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RAISING CHICKS ARTIFICIALLY

By J. H. Stewart and Horace Atwood

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THEIR FIRST OUTING.

RAISING CHICKS ARTIFICIALLY.

Although chicks have been raised by artificial means in Egypt, China, and perhaps other warm countries almost from time immemorial, yet, in the temperate zones where the climate is not so favorable for this purpose artificial incubation and brooding is practically a recent development. On account of this fact the art of raising chickens artificially has not been perfected so fully as in the case with most other branches of husbandry which have been engaged in for a much longer time.

During the past eight or nine years one thousand or more chickens have been raised annually at the Station by artificial means and various experiments connected with this work have been performed. Some of the results of these experiments have been published in previous bulletins, and in this publication it is planned to give, not so much the details of experiments, but rather the practical results as the outcome of all of them.

THE PRODUCTION OF EGGS SUITABLE FOR HATCHING.

In order to raise chickens successfully it is very essential to begin with eggs which will hatch well and produce strong vigorous chicks. If the germs are naturally weak no amount of attention and good care during the incubation of the eggs and the brooding of the chicks will make up for the original lack of vigor. In spite of all that can be done the hatch will be poor, if the germs are weak, and many of the chicks which do hatch will die. As one cannot determine by an examination of the unincubated egg whether the germ is strong or weak the only thing that can be done in practice is to select the breeding stock with such care and give it such attention that eggs suitable for hatching must of a necessity result.

Breeding stock should be mature. The first eggs laid by pullets should not be used, but when the eggs have attained their normal size, and the fowls have reached the age of one year or more the eggs should hatch well provided that all of the other conditions which influence the production of fertile eggs are favorable. The fowls should be fed a ration containing in proper proportion the different food elements required. Green food, grit, pure water, pure air, and the opportunity to take exercise are all important. Whenever possible the breeding stock should be allowed unrestricted range as this induces them to take plenty of exercise which tends to keep them healthy, and they are also able, to a certain extent, to balance their own rations by means of the bugs and worms which they secure.

In feeding it is important neither to feed too much nor too little, for one extreme is as bad as the other. If fed too much the fowls are apt to become sluggish and lazy, and the chickens which result will almost invariably be weak. On the other hand if the fowls are fed too scantily a large proportion of the eggs will be unfertile, and the chicks will not be as vigorous as they otherwise would. The fowls should be well fed but not overfed on a ration containing enough protein. This may be supplied by beef scrap, ground fresh meat and bone, skim milk, or some other substance of a similar nature. With the small active breeds of fowls like the Leghorns mash may be fed with safety once per day, but with the meat breeds which have a tendency to become too fat it is usually best to feed mostly whole grain scattered in litter. The method of feeding Leghorns for the production of eggs suitable for hatching which has been adopted at the Station is as follows: In the morning whole grain consisting of equal parts by weight of corn, wheat and oats is scattered in the litter covering the floors of the poultry houses. This is fed at the rate of from 7 to 10 quarts per hundred fowls. In the evening mash is fed consisting of equal parts of corn meal, ground oats and wheat middlings to which is added ten per cent of beef scrap or meat meal. The mixture is moistened with skim milk or water, and fed at the rate of from 6 to 8 quarts per hundred fowls. If this is eaten up quickly and the fowls appear hungry more whole grain is

scattered in the litter. Under this system of feeding and allowing one vigorous cock to ten or fifteen hens the eggs have uniformly run high in fertility, and the chicks have been strong and hearty. It is a very bad plan to use eggs for incubation which have been produced by hens that have been fed heavily during the winter for egg production. Under these conditions the vigor of the hens, when spring comes, is apt to be reduced, and even though the eggs may hatch fairly well the chicks are apt to be weak and puny. The breeding stock must be vigorous in order to produce the right sort of eggs.

INCUBATION.

The success or failure of artificial incubation depends largely upon the machine selected to do the work. Therefore great care should be exercised in making the selection. To be satisfactory a machine must be durable. There are many machines on the market which will hatch well when new but which are constructed so flimsily that in a short time they become worthless, and in this connection it should be remembered that an incubator which fails to give good hatches is worse than useless as each time that it is operated unsuccessfully the eggs are lost, the oil used to heat it is wasted, and the opportunity to make a profit from the chickens which should have been hatched is gone forever. Therefore, if artificial incubation is practiced it is wise to have good machines with which to do the work. Personally I am in favor of hot air machines because there is no water to bother with, no tanks to rust out and leak, or freeze and burst in cold weather when not in use.

THE LOCATION OF THE INCUBATOR.

Although the modern incubator can be operated almost anywhere, yet to be most successful it should be located where the temperature is as uniform as possible. The advice has frequently been given to locate the incubator in the cellar. This advice is all right provided the cellar is clean, light and well ventilated. A close, dark, ill-smelling cellar is about the worst place imaginable for this purpose. A half-cellar, four feet in the ground and three feet above, is an ideal place in which to run an incubator. Such an arrangement admits of enough air and

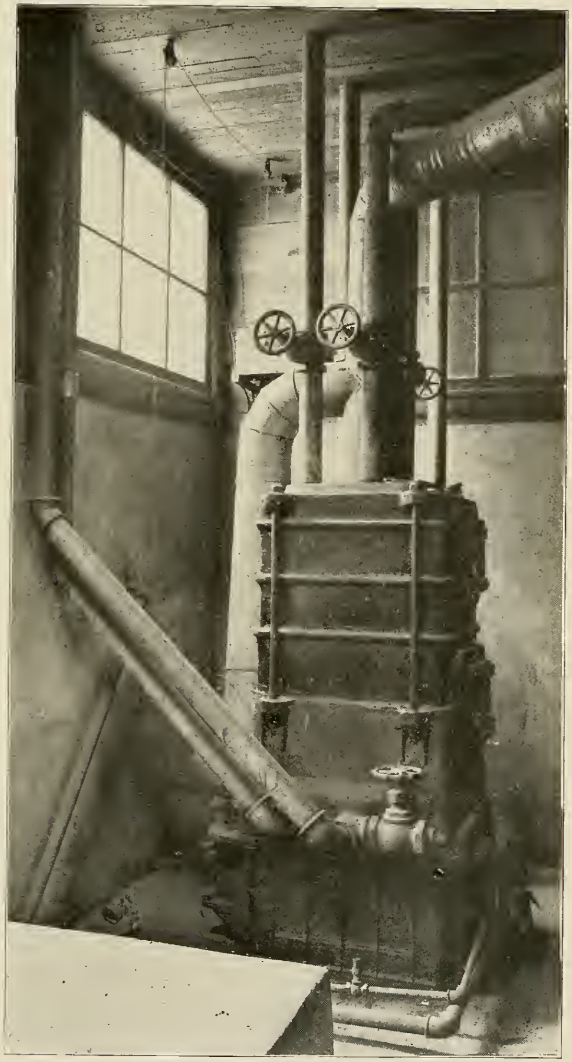
light, and affords a temperature uniform enough for all practical purposes. In operating an incubator in a dwelling house it is well to remember that many insurance policies do not provide for risks of this nature, although in reality there is scarcely any danger from fire if the incubator is given reasonable attention.

THE OPERATION OF THE INCUBATOR.

The machine should be set up carefully according to directions and the incubating chamber gradually brought to the proper temperature. The temperature which the thermometer should register depends somewhat upon its position in the incubating chamber. If the thermometer merely records the air temperature on a level with the tops of the eggs as they lay upon the trays, and is suspended near the center of the chamber then a temperature of 102½ will bring the chicks out promptly on the twenty-first day. The eggs should not be placed in the incubator until after the operator is able to maintain a fairly uniform temperature. Unless the regulator is properly adjusted to the right temperature and all the parts in good working order it is a very easy matter for the temperature to run too high and thus injure or totally destroy the hatch. The temperature should be maintained as uniform as possible. All violent fluctuations are unnatural and injurious. This is especially true of temperatures above the proper incubating temperature. Cooling the eggs a few degrees below the proper incubating temperature does no harm and in case the ventilation of the machine is not sufficient to supply the germs with enough oxygen this cooling may be necessary for a good hatch.

VENTILATION AND MOISTURE.

The ventilation of the machine is next in importance to the temperature. During their development the germs absorb oxygen and throw off carbon dioxide or carbonic acid gas as it is sometimes called. If the carbon dioxide is allowed to accumulate, or in other words if the vitiated air is not replaced by pure air with sufficient rapidity, the germs will be weakened and those which are somewhat naturally weak will be killed. It is my impression that bowel trouble, and non-absorption of the contents of the yolk sack, two very common



HOT WATER HEATER IN BROODER HOUSE.

ailments of incubator chicks, are frequently caused by lack of fresh air in the incubating chamber during the hatch. For good results the eggs must be given plenty of fresh air. When this is overdone another trouble is encountered. The eggs lose too much moisture and the chicks dry fast to the shell, thus destroying many chicks and producing many cripples. On the other hand if the eggs do not lose enough moisture the chicks are weak and flabby and do not have sufficient room so that they are able to break their shells and thus make their escape. Between the two extremes of too much moisture and too little there is a medium where the moisture conditions are just right, and which when closely adhered to in practice gives best results. In bulletin No. 73 the loss in weight of eggs while being hatched by hens is discussed, and I quote as follows from that publication which is now out of print.

"Artificial incubation is rapidly assuming immense importance not only on the large poultry farms where all of the hatching is done by incubators, but thousands of people who keep a few hens find that it is easier to hatch by artificial methods. Artificial incubation would be more widely used if poultrymen had some simple and reliable method of determining whether the eggs, while incubating, are receiving the proper amount of ventilation and at the same time are not drying up too rapidly. A proper and uniform temperature can usually be secured in most modern makes of incubators, but at the present time operators rely almost entirely upon experience to determine whether the eggs are kept sufficiently moist, and are receiving enough ventilation for the best results. It is true that charts have been constructed showing the proper size of the air cell for each day of the incubating period, but in using a chart considerable experience and good judgment are necessary because the apparent size of the air cells in individual eggs may vary considerably from each other in the same incubator, and the average size of the air cells on any particular day may depart quite widely from the normal without an inexperienced operator realizing that the incubation is not progressing in a satisfactory manner. In addition, the air cells may be of the proper size and yet the embryos

may perish either on account of an insufficient amount of oxygen, or because the gases resulting from the growth of the embryos are not carried away with sufficient rapidity."

"It is unnecessary to describe in detail the stages in the development of a chick. The chick, however, absorbs oxygen, and moisture and certain gases are thrown off through the shell. Under normal conditions the total amount of moisture and gases which have been thrown off at any particluar time corresponds to that particular stage in the development of the chick, or in other words, when the egg is incubated under perfectly normal conditions the total loss in the weight of the egg corresponds, within certain limits, to the stage of development of the embryo."

"If the operator of an incubator knows how much a certain number of eggs have lost in weight since the beginning of the incubating period and compares this loss with the normal loss of the same number of eggs for the same length of time he will know definitely whether the eggs have decreased properly in weight. If they have lost too much, provided of course that the temperature has been normal, they are drying up too rapidly, and either more moisture should be supplied, or the amount of ventilation should be reduced, but in reducing the circulation of air through the incubating chamber it must be remembered that pure air surrounding the eggs is just as important as a proper temperature; on the other hand, if the eggs are not losing weight as rapidly as they should they are either kept too moist, or they are not receiving the proper amount of ventilation, or perhaps they may be kept too moist and insufficiently ventilated also."

"The object of this bulletin is to furnish sufficient data to enable the operators of incubators to exercise a more intelligent supervision over the operation of their machines. A number of experiments have been performed to determine the normal loss in the weight of eggs during the incubation, and for this purpose the natural method of hatching has been employed. Eggs have been weighed, placed under broody hens in locations suitable for a perfect hatch, re-weighed on a chemical balance at suitable intervals, and the loss determined."

As a result of the studies detailed in bulletin No. 73 direc-

THE INCUBATOR CELLAR.

tions were issued covering the practical points involved and as these directions are also out of print they are reproduced herewith.

DIRECTIONS.

After placing the eggs upon the trays ready for the incubator set the trays upon a pair of scales reading to ounces and note the total weight of the eggs and trays. (The trays should be thoroughly dry.) After a few days weigh again. Subtract this from the first weight. This will give the actual loss in weight of the eggs.

Example.—Suppose that you have 208 eggs on the trays; that the first weight with trays is 24 pounds 2 ounces; and that on the sixth day the weight is 23 pounds 6 ounces. Then the loss in weight is 12 ounces. Now look in the table for the loss in weight of 100 eggs for six days. This is 10 ounces. Ten ounces multiplied by 2.08 gives 20.8 ounces, which is the calculated loss for 208 eggs for six days. Therefore the eggs have not been losing weight as rapidly as they should, and the eggs should be given more ventilation or the incubator should be removed to a drier location. (It is assumed that the eggs are kept uniformly at the proper temperature.) After the eggs have been tested for the infertile ones weigh again and proceed as before.

RULES.

If the eggs have *lost too much weight* give more moisture or less ventilation, but in reducing ventilation great care should be used, as pure air in the egg chamber is absolutely necessary.

If the eggs have *not lost enough weight* open the ventilators, or place the incubator in a drier place.

Table showing normal loss in weight of 100 eggs in ounces for the first nineteen days of incubation.

1.....1.65	7.....11.72	13.....22.10
2.....3.31	8.....13.44	14.....23.88
3.....4.96	9.....15.16	15.....25.66
4.....6.62	10.....16.88	16.....27.44
5.....8.28	11.....18.60	17.....29.21
6.....10.00	12.....20.33	18.....30.99
		19.....32.77

TURNING.

The eggs should be turned twice per day until the nineteenth day of the hatch. It is not necessary to turn each egg just half way over each time. This is unnatural and, I think, to a certain extent injurious, and it is probably partially due to this fact that the extra-tray method of turning seldom gives as good satisfaction as hand turning. In turning eggs by hand on trays built like the Cyphers the eggs at the center of the trays are picked up and other eggs rolled into their place. The eggs taken from the center are then placed at the ends. This method possesses the advantage of systematically changing the relative position of the eggs upon the trays, thus equalizing the effect of any possible inequalities of temperature which may exist in the incubating chamber. This principle of overcoming the effect of any variation in temperature is further carried out by changing the trays from side to side at one turning, and at the next turning change them from end to end, and so on. When these things are done the chickens nearly all hatch at about the same time. A hatch which is long drawn out usually indicates that there are inequalities in the temperature of the incubating chamber which have not been overcome by changing the eggs about as indicated above.

AIRING AND COOLING.

When the trays are taken from the incubator for the purpose of turning the eggs, they are to a certain extent both aired and cooled, and if the machine is properly ventilated this amount of airing and cooling is sufficient for all requirements. If the circulation of air is too sluggish, however, better hatches will be obtained if the eggs are left outside the machine for several minutes longer, the length of time depending upon the outside temperature and gradually lengthening as the hatch proceeds.

TESTING.

The unfertile eggs and those with dead germs are usually tested out twice during the hatch. This is done so as to keep the air in the incubator as pure as possible, and when these eggs are used for feeding young chickens the more promptly they

are removed after their condition can be determined by the egg tester the better.

Now, having started with eggs suitable for hatching; having kept them at the proper temperature; having turned them regularly twice each day; having given them sufficient fresh air for the germs to develop properly; and having regulated the moisture conditions just right, allowing the eggs neither to dry down too much nor to retain too much moisture, the chicks on the nineteenth day should begin their efforts to divest themselves of their shells and on the twenty-first day the incubator should be full of downy bright-eyed chicks anxiously awaiting their liberation.

TAKING OFF THE HATCH.

After the eggs begin to pip they should be interfered with as little as possible. The front door should not be opened to see how the hatch is progressing, as this reduces the humidity of the air in the incubator and also lets cold air strike the chicks not yet dried off, both of which things are injurious. Close watch should be kept of the thermometer at this time and if the temperature tends to drop, due to the drying off of a large number of chicks, the lamp should be turned up higher for a time, or the regulator slightly adjusted. On the other hand it is frequently necessary when the weather is warm to remove the lamp entirely during the latter part of the hatch, the heat generated by the chickens being sufficient to keep up the temperature.

After the chicks hatch they tend to crowd towards the light, and it sometimes happens that those in the front part of the incubator become so hot by being crowded together that they pant. Impure air, also, may cause them to pant. Whether caused by too much heat or by impure air the panting of the chicks is unnatural and injurious, and should be stopped either by opening the ventilators so as to give more air; by reducing the temperature; or by removing some of the chicks to the brooder so as to give those remaining more room.

From the time the chick pips the shell until it is transferred to the brooder and has become hardened and accustomed to its

new surroundings is a very critical time in its history, and mistakes made at this time are almost irreparable. If a cold draft of air strikes the chicks which are not dried off; if they are exposed to the cold air while being transferred to the brooder; if the brooder is too cold for them; or if, after being placed in the brooder, they wander outside and become chilled before they learn where to go to get warm, they will catch cold, inflammation of the lungs will result in many instances, and the chicks will die. Or if the chicks become overheated in the incubator, or are allowed to pant on account of the lack of sufficient fresh air, they are seriously weakened, and many of them will die before they are ten days old from bowel trouble. In fact to obtain the best results almost constant supervision should be exercised during this trying period of the chick's life.

BROODING.

Temperature. In brooding chicks either in individual brooders or in brooder houses the main thing which must be watched is the temperature, for if the temperature is either too high or too low the results will be totally unsatisfactory even though all of the other conditions governing the health of the chicks are ideal. Chicks three or four days old are fairly hardy little creatures and can endure a considerable degree of cold provided that as soon as they become too cold they can quickly get warm again. But if they are forced to remain where the temperature is too low they catch cold very quickly, the lungs soon become inflamed, little nodules of light colored cheesy matter form in them and death results.

The temperature of the brooder or brooder house when the chicks are first transferred from the incubator should be practically as high as the temperature of the incubator from which the chicks have just been removed, or from 95 degrees to 100 degrees F. This temperature should be maintained for the first week, never allowing it to fall below 95 degrees. The second week the temperature should not be allowed to drop lower than 90 degrees. These temperatures refer to the air temperature taken on a level with the chicks. After the second week the temperature should be reduced gradually until the chicks are old enough

YOUNG STOCK AT MEAL TIME.

and hardy enough to do without artificial heat. At no time should the chicks be uncomfortable either on acocunt of too much cold or too much heat. If they are too cold they will huddle together, those on the inside of the bunch will become too warm and will pass to the outside where they become too cold again. Under these conditions the chicks rapidly catch cold and die. On the other hand it is almost as bad to have the temperature too high, for in this case the vigor of the chicks will be reduced and they will be unprofitable.

Where the chicks are to be raised on a large scale the brooder house heated by hot water pipes is the most economical, for in this case there is only one fire to attend, and the work of feeding and watering the chicks can be done much easier than when the chicks are scattered about in individual brooders. In fact it has been my experience that outside brooders are not very satisfactory. Unless an enormous amount of care and attention be given to them the temperature is sure to vary so much that the chicks do not thrive. In addition the work has to be done out of doors in all sorts of weather making it disagreeable and costly to perform.

Feeding. Next in importance to the temperature at which the little chicks are kept is the food which they receive. In the case of a chick nature provides for its sustenance until it is able to run about and obtain food partly by its own efforts. The food material thus provided consists of the contents of the yolk sack which is slipped into the abdominal cavity a few hours before the chick is hatched. The yolk sack is connected with the intestine by a duct through which the semi-fluid mass passes into the digestive system where is it absorbed. It is due to this provision that it is not wise to feed chicks until they are two or three days old. If fed too soon or too much there seems to be a tendency for the material which is present in the yolk sack to remain unabsorbed. When this occurs putrefactive changes soon begin to take place, some of the products thus formed pass into the circulatory system of the chick, bowel trouble results, and the chick dies. Not only may the non-absorption of the contents of the yolk sack be caused by feeding too soon or too much, but it is

quite probable that this trouble may also be caused by the breeding stock being too fat or otherwise out of condition, or by too variable a temperature or by a lack of sufficient ventilation during the incubation of the eggs.

During the first two or three days after the chicks are hatched they require warmth and the opportunity to gain strength rather than to receive food. They should be supplied with water, however, and it will do no harm if they have a little fine chick grit at which to peck. After the second day they are usually fed as follows:—The infertile eggs are boiled and run through a food chopper, shell and all. The ground egg is then thoroughly mixed with five or six times its bulk of rolled oats. This mixture constitutes the first and last meals of the day for the first two weeks. and is fed on shallow troughs or on plates. At the morning meal care should be taken that the chicks do not eat too much. They should be left somewhat hungry at this meal so that they will exercise during the middle of the day by scratching for the hard grain which is scattered in the litter. At the evening meal they may be fed more liberally on the egg and rolled oats mixture. The hard grain consists of a mixture of cracked corn, cracked wheat, oatmeal, millet seed, broken rice, etc. For small chicks the grains should be cracked fine, the pieces of corn not being larger than one half of a kernel of wheat. At times I have used the prepared chick foods for scratching material and have found most of them satisfactory. The fine cracked grains should be scattered in the litter as often as convenient so that the chicks may be kept busily engaged all day long hunting for the grain, and care should be exercised that they do not find it too easily..

After two or three weeks cracked wheat and cracked corn are gradually substituted for the prepared chick food, and a mash composed of corn meal, wheat bran, wheat middlings and beef scrap is substituted for the egg and rolled oats.

I have also had excellent results in feeding little chicks according to the method advocated by the Maine Experiment Station. Briefly this method is as follows: —

A mixture of three parts of corn meal, one part wheat bran,

and one part wheat middlings or flour is used from which to make bread. This is mixed very stiff with skim milk or water and salted as usual for bread. It is baked in a slow oven, and when done the loaves are split open and returned to the oven where it remains until the bread is thoroughly dry. The crusts are then pounded until they are pulverized. The infertile eggs are hard boiled and ground shell and all in a sausage mill. One part ground egg and four parts bread crumbs are then mixed together and the mixture run through the sausage mill or food chopper.

The chicks are fed in the morning and at night on the bread and egg mixture, and during the middle of the day they scratch in the litter for the dry cracked grain or chick food which is provided for them. The egg mixture is used for about two weeks, and although it is expensive when infertile eggs are not available yet it makes the chicks thrive wonderfully well. Grit and charcoal must be freely provided and after the chicks are a few days old green food in some form becomes a practical necessity.

After the chicks become old enough and hardy enough to do without artificial heat they are removed from the piped brooder house and placed in colony houses. These are eight feet square, have a door and window in front and are provided with perches. When the chicks are placed in these houses temporary runs are made by means of poultry wire. The chicks are thus confined for a week or two until they become waywised to their new home. Then the wire is removed and the chicks are allowed unrestricted range for the rest of the season.

If the colony houses are too near together the chicks sometimes get in the habit of crowding into certain houses at night instead of remaining uniformly distributed among the different houses. This can be prevented, quite largely, by closing all openings so as to exclude animals prowling about at night, for the entrance of a skunk or weasel into a house will cause the chicks to shun that particular house when they go to roost on the following night. Also the chicks are enabled to find their own homes more promptly when the houses are painted different colors.

During the past few years we have found that by raising

chickens in a piped brooder house and then transferring them to colony houses the labor of attending to individual brooders is not only avoided, but the chicks have been healthier and more of them have been raised to maturity. Outdoor brooders have not been successful. They are difficult to attend to in stormy weather, and in a few years become old and out of repair, and if in-door brooders are to be used on any considerable scale it seems wiser to construct a piped brooder house kept warm by a heater burning coal or gas rather than to bother with a number of individual lamps, each of which is almost of as much trouble to attend as the large heater.