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INCUBATOR HYGIENE
An Important Factor in the Control of Hatchery Diseases of Chickens

By

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THE rapid expansion of the poultry industry is due in no small measure to the introduction of the cabinet type of incubator. However, the widespread use of these machines in which large numbers of chickens are confined, for a period, to a very small space, has also favoured the spread of many diseases, and unless steps are taken to prevent the introduction of these diseases to the newly-hatched chickens disastrous losses are likely to occur.

Pullorum, salmonellosis and omphalitis are the bacterial diseases of young chickens most frequently associated with hatching, but by taking suitable precautions, as outlined in this article, losses from these conditions can be virtually eliminated.

PULLORUM DISEASE

One of the most serious diseases to be contended with in the poultry industry is pullorum disease, with its extremely heavy mortality in young chickens and reduced productivity in laying hens. The disease is transmitted through the egg, and the hatching of one infected chicken results in the scattering of infective fluff and dust throughout the whole of the hatching compartment. As a result, practically the whole of the hatch may become infected and die.

Pullorum-infected eggs come only from infected hens and these birds can be detected by the pullorum blood-test. It therefore follows that if eggs for hatching are obtained only from flocks in which pullorum disease has been eliminated by the use of this test and the destruction of positive reacting birds, then risk of outbreaks originating in the incubator becomes negligible.

Because the causal organism of this disease is actually within the egg it is useless to attempt to control it other than through elimination of infected hens. Disinfection of the incubator will prevent the disease being carried over from one hatch to the next, but it will not prevent its occurrence in a hatch containing infected eggs.

SALMONELLOSIS

This disease can be caused by a number of related organisms but for practical purposes of control all can be considered alike. Only occasional outbreaks have been known to occur in this State.

Like pullorum disease, salmonellosis can be transmitted through the egg, but more commonly the organisms are found on the shells of eggs from infected birds which eliminate the organisms in their droppings. Unlike pullorum, however, there is no really satisfactory method of
INCUBATOR FUMIGATION

Fig. 1.—Preparing the fumigants. The bottle contains formalin and the large container on the right holds permanganate of potash. The operator is placing permanganate into the receptacle to be used for mixing the fumigants.

Fig. 2.—A measure of formalin has been added to the permanganate and fumes may be seen rising. This was done for demonstration purposes only. In practice, the mixing would be done in the incubator so that none of the fumes would be wasted, and a porcelain receptacle would be preferred to the tin.

Fig. 3.—Illustrating the actual fumigation of the setting compartment while the eggs are in the machine. Formalin is about to be added to the permanganate in the tin.
detecting infected hens, so control must be principally through disinfection of contaminated eggs after they have been selected for incubation.

Should an outbreak occur in newly-hatched chickens then proper disinfection before the next hatch is due will prevent the further spread of the disease, as with pullorum.

Salmonellosis may infect animals as well as birds. Rats and mice may be sources of infection. Where trouble is experienced with this disease, vermin control may assist considerably in preventing further outbreaks.

**OMPHALITIS (Navel Disease)**

Caused by a variety of bacteria, this disease is rather different from those already mentioned. It is generally understood to be due to infection through the unhealed navel soon after hatching, although there is some evidence that egg transmission is also possible. The disease is more likely to occur when hatching takes place in soiled or dirty compartments which have become heavily contaminated. Although infection only occurs during a short period, losses may be quite severe.

**PREPARATION OF EGGS FOR INCUBATION**

Only clean eggs should be used for incubation. Soiled eggs may cause heavy bacterial contamination of the incubator and lead to an outbreak of disease.

If circumstances force the use of soil ed eggs they should be properly cleaned before setting.

Washing eggs in water or with a wet cloth may assist bacteria to penetrate the shell and may spread contamination from egg to egg. Gross dirt should be removed from the shell while dry by rubbing gently with steel wool.

Storage of hatching eggs should be for as short a period as possible. A cool atmosphere is essential both to maintain quality and to minimise the risk of shell penetration by bacteria.

**PREPARATION OF INCUBATOR**

It is assumed that at the commencement of the hatching season the incubator is reasonably clean. Nevertheless it should be thoroughly disinfected before the first batch of eggs is set.

If the machine contains dust, this may be removed with a vacuum cleaner and the whole interior is then washed down thoroughly with disinfectant after making sure that all solid particles of dirt and shell have been scraped off the surface of walls or trays. The trays should be washed in hot water and then soaked in a bath of disinfectant for about 12 hours.

Such disinfectants as lysol, Dettol, 5 per cent. or 10 per cent. formalin in water and hypochlorite solutions are all quite satisfactory, although formalin is rather unpleasant to use. Steam under pressure is effective if available.

Remember that few disinfectants are effective against bacteria encased within solid masses of grease, dirt or droppings. Hence the need for very thorough cleansing before the final disinfection.

All dirt, sweepings, fluff, etc., from incubators should be burnt to prevent contamination of buildings or yards.

After this preliminary disinfection has been completed the machine can be assembled and switched on for checking before incubation commences. At this stage it is well to take the opportunity of giving a final disinfection, by fumigating with formaldehyde gas according to the instructions set out below.

Spraying of the walls and floors of the incubator room with a disinfectant will reduce the risk of re-contamination of the interior of the incubators when the doors are opened.

**DISINFECTION DURING INCUBATION**

Once the incubator has been loaded with eggs all subsequent disinfection is by fumigation with formaldehyde.
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BLOOD TESTING TO DETECT PULLORUM DISEASE

Fig. 1.—Tester dropping antigen on to glass slide.

Fig. 2.—Taking blood from the vein on the underside of the fowl's wing by means of a needle with wire loop attached.

Fig. 3.—A small quantity of blood is transferred from the loop to the prepared slide which is placed on a water-heated oven for 1½ to 2 minutes.

Fig. 4.—Reading the test slides. In the case of a bird infected with pullorum disease, the test shows the micro-organisms which cause the disease clumped together, or agglutinated, in the mixture of blood and antigen. No “clumping” takes place if the blood is from a pullorum-free bird.

Fig. 5.—After the blood samples are taken, the birds are placed in separate numbered compartments in the holding crates. Crate numbers coincide with slide numbers so that when the tests are completed, any positive reactors may be isolated for slaughter and pullorum-free birds returned to the flock.
It is desirable that the first fumigation should be carried out within a few hours of setting in order to destroy any bacteria contaminating the shells of the eggs. Penetration of shells, with consequent infection of the embryos and contamination of the incubator is thus minimised.

In machines where hatching takes place in the same compartment as the incubation it may not always be possible to fumigate at the correct time if setting and hatching dates coincide. In such cases the eggs can be fumigated in a separate box before they are put in the incubator. Under these circumstances fumigation is best carried out at ordinary room temperature and humidity, especially if a few days are to elapse before incubation commences.

This fumigation procedure must be carried out with every new batch of eggs that is set. As setting often takes place at twice-weekly intervals in large machines it means that each batch of eggs is fumigated six times during incubation. This six-fold treatment will give considerably greater protection than a single treatment, which, in practice, cannot be relied on to give absolute destruction of every contaminating organism.

In small incubators where only one hatch at a time can be accommodated it is advantageous to fumigate about six to eight hours after setting and again towards the end of the incubation period, say between the 15th and 18th days.

Immediately following and at the completion of the hatch a thorough cleaning is necessary to remove all fluff, shell fragments and droppings, which must be regarded as a source of infection. It is well to remember that if a pullorum-infected chicken hatches, the whole compartment will be contaminated, and there is every possibility that many chickens in the batch will become infected although signs of infection may not commence to show up in the batch for several days.

THE DANGER PERIOD FOR FUMIGATION

Fumigation should not be carried out between the 24th and 96th hours after setting. During this period the susceptibility of the embryo to adverse conditions is greatest and fumigation is likely to cause some mortality.

Outside this critical period, fumigation can be carried out at any time. It is sometimes carried out after hatching has commenced, but there is no particular advantage in this practice and it is certainly not advisable once the chickens have commenced to dry out.

FUMIGATION METHODS

It is recommended that incubators be fumigated with formaldehyde gas. Formaldehyde is obtained as a 40 per cent. solution in water, known as formalin. The gas can be produced from this solution by (a) simple evaporation or (b) by mixing with potassium permanganate.

(a) In the former method, pieces of cheese-cloth about one yard square are soaked in the required amount of formalin (40 c.c. or approximately 1½ fluid ounces per 100 cubic feet of incubator space). These are then hung up near the fan so that evaporation takes place in a few minutes. In actual practice this method does not seem to be quite as efficient as the following alternative method which depends on the rapid generation of formaldehyde gas when formalin is mixed with potassium permanganate.

(b) For routine fumigation use 75 c.c. (2½ fluid ounces) of formaldehyde and 50 grammes (1¾ ounces) of potassium permanganate per 100 cubic feet of incubator space. The fumigation should be continued for 30 minutes.

If an outbreak of disease occurs in the chickens it would be advisable to use a much larger amount of gas for at least one fumigation. For this, 150 c.c. (5¼ fluid ounces) of formalin and 100 grammes (3½ ounces) of potassium permanganate are recommended per 100 cubic feet.
It is desirable that the period of fumigation be as long as possible. It has been demonstrated that even the largest amount of gas mentioned above has no significant effect on hatchability when fumigation is prolonged for 30 minutes, provided the eggs do not already have some inherent fault such as weak germs and providing they have not been stored for a long period prior to incubation. In these latter cases the death rate of the embryos is increased somewhat.

The exact amount of each ingredient should be used. To use an insufficient amount of potassium permanganate means that the full amount of gas is not produced, while an excess of potassium permanganate is merely wasteful as it is not used.

Fumigation is best carried out at a temperature of about 100°F. A high degree of humidity is desirable within the incubator for best results. During fumigation the relative humidity should be at least 68 per cent. This degree of humidity is obtained when the dry bulb thermometer reads 100°F and the wet bulb thermometer reads 90°F.

In most large machines, closing the vents is all that is required to increase the humidity. In others it may be necessary to add additional water either

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**TEMPERATURE AND HUMIDITY**

For efficient management of incubators the operator should be familiar with the use of wet bulb thermometers which are used in conjunction with the ordinary dry bulb thermometer to determine relative humidity.

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Diagram showing cycle of infection of Pullorum Disease and Control Measures recommended.

[Adapted from Biester and Devries.]
in trays or by placing wet bags on the incubator floor. These should be removed as soon as the fumigation has been completed.

**PROCEDURE FOR FUMIGATION**

1. Calculate the size of the inside of the incubator making no allowance for space occupied by eggs or trays. To do this, measure the length, breadth and height of the interior of the compartment in feet and multiply the three figures together.

2. Measure out the proper quantities of formalin and potassium permanganate according to the size of the incubator. It may be more convenient to have these amounts put up by the chemist from whom they are purchased.

3. Place the potassium permanganate in a wide china, earthenware or enamel basin. This should be sufficiently wide and deep to prevent splashing as some frothing occurs when the two ingredients are mixed. The bowl is then placed in a level position on the floor of the incubator, near the door.

4. Close the vents and bring the temperature and humidity to the correct levels for fumigation (dry bulb 100°F., wet bulb 90°F.).

5. When both temperature and humidity are correct shut off the motor, open the door, add the formalin to the potassium permanganate in the basin, close the door and turn the motor on immediately.

6. Allow the fumigation to proceed for the appropriate time (say 30 minutes).

7. Remove the bowl containing the used material, leave doors and vents open and run the motor for about five minutes to get rid of the formaldehyde.

8. Shut doors and return machine to its normal setting.

The above instructions are written primarily for large forced-draught machines and some adaptation may be required for use in smaller incubators. In still-air models considerable variation is likely to occur in the concentration of gas in different parts. For this reason the amounts of formalin and potassium permanganate should be increased slightly in order that the maximum lethal concentration will be obtained throughout.

Unlike forced-draught machines the hot-air types have a different system of ventilation and as these systems vary considerably according to the make and size of the machine, it is essential that all ventilators be closed while fumigation is being carried out. The temperature of hot-air machines should be maintained at 103°F. and the wet bulb at 93°F. during the fumigation period.

**Internal Sizes of some Commonly used Incubators**

1. “Lanyon” still air, 120 egg capacity: approx. 2 ft. x 2 ft. x 1 ft. = 4 cubic feet.

2. “Multiplo” 1,350 egg capacity: 3 ft. x 2½ ft. x 4 ft. = 30 cubic ft.

3. “Gamble” 4,000 capacity—
   (Setting compartment) = 3 ft. x 5 ft. x 5½ ft. = 79 cubic ft. (approx.).
   (Hatching compartment) = 3 ft. x 2½ ft. x 5½ ft. = 39 cubic ft. (approximately).

**Estimation of Ingredients Required for Fumigation**

*Example:*

Inside measurements of incubator: 3 ft. x 6 ft. x 5 ft. = 90 cubic ft.

Using 75 c.c. formalin and 50 grammes potassium permanganate per 100 cubic feet 90 c. ft. = 9/10 of 100 c. ft.

Amount of formalin required = 9/10 x 75 = 67.5 c.c.
Amount of pot. permang. required = \(\frac{9}{10} \times 50 = 45\) grammes.

Note.—To convert c.c. to fluid ounces or grammes to ounces divide by 30. This will give an approximately correct result, e.g., 75 c.c. = \(\frac{75}{30} = 2\frac{1}{2}\) fl. oz. (approx.).

Ingredients required for incubators of various sizes, using 75 c.c. formalin and 50 grammes potassium permanganate per 100 cubic ft. (if 150 c.c. formalin and 100 grammes potassium permanganate are used, double these quantities will be required):

<table>
<thead>
<tr>
<th>Incubator space</th>
<th>Formalin required</th>
<th>Pot. permang. required</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 cubic ft.</td>
<td>3 c.c.</td>
<td>2 grammes</td>
</tr>
<tr>
<td>30 &quot; &quot;</td>
<td>22.5 &quot;</td>
<td>15 &quot;</td>
</tr>
<tr>
<td>40 &quot; &quot;</td>
<td>30 &quot;</td>
<td>20 &quot;</td>
</tr>
<tr>
<td>80 &quot; &quot;</td>
<td>60 &quot;</td>
<td>40 &quot;</td>
</tr>
<tr>
<td>120 &quot; &quot;</td>
<td>90 &quot;</td>
<td>60 &quot;</td>
</tr>
<tr>
<td>175 &quot; &quot;</td>
<td>131 &quot;</td>
<td>87.5 &quot;</td>
</tr>
</tbody>
</table>

In conclusion, it must again be stressed that fumigation is only one step in the control of hatchery diseases.

Emphasis must be placed on efficient pullorum testing of adult poultry as the main line of defence. Good all-round poultry husbandry will effectively reinforce these measures.

WHITE CABBAGE BUTTERFLY
Parasitic Moths Released.

During January a consignment of small wasps which parasitise the white Cabbage Butterfly were received in this State from the C.S.I.R.O., Canberra, and were released on cabbages in the Coogee area.

The Government Entomologist (Mr. C. F. H. Jenkins) stated that since the White Cabbage Butterfly was first recorded in this State in January, 1943, three different species of wasp parasite had been released and were contributing to the control of the butterfly. The White Cabbage Butterfly in its larval form caused tremendous damage to plants such as cabbages and cauliflowers unless control measures, usually in the form of dusts, were applied.

It was difficult to estimate the degree of control achieved biologically by means of the wasps but there was always hope that a particularly favourable set of conditions would help the parasites to destroy large numbers of the caterpillars. The wasps laid their eggs in the bodies of the caterpillars, just prior to the chrysalis stage being reached and this meant that a number of young wasps emerged from the chrysalis instead of the adult butterfly.

TREES OF WESTERN AUSTRALIA
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POISON PLANT SERIES

Owing to the absence from Perth of the Government Botanist (Mr. C. A. Gardner), we regret that the drawings and letterpress for the series, "Trees of W.A." and "Poison Plants of W.A." were not available in time to be included in this issue.

Mr. Gardner has been in the Kimberleys, carrying out investigations into plants suspected of causing "Walkabout Disease" of horses, but should be back in time to continue his series of articles in the July-August issue of the "Journal."

THE EDITOR.
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