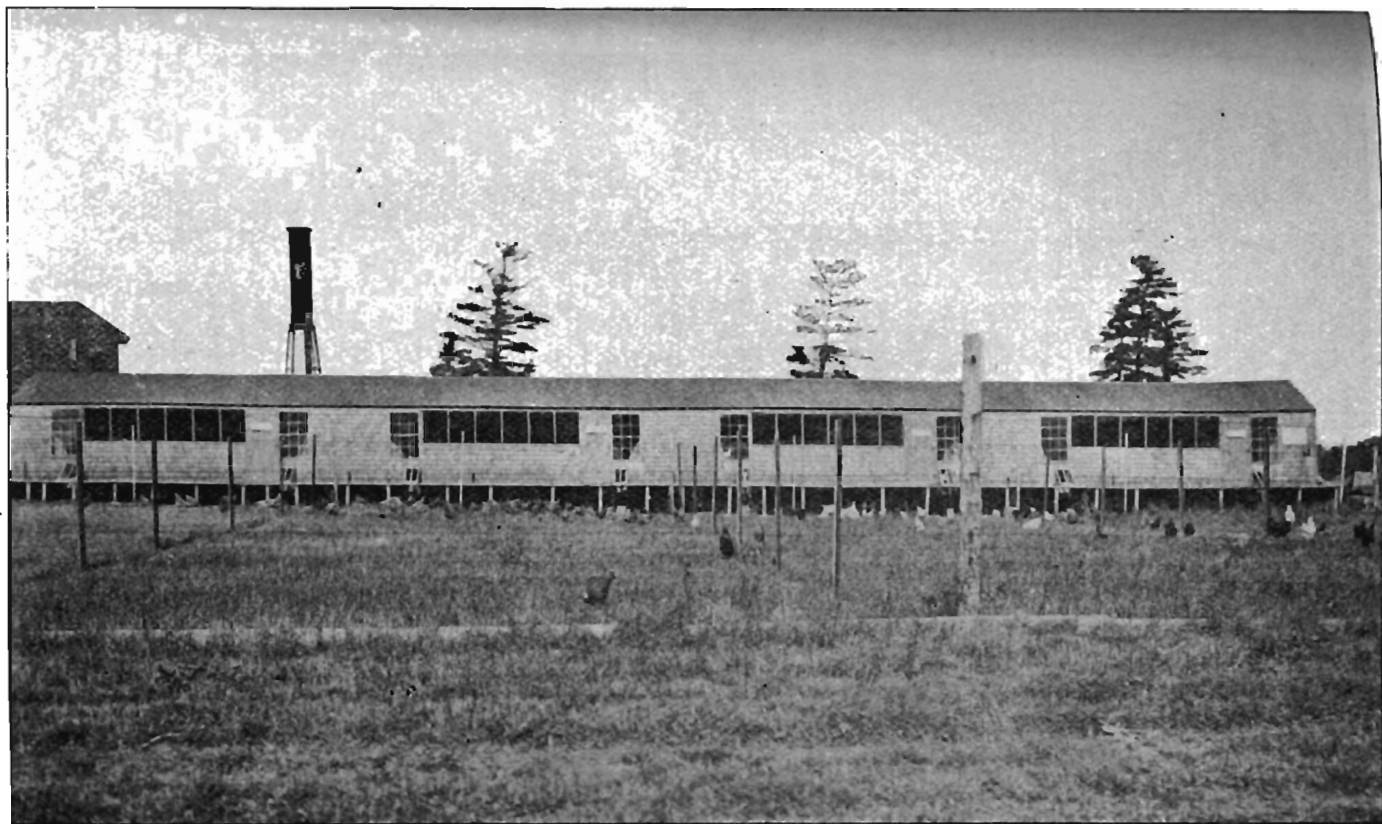


FIG. 56. Curtain-front poultry house No. 3, at the Maine Agricultural Experiment Station.

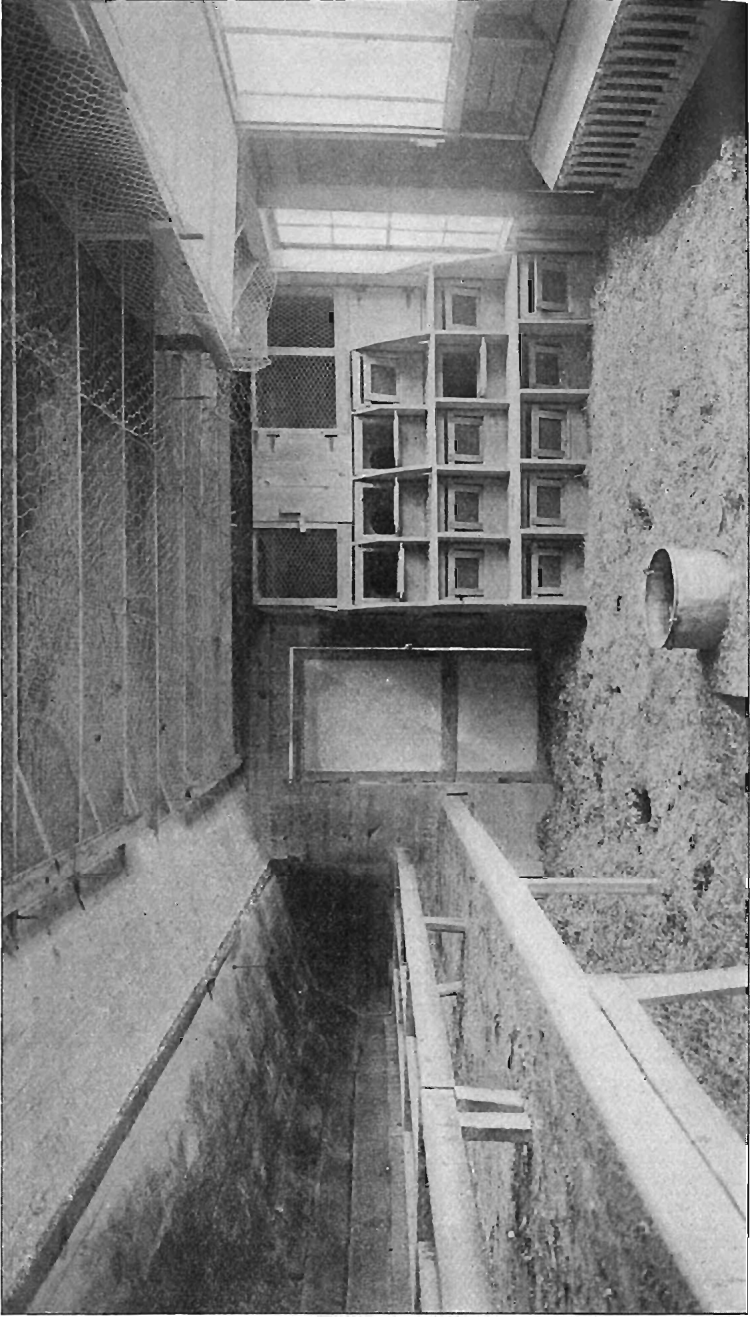


FIG. 57. Interior of curtain-front poultry house No. 3.

Actually practical poultry feeding is much more of an art than a science, in the present state of knowledge. While for pedagogical reasons it seems wise in the teaching of poultry husbandry to spend a considerable amount of time in calculating balanced rations and nutritive ratios it is very doubtful if all such activity has any very real or tangible relation to practical poultry feeding.

Such attempts at a science of poultry feeding would appear to suffer from a serious defect. The assumption is made in calculating a nicely balanced ration that all hens are going to partake of this ration in the same way. But this is very far from the biological actuality. Some individual hens like no grain except corn, and if fed a mixture will eat only corn. Others are very partial to beef scrap, and so on. To anyone who studies the behavior of fowls it is clear that the ration on paper and the ration in the crop are two very different things.

The successful feeding of poultry depends upon experience and acquaintance with fowls. The basic biological factor is, once more, individuality. Each individual hen is an independent living thing, possessing well marked likes and dislikes of her own with respect to food. There can be no question that the best results in the way of egg production and meat production would be obtained if a skillful feeder could feed each individual fowl by and for itself. Evidence that this is the case is found in the fact, which is universal wherever poultry is kept, that on the average fowls kept in small flocks, of say under 25 birds each, do relatively much better than larger flocks. The production and money returns per bird are greater. The fundamental reason for this is that the birds in small flocks get better care as individuals. When a man has only such a small number to take care of he can recognize their individual peculiarities more easily. Furthermore an individual bird stands a better chance of having its peculiar taste gratified in a small than in a large flock.

So while the biological ideal would be to feed each bird individually, this is obviously impossible in practice. With poultry the individual unit of production (the hen) is so small that it must be handled in flocks. The correct principle of management is to feed and handle a flock in such a way as to afford the maximum opportunity for the expression and gratification

of the individual preferences of the component units, with a minimum labor cost. The larger the flock and the plant as a whole, the more machine-like the methods of feeding and handling must be. They must of necessity be calculated to suit that mythical creature, the average hen. Coincidentally the total production or profit per bird will diminish. Presently a point is reached in size of plant where the outgo exceeds the income over a period of years. Such a plant if it has a hustling business man at the head takes a fancy name to itself, advertises a great deal, invents a "system," writes and sells a book about it, manufactures incubators and supplies, in general endeavors to make a loud noise about what a profitable thing the poultry business is, and finally goes dismally, completely and permanently "broke."

In the practical feeding of flocks of poultry large enough to be a commercial proposition, the methods which have been worked out empirically by the successful poultryman are essentially attempts to satisfy the individual tastes of the birds to as great a degree as possible, at a minimum labor cost. This result is obtained in practice by offering to the flock a variety of food materials so that they may have some opportunity of choice as to what they shall eat. If we feed corn, wheat, and oats the fowl which likes corn has the opportunity to live on corn, whereas the fowl which likes about three parts wheat and one part oats is able to satisfy her taste in this regard.

As a result of this manifest need for a variety of food it has come about that the practice now generally accepted as best is to put regularly before fowls food substances belonging to four different categories. These categories are:

1. Dry whole (or coarsely broken) grains (e. g., corn, wheat, oats, barley, etc.).
2. Ground grains (e. g., bran, middlings, corn meal, linseed meal and other finely ground grains).
3. Animal products (e. g., beef scrap, blood meal, fish scrap, green cut bone, etc.).
4. Succulent or green foods (e. g., mangolds, cabbages, beets, sprouted oats, green corn fodder, etc.).

The proportions in which these different kinds of food material are fed differ to a considerable extent among different poultrymen. The *exact* proportions in which they are given

really matters very little, owing to the fact, already brought out, that the hen compounds her own ration to her own taste if given the material. Furthermore it makes little difference whether the ground grains are fed dry or wet. It is cheaper to feed them dry (because of labor saved), and therefore the "dry-mash system" of feeding has become popular.

At the Maine Agricultural Experiment Station the following ration is fed to laying pullets.

Dry whole (or cracked) grains.

Early morning. Cracked corn in litter.

11 A. M. Mixture of equal parts of wheat and oats
in litter.

These grains are fed at the rate of about 2 quarts for 50 birds.

Ground grains (dry mash) thoroughly mixed together.

First month pullets are in laying house.

Wheat bran 300 lbs.

Corn meal 100 lbs.

Daisy flour (or other low grade flour) ... 100 lbs.

Meat scrap 100 lbs.

Second month in house.

Wheat bran 200 lbs.

Corn meal 100 lbs.

Daisy flour (or other low grade flour) ... 100 lbs.

Gluten feed 100 lbs.

Meat scrap 100 lbs.

Third month in house.

Same mixture as second month with 50 lbs. linseed meal added.

Fourth month in house.

Same mixture as second month.

Thereafter put 50 lbs linseed meal in second month mixture on each alternate month.

This ground grain mixture or "dry mash" is kept in open hoppers before the pullets at all times.

For green or succulent food either cabbages, mangolds or green sprouted oats or a mixture of these materials.

A detailed account of the methods of feeding poultry in the use at the Maine Station is given in Circular No. 471 of that Station, entitled "Poultry Management at the Maine Station.

Other ration formulæ for fowls are given in all books on poultry husbandry and in bulletins published by agricultural experiment stations in the various states and by the Department of Agriculture in Washington.

In feeding fowls in flocks it is important, in accordance with the principle of individuality, to select the birds which are to make up a flock so that they will be as uniform a lot as possible in respect to size, stage of development, etc. Careful grading in this way in putting birds into the laying house pays in the egg basket. The more nearly uniform in structure and habit the component units of a flock are, the more will the effect of individuality be minimized.

In conclusion it may be said that while the poultry business is not a gold mine, nor a get-rich-quick scheme, it is a legitimate business. When properly conducted it will pay liberal interest on the investment of capital and labor. The keynote to success in it is to begin in a very modest way, and only enlarge the plant, if it be enlarged at all, as the fundamental principles of breeding and management are thoroughly mastered. Chickens are not machines. They are living creatures. A poultry plant is not a factory. It partakes much more of the nature of a girl's boarding school, with a strong leaning on the part of its inhabitants towards suffragette doctrines. Poultry management is a biological problem, and to be successful must have due regard to fundamental biological principles.