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ARTIFICIAL INCUBATION

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Selecting Eggs for Hatching.—Care and judgment should be exercised in the selection of the eggs that are to produce the future layers. These eggs should be rigidly selected for (1) fairly large size, (2) uniformity of size, (3) regular shape, (4) uniformity of shape, (5) color, (6) uniformity of color, and (7) strong shell texture. Eggs for incubation should weigh from 24 to 26 ounces per dozen, as those of fairly large size will hatch heavier chicks than small eggs. The small chick is seriously handicapped when forced to compete for food and warmth with larger, stronger chicks. Hatching eggs should also be uniform in size for those too large or too small make turning difficult, and they should have strong shells for eggs with weak shell texture break very easily in turning.

There is evidence that size, shape and color of the egg are inherited characters, for example, eggs of large size are a breed characteristic of the Minorca, white eggs a breed characteristic of the Leghorn, and brown eggs a breed characteristic of the Plymouth Rocks. Therefore, continued careful selection of hatching eggs should result in a few years in the development of a flock producing uniformly large, well-shaped, evenly colored eggs of good shell texture, because like tends to produce like. The exercise of care and judgment in the selection of hatching eggs will not only facilitate handling during incubation, but will also make for the building up of a flock that should average a larger percentage of "extras," and every increase in the number of good-sized eggs laid by a flock means an increased profit to the owner.

Saving Eggs for Hatching.—Eggs intended for hatching should be kept in a closed receptacle at a temperature of about 60 degrees F. and turned daily. If kept in open trays exposed to the air, more or less moisture will evaporate from the eggs and injure their hatching quality. A 30-dozen-size egg case provided with a hinged cover is an excellent container in which to save hatching eggs. The selected eggs are put in the egg case each day, the empty fillers replaced and the case closed. To turn the eggs, lay the case on one side the first day, on one end the second day, on the other side the third day, etc. Revolving the case in this way every day turns the eggs one quarter and keeps them on their sides, which is the preferable position for eggs before and during incubation. Hatching eggs should not be more than 10 days to two weeks old when set. The sooner they are set the better.

Getting the Incubator Ready.—Before the beginning of the hatching season each year, the incubator equipment should be carefully gone over. Each incubator should be overhauled to see that all mechanical parts are in good order and working freely. One or two extra thermometers and a few wicks should always be kept on hand.

Locating the Incubator.—Place the machine in a room where the temperature remains fairly uniform at all times and where there is plenty of ventilation without drafts. A cellar is usually best because it is well protected from the direct rays of the sun and the temperature is uniformly low. A good temperature for an incubator room is 60 degrees F.

Good ventilation can be obtained in the incubator room by using an ample number of ventilators opening near the ceiling for the ingress of fresh air, and by having a 6″ to 8″ ventilator for the removal of foul air. The fresh-air ventilators should be provided with baffles in order to reduce the velocity of the incoming air and to direct it toward the ceiling. It will then mingle quietly with the air of the room and not produce any strong air currents.

A simple method of obtaining effective ventilation as well as good lighting of an incubator room is that of placing transom or cellar sash about two-thirds of the way up the side walls toward the ceiling. They should be spaced approximately six feet apart on centers and hinged at the bottom so as to swing in. A triangular wooden shield should be placed on each side of the window (see Fig. 1) to force the incoming fresh air over the top of the window when open. These shields will also support the window when it is open. A light frame covered with coarse, light-weight burlap and hinged to the wall just above the window so as to rest on the wooden shields and fully cover the opening over the shields, will check the velocity of the incoming fresh air on windy days sufficiently to prevent strong air currents in the incubator room. Such air currents might cause the incubator lamps to flicker and blow out or affect the temperatures of some machines.

One exhaust ventilator, 6″ to 8″ square inside, should be provided for approximately every 300 square feet of floor space. This ventilator should be built with the bottom 18″ above the floor and the top extending well above the highest point of the roof. The higher the top of this ventilator, the stronger will be the suction. An especially designed metal ventilator cap placed on the top of the ventilator will also increase its suction.

Having located the incubator, level it with a spirit level. Leveling is very important, for if the machine is not level, one part of the egg tray will be higher than another, and the eggs in that part will therefore obtain more heat than the others.

Fig. 1.—Interior of a brooder house showing how wooden shields are used at sides of windows to divert all incoming fresh air over tops of windows when open. Windows open inward at top.

Disinfection.—Before and after every hatch, the incubator should be thoroughly washed and sprayed and the movable parts placed in the sun to dry. Thoroughly cleanse every part with soap, water and a good scrubbing brush. A few hours before putting in the eggs spray all parts of the interior of the incubator with a spray pump, using about a two per cent solution of some good disinfectant, such as a cresol compound or any of the ''eum'' preparations. The fumes of the disinfectant will penetrate every crack in the hot interior of the egg chamber and the vapors remaining when the eggs are put in will, to some extent, disinfect the exterior of the eggs. To disinfect thoroughly the surfaces of the eggs, dip them fairly rapidly in 95 per cent pure, non-beverage alcohol just before putting them into the incubator.

The Lamp.—Every season the lamp should be thoroughly cleaned, the burner boiled in a solution of washing soda and a new wick put in, if necessary, before the machine is started.

In beginning the hatch, use a medium flame, and adjust the thermostat to it. If too small a flame is used to start with, the flame cannot

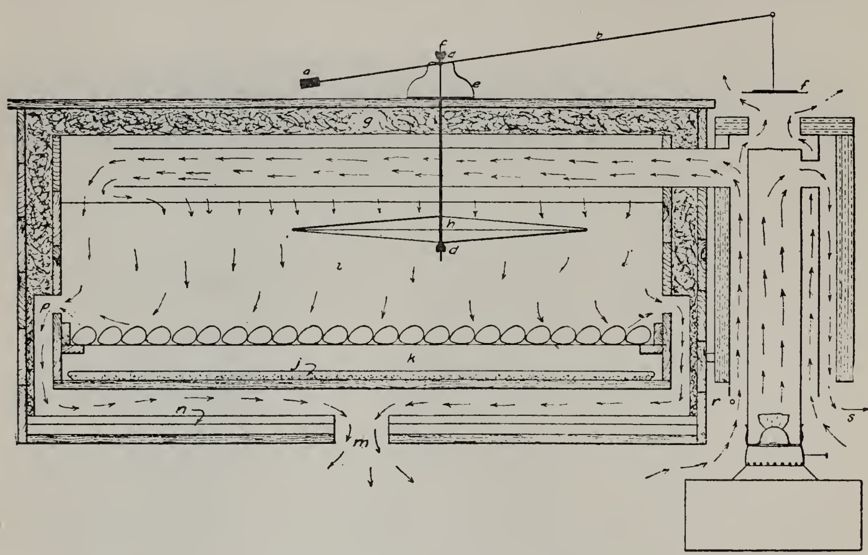

Fig. 2.—Cross-section of a hot-air heated incubator showing the method of regulating the temperature, the ventilation system, and the general construction. (*a*) Counterpoise weight; (*b*) regulator arm; (*c*) connecting rod; (*d*) thumb nut; (*e*) pivot casting; (*f*) heater disc; (*g*) cotton batting filling between inside and outside cases; (*h*) thermostat; (*i*) egg chamber; (*j*) moisture pan filled with sand kept wet; (*k*) nursery; (*m*) bottom ventilator for escape of air from egg chamber; (*n*) insulation in bottom of incubator; (*p*) one of four pipes to discharge air from above level of eggs into false bottom beneath egg chamber; (*r*) fresh air intake; (*s*) outlet for escape of lamp fumes. No fumes can get into machine.

be turned low enough at the end of the hatch, in warm weather, to keep the temperature from running up. If too high a flame is used the lamp will smoke.

The lamp should be cleaned and filled every morning AFTER turning the eggs. If filled BEFORE turning the eggs, the hands, being smeared with oil from the lamp, will leave a coating of oil on the eggs and cause serious injury to the growing embryos. Trim the wick with a cloth by simply rubbing off the charred crust and then wipe away all dirt and oil from all parts of the lamp before replacing in the incubator. In trimming, cover the end of the finger with a cloth and turn the wick just high enough to expose the charred part above the top edge of wick tube. Rub off the charred crust by rubbing in one direction only; this causes all the threads of the wick to lie smoothly in one direction and results in a more even flame. Then turn the wick up about one-sixteenth of an inch and pat down the corners lightly to prevent high corners on the flame which would cause smoking. A flame that is straight across the top and rounded at the corners gives the most heat and will not smoke.

Thermometer.—In order to be certain that the thermometer is correct, the operator should test it with a clinical thermometer. Place both thermometers in luke-warm water with bulbs close together and while stirring, add hot water slowly until the clinical thermometer registers 103 degrees. Observe whether the incubator thermometer gives a similar reading. If not, the operator knows that at 103 degrees the incubator thermometer reads, perhaps, 102½ degrees, and he must allow for this error in operating his incubator. Faulty thermometers have caused more damage in the way of poor hatches than is generally realized.

Temperature.—In all incubators the temperature is regulated or controlled by a thermostat. The all-metal thermostat (see Fig. 2) consists of three pieces of metal riveted together at the ends and is designed on the principle that different metals expand different definite amounts for every degree F. rise in temperature and contract the same amounts for every degree F. fall in temperature. The central piece of metal (*h*, Fig. 2), does not expand or contract as much for every degree of change in temperature as do the two outside pieces. As a result, since all three pieces are riveted at the ends, the two outside pieces, expanding more rapidly than the central piece, are forced outward in the middle when the temperature rises. This buckling or spreading apart of the two outside pieces of metal in the thermostat causes a downward pull on the connecting rod (*c*), which in turn pulls on the lever arm (*b*) and raises the disc (*f*) off of the heater.

When the temperature in the incubator rises above the desired temperature, the expansion of the thermostat lifts the disc from one-half inch to one and one-half inches above the heater, allowing the surplus heat to escape. As soon as the temperature returns to its proper place, the disc is again lowered. If the temperature of the machine should drow BELOW the "running" temperature, the thermostat will contract and allow the disc to settle down on the heater, thus tightly closing the opening and forcing all the heat into the egg chamber. When the temperature is properly regulated, the disc should stand about one-sixteenth to one-eighth inch above the opening in the top of the heater. There are a number of different kinds of thermostats or heat-regulating devices used on different makes of machines, but all are based on the principle of expansion and contraction of a thermostatic device within the egg chamber to control the amount of heat entering, and thus automatically regulate the temperature of the egg chamber.

In the type of heater shown in Fig. 2, the fumes from the lamp cannot get into the egg chamber, but must escape through the opening (*s*). The fresh air (as shown by arrows) is heated by the lamp as it is drawn into the opening (*r*). It passes into the top of the incubator and then diffuses through a burlap or muslin diaphragm into the egg chamber. After circulating around the eggs, absorbing the carbon dioxide thrown off by the eggs and giving up oxygen, the air current passes through the openings at the sides of the egg chamber and escapes through the bottom of the machine.

The temperature throughout the hatch should be 102 degrees when the center of the thermometer bulb is on a level with the tops of the eggs. If the thermometer is hung so that the center of the bulb is above the tops of the eggs, the temperature must be run higher according to the height of the bulb above the eggs. The heat in nearly all incubators comes into the egg chamber from the top and the nearer the thermometer is to the top of the egg chamber the higher it will read. While chicks are hatching the temperature can, and often does, run up to 104 degrees without doing any harm.

Ventilation.—Good ventilation of the egg chamber is a very important part of the process of incubation. During the growth of the embryo, it has for its food supply the stored-up food within the egg. In order to utilize this stored-up food and transform it into new body tissues, heat, and muscular action (such as the pumping of the blood through the blood vessels that radiate through all parts of the developing egg), oxygen is absolutely necessary. Without oxygen, growth could not go on and the embryo would die. The net-work of blood vessels which extend in great numbers close to the inside of the shell and to the air-cell, takes up oxygen from the incoming fresh air and throws off carbon dioxide, which is given off as a waste product by the growing body tissues. Therefore, plenty of fresh air is essential to the production of strong, vigorous chicks. Briefly stated, the developing embryo breathes in fresh air through the pores of the shell and from the air-cell. It exhales poisonous carbon dioxide through the pores of the shell and into the air-cell. The ventilation of the incubator should be such as to carry fresh air into the egg chamber as rapidly as it is needed and to carry away the carbin dioxide as rapidly as it is given off. *Insufficient ventilation will rob the chicks of vitality even though it may not prevent hatching.* Too much ventilation cannot be given, provided proper temperature and moisture conditions are maintained in the egg chamber. It is better to give too much rather than risk too little.

Insufficient ventilation in the egg chamber, which is not always readily detected during the first 19 days of the hatch, will reveal itself after a good many of the chicks have hatched out. The panting of the chicks after hatching is invariably caused by too little ventilation, rather than by too much heat. Even though the hatch is not over, more ventilation must be given if the chicks already hatched are not to be weakened.

Moisture.—The process of exhaling in the developing egg is closely analogous to that in human beings. The exhaled air is laden with moisture, and it is as a result of giving off used moisture in this way that the eggs ''dry down'' during embryonic growth. This drying down causes a gradual loss of the water content of the egg and a correspondingly gradual increase in the size of the air-cell. When the air passing through the egg chamber is very dry, it not only takes up and carries off the moisture naturally exhaled by the egg, but also passes through the porous shell and absorbs still more moisture. By such excessive drying down of the egg the embryo will be injured. Nature supplies the egg with just enough water to enable it to carry on its life processes and to evaporate gradually by the process of exhalation. From this we can clearly understand the vital necessity of having the air passing through the egg chamber sufficiently saturated with moisture to prevent undue evaporation of the moisture from the egg. Sixty per cent humidity is generally considered adequate.

It is evident that ventilation and moisture conditions are closely related and cannot be considered separate problems. Geographical location, time of year, and other factors must determine whether artificial means of adding moisture to the air entering the egg chamber is necessary or not. In the better types of incubators, ventilation is very well taken care of, so that the chief problem to consider is the maintenance of sufficient moisture in the circulating air. One should always follow the instructions sent out by the incubator manufacturer in this regard until sufficient experience has been gained to enable one to act intelligently in making any change that may appear advisable. The increase in size of the air-cell, the drying of the membrane exposed when the chick pips the shell, the collection of moisture on the inside of the glass of the incubator door (see following page), and the ease with which the chicks break from the shell, will serve as definite guides in properly regulating moisture conditions and ventilation in artificial hatching.

During the hatching period, frequent observations of the air-cells will indicate the rate of evaporation of the egg and will enable one

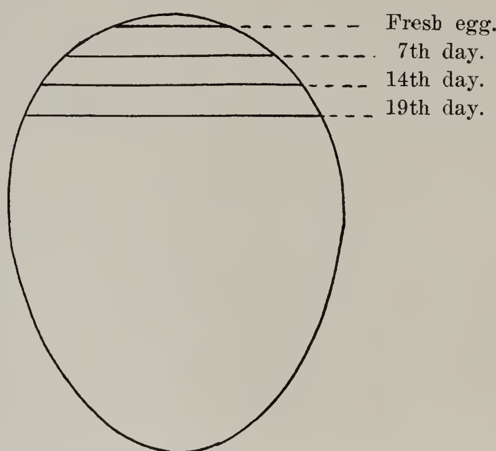

Fig. 3.—Showing gradual increase in size of air-cell due to evaporation of water during the period of incubation.

to determine if too much or too little moisture is being supplied. Experience will soon teach one the proper rate of evaporation as shown by a gradual increase in the size of the air-cell. It is a good plan for the beginner to set a hen on the ground in an out-door setting coop at the same time that he sets the incubator and compare the increase in the size of the air-cell in both cases every few days.

After the chicks have begun to hatch, a light film of moisture or a few beads of water should appear along the lower inside edge of the glass of the incubator door. Only a little moisture should collect on the inside of the glass door. Too much humidity in the egg chamber is indicated at this time by a considerable collection of moisture on the glass and can be corrected by increasing the ventilation or by reducing the amount of moisture supplied. Too little humidity is indicated by no moisture on the inside of the glass door, and by the rapid drying and whitening of the shell membrane exposed around the edges of the opening where the chick has pipped the shell and before it has gotten out. As the shell membrane dries it becomes so tough that the check is unable to tear through it and dies in the effort to get out. The membrane should remain moist while the chick is breaking out of the shell, for it is then soft and easily torn.

One of the best ways to supply needed moisture when using a ''non-moisture'' machine, is to keep the floor well soaked. The evaporation of moisture is in proportion to the water surface exposed to the air, so that wetting down the floor exposes a large water surface and enables the air to become well saturated before entering the incubator. The purpose of such moisture is not to supply it to the eggs, but to keep the air entering the incubator moist enough not to take up too much moisture from the eggs and thus rob the embryos of the water they absolutely need in order to develop into strong, lusty chicks.

Turning.—Turning is usually begun from 24 to 48 hours after the eggs are put into the incubator and continued morning and night until the first egg pips. The turning periods should be as nearly 12 hours apart as possible. Perhaps the easiest and best way to turn is to use a rotary motion, rolling the eggs slowly with the palms of the hands. They will not break even if considerable pressure is used, provided they are not jarred or handled with sudden motions. The eggs do not have to be turned completely over. All that is necessary is that the eggs be shifted around a little so that the embryos will not stick to the shells.

Cooling.—The purpose of cooling is to thoroughly air the eggs and strengthen the embryos. It corresponds to the opening of the windows by the housewife each morning to air the bedroom. The incubator door should not be left open while eggs are being cooled. The aim is to cool the eggs, not the incubator. The hen's body temperature is the same when she returns to the eggs as it was when she left them. So it should be with the incubator.

In setting the eggs out to cool do not allow any part of the tray to project beyond the table or incubator, as the eggs will then cool unevenly and those in the projecting part of the tray will become chilled by the time the others are ready to go back into the machine. Begin cooling on the seventh day and cool every evening when the eggs are turned. Cool a little at first and gradually lengthen the cooling period as the hatch advances. A most satisfactory way to tell when the eggs are cooled sufficiently is to hold the small ends of a few to the eye. When they feel barely warm the eggs are cooled enough. A little experience will make one expert in gauging the cooling period. They will cool down rapidly at first, but as the embryos develop and contain animal heat of their own the cooling will take place more slowly. In the month of May, from 20 to 60 minutes is often required to cool eggs that have been in the incubator from 14 to 18 days. The amateur usually errs on the side of too little, rather than on that of too much cooling.

Testing.—Test on the seventh and fourteenth days, at night when the cooling is done. The first test will remove all infertile eggs and dead germ eggs up to that period. The infertile eggs are still perfectly good and can be used for cooking. The writer has known them to be so used and considers them as good as cold-storage eggs for cooking purposes. The dead germs at the seventh-day test contain either blood clots or blood rings. Every egg in which a dark movable

Dead germ, seventh day. Fertile egg, seventh day. Infertile egg.

Fig. 4.

black spot, a little larger than a pinhead, with numerous radiating blood vessels is not distinctly visible at this time should be discarded as worthless. Only good, strong eggs will hatch vigorous chicks. On the fourteenth day the strong eggs will be opaque and nearly black, and if such an egg can be held still before the tester, the embryo can be seen to move. Dead germs at this time contain either blood rings or blood streaks, or are perfectly translucent and cloudy.

The Hatch.—After the last turning, close the incubator and do not disturb it again until the hatch is over, except to fill the lamp. As soon as all the chicks have dried off, open wide the ventilators, remove the egg tray and all eggshells, and wedge open the door with a match stick so as to harden the little fellows, but do not let the temperature in the nursery go below 100 degrees F. Darken the egg chamber by hanging a cloth in front of the glass door to keep the chicks from picking at the droppings and at each other's toes. After 24 hours remove them to the brooder in a flannel-lined and hooded basket. A chilling draught striking them at this time would prove disastrous.

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