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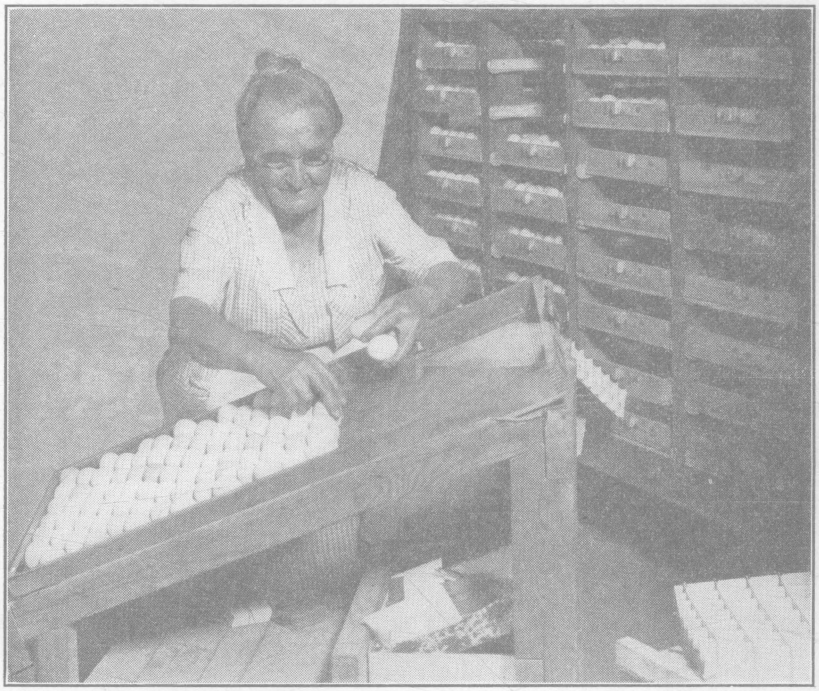
Sanitation in the Hatchery



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SANITATION IN THE HATCHERY*

This bulletin is prepared in the hope that the suggestions made will prove helpful to those poultrymen and hatcherymen engaged in producing baby chicks. There has been an increasing demand on the part of many baby chick producers for a program of disease control and sanitation which they could apply and toward which they could direct their plans for the future.

Many of the ideas in this bulletin have been expressed by scientists and poultrymen both in publications and in lectures. Some of the ideas are the application to the incubator and baby chick of established principles of sanitation, even though no experimental evidence has ever been presented to show that they would result in a direct decrease in chick mortality. We have felt free to make suggestions, therefore, on the assumption that after all a baby chick is not greatly different from other living animals, and that the fundamental principles of sanitation are the same for all creatures. The application of the principles may vary, however, and an attempt has been made to have the suggestions as practical as possible.

HOW BACTERIA ARE SPREAD

It is generally recognized that bacteria have no way of traveling from one place to another except when they are carried. They do not fly or walk. They may be carried by animals or by poultrymen. Certainly they are carried by flying dust particles. Bacteria seldom leave a wet surface. Unless some of the moisture is carried from one place to another, they will remain on a wet or moist surface until it dries and dust particles are carried into the air.

WHAT IS NECESSARY FOR BACTERIAL GROWTH?

Heat, moisture, food, and air are essential for bacterial growth. The temperature at which bacteria will live varies from below zero to above the boiling point of water, depending upon the kind of bacteria. The temperature range for the growth of bacteria that cause poultry diseases does not cover wide extremes. The temperature best suited to them is from 98° to 105° Fahr. Bacteria may live under very low or very high temperatures without increasing in number. When favorable conditions are provided, however, they grow and multiply rapidly. Such favorable conditions are found in the incubator and hatchery room, and unless care is used disease is likely to spread.

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The moisture essential for bacterial development is usually found in all poultry houses, and a properly operated incubator is ideal for bacteria as well as for baby chicks.

The food supply comes from organic substance such as fecal material that may be present on the shell of the egg or on the incubator trays. Probably the most important supply is from the contents of the egg itself. This is especially true of such diseases as bacillary white diarrhea.

HOW BACTERIA ARE DESTROYED

Bacteria are destroyed by both chemical and physical means. The physical agents which are harmful to bacteria include drying, sunlight, and heat. Many of the pathogenic types if merely deprived of moisture soon die. Some forms, however, can withstand drying for long periods of time. Direct sunlight is very destructive to bacteria and will destroy the most resistant types if they are exposed to it for a sufficient length of time.

Many chemicals are used to destroy bacteria. Some are mixed with water and used in the liquid state. The more common substances used are Phenol in 5 per cent solution, Lysol in 3½ per cent solution, and Bichloride of Mercury 1 to 1000 solution.

Certain gases when liberated are very destructive to bacterial life. The gas most commonly used is formaldehyde. There are several methods for generating it. The one most commonly employed is the potassium permanganate method, which consists of placing the required amount of formalin in a vessel and adding potassium permanganate crystals to it, or vice versa. This method is described in detail on pages 13 and 14.

The gas is much more efficient if the air in the room is warm and well saturated with moisture. The amount to use will depend upon the rate of air movement, the humidity, and the temperature. It takes more to disinfect a room in which the air is still dry and cool than it does an incubator where conditions can be made right for destroying bacteria.

CONTROL THE EGG SUPPLY

Unless eggs are produced by healthy hens under sanitary conditions the chicks produced will be exposed to the disease of the parent stock. A rigid system of inspection and the elimination of all flocks and hens not kept up to a high standard of health should be practiced by every hatcheryman. Sometimes a flock suddenly "goes bad." This may be due to intestinal parasites, tuberculosis, coccidiosis, cholera, typhoid, or white diarrhea. Regardless of what

the cause may be, eggs from such a flock should never be put in the incubator.

INSPECTION OF HATCHERY FLOCKS ADVISED

The only known way to check on the physical condition of hatchery flocks is by frequent inspection. Certain diseases, such as white diarrhea, cannot be identified unless the flock is tested for the disease, and hatcherymen having trouble from this disease should arrange to eliminate the hens having the infection from all flocks supplying eggs.

EGGS SHOULD BE CLEAN

Dirt on the surface of the eggs is a source of bacterial contamination. Either this dirt should be kept off the egg, or the bacteria should be killed before the chicks hatch. The suggestion has been made that all eggs be dipped in a disinfectant before being placed in the incubator. Several different chemical solutions have been mentioned, among which are: colloidal iodine, chlorine compounds, and bichloride of mercury.

The authors of this bulletin believe that if the incubator is disinfected with formaldehyde, as described later, the surface of the egg that is reasonably free from organic matter will be thoroughly free from bacteria. This probably is not true of coccidia. In case of coccidiosis being present in the breeding flock there is the danger that this organism may be carried into the incubator on the surface of the egg. Dipping the egg is probably the only means of control for this source of infection. There is need for more research work on this subject.

MANAGEMENT IN THE HATCHERY BUILDING

The room in which the incubators are located is the source from which the air is secured for ventilating most machines. Since the air contains dust particles on which are carried millions of bacteria, it is obvious that an incubator is only as clean as the room in which it is located.

The floor of the hatchery room is the most common source of dust and dirt. The floor should be kept clean. Less dust will be stirred up if the floor is scrubbed or flushed off with water instead of being swept with a broom. When the incubator room is located on a floor where the use of water is impossible, sweeping compounds should be used. If possible, the floor of the room should be kept wet down. This prevents dust, and by increasing the humidity of the air is an aid in hatching larger and better chicks.

The practice of dropping or deliberately throwing eggshells, unhatched eggs, or dead chicks on the floor is bad. This refuse should be carefully handled and removed from the incubator at once. It is impossible to picture by written words the spread of bacteria that results from such practice. Incubator trays should be emptied into special receptacles located entirely outside the incubator room.

The egg receiving and storage rooms, and the chick packing, storage, and shipping rooms should all be separated from the incu-

Clean eggs, clean incubators, and sanitary surroundings produce healthy chicks.

bator room proper. Chick storage batteries and other brooding quarters for hold-over or started chicks should likewise be separated from the incubator room, and, in most cases, a separate building or separate part of the main building should be used.

The hatchery room is not greatly unlike a hospital. Clean walls, clean floors, clean equipment, and clean attendants are essential. There is no reason why attendants and workmen in the incubator room should not be required to wear white suits or coats and change them frequently. They should never be permitted to work with

mature stock or older chicks unless they change clothing, disinfect their shoes, and clean up before going back into the incubator room. All this may sound like unnecessary attention to detail. The suggestion, however, that the impression given by such a system of management upon visitors would prove profitable may encourage some hatcherymen to adopt it. The effect upon the workmen would be valuable. A man who is permitted to work with filthy equipment in dirty clothes is not likely to take pride in producing a healthy chick.

Boxes used for removing the chicks from the incubator should be clean and new. The practice of using the same box over and over throughout the season is inexcusable. When chicks are held for shipment in boxes or brooders great care should be taken to see that everything is clean. Such holding boxes and brooders should be thoroughly disinfected by using a standard disinfectant as directed by the manufacturer. Old chick boxes should be burned and under no conditions should used boxes be returned to the hatchery.

SANITATION IN THE INCUBATOR

The incubator is the most important part of the hatchery. Here the eggs are held for twenty-one days; here thousands of chicks are hatched week after week throughout the season. Disease, once established in an incubator, may grow steadily more damaging as each succeeding hatch is taken off. Hatcherymen frequently remark: "We never had a complaint from our first hatches, but later in the season the chicks didn't seem to have the vitality and 'livability' they should. Hatches were good, but the chicks seemed to be weak. They were hard to raise. Most of my complaints are concerning chicks hatched after the season is well advanced."

There may be many reasons for this, but one reason is that conditions in the incubator have grown more insanitary with each batch. There has been a constant increase in the amount of infection brought into the incubator, from the breeding flocks, on the eggs, by the operator, and from the incubator room. The temperature, moisture, and air in an incubator are ideal for growth of bacteria. The food for this increased growth is always available from fecal material, eggshells, dead chicks, cracked or broken eggs. Consequently, trouble increases as the season advances.

Suggestions have already been made for reducing the amount of infection introduced into the incubator. How to reduce or eliminate the growth of bacteria in the incubator itself is another problem which must be dealt with in a special manner.

CLEANING THE INCUBATOR

The first step is to remove and prevent the accumulation of visible dirt inside the incubator. The chick down, fecal material, eggshells, unhatched eggs, dead chicks, and all dirt should be removed from the machine as soon as possible. A vacuum cleaner is helpful in cabinet machines. The machine should be scrubbed out with a good disinfectant between each hatch. This applies especially to the hatching compartment in sectional machines.

The egg trays should be scraped and brushed with a steel brush to remove all dry matter such as chick droppings, broken eggs, and blood from mashed chicks. They should then be dipped in a tank containing a disinfectant and permitted to stay there until the liquid has had time to penetrate to every part of the tray and soak loose any dry dirt.

In types of incubators where nursery trays are used, we suggest the use of paper and the elimination of the insanitary cloth covering. There may be some objection to this when it interferes with the proper circulation of air, but in the sectional type of incubator this objection can be overcome by having the paper ¼ inch or so smaller than the tray. Old newspapers may be used. Wrapping paper just the proper width can be secured. The paper may then be cut to exact size without folding. A rack for holding this roll of paper with a cutter attached will prove a time saver. These papers are easily destroyed, are sanitary, and eliminate the laundry problem.

Moisture pans should be emptied between each hatch, scrubbed and disinfected before being refilled. The clean water may have a disinfectant added which will prevent the growth of bacteria.

CHICK DOWN SPREADS BACTERIA

During the season of 1928 studies made at Ohio State University showed that disease germs are spread on the down of infected chicks. This means that *all* chicks hatching in an incubator are exposed to all the diseases with which *any* of the chicks may be infected. The down is light, and floats in the air of the egg chamber; it also floats in the air of the incubator room. Studies made by the Bureau of Animal Industry of the United States Department of Agriculture show that disease may be spread from one end of a machine to the other even though the egg chambers are separated. The dust and chick down floating in the air of the incubator room are taken into the machine with fresh air for ventilation, and no doubt cause the spread of the disease.

There are at least three important factors that may influence the damage caused from chick down:

1. *The rate of air movement.*—If the air moves slowly less down will be carried from place to place. This is a difficult factor to control, since air movement is necessary for proper ventilation. Then, too, the air inside the incubator room is kept moving by heat, ventilation, and the movements of workmen.

2. *The amount of moisture in the air.*—Observations show that particles of dust and chick down settle out of the air when the air is moist. This is probably due to the fact that chick down and dust absorb moisture and become too heavy to float. Studies both at the Ohio State University and Kansas State Agricultural College indicate that the spread of bacteria is materially reduced in an incubator when the wet bulb reading is kept around 90°.

3. *The amount of infection present.*—The third factor determining the damage done by floating down in the incubation chamber is the amount of infection present in the hatchery trays. If there are no eggs hatching that contain injurious disease germs no damage is done. The chick down itself is not injurious. It is obvious, therefore, that here again we see the need of reducing the number of eggs set from infected hens, and for keeping the egg supply, incubator room, and incubator itself free from disease germs.

Nothing the hatcheryman can do will reduce the amount of infection inside the egg. Chicks hatched with infection must have had it transmitted to them from the parent stock. Such chicks are sure to have a high mortality. As a matter of fact, many of them die in the shell. The great damage is done, however, by these chicks serving as the source from which other chicks, hatched free from disease, are contaminated; the result is an endless chain of spread from infected to healthy chicks, with a very high mortality during the first few weeks of brooding.

A STUDY OF DISINFECTION DURING INCUBATION

Great danger lurks in the floating dust and chick down in the incubator room and incubator. There can no longer be a question about the spread of disease in all types of incubators from infected to healthy chicks by this means. Suggestions have been made on preceding pages which, if followed, will reduce the infection present and the amount of down and dust in the air. However, some disease may be carried into the incubator, where it will spread. Not every hen can be eliminated that transmits disease to her chicks. One chick may be the source of infection for thousands hatching in the same incubator or even in the same room.

This question of infection leads to a study of the possibilities of killing the bacteria before they have done great damage. It is known that chicks hatched with the infection cannot be cured. Such chicks usually die. The question of preventing the spread from this infected chick to the healthy one leads to a study of the use of formaldehyde gas as a means of control. A report by Canadian investigators indicated the possibilities of this gas. Unpub-

The floor of the hatchery room should be kept clean. Flushing off prevents dust rising and increases humidity of the air.

lished reports that a commercial hatchery operator in Kansas, with the aid of C. T. Coon, had successfully disinfected force draft incubators with formaldehyde, further stimulated interest. Two commercial incubator manufacturers were interested in the study, and sufficient funds were provided by them to carry on the work.

Bacillary White Diarrhea, the most serious disease affecting baby chicks, had been shown by Hinshaw (1927) to be transmitted from diseased to free chicks during incubation. Because of the economic importance of this disease the study was confined to its spread and control.

The Eggs Used.—Eggs for the experiment were secured from two flocks on the University Farm. One flock consisted of hens that reacted negatively three times to the agglutination test and were believed to be free from white diarrhea. The other flock consisted of hens that had reacted positively to the test and were believed to be hens with bacillary white diarrhea. These flocks were housed separately and cared for by different men.

Late in the experiment some eggs from known reactors were purchased from a commercial firm. All eggs used were from Barred Plymouth Rocks, except eggs which were secured through the courtesy of Dr. M. A. Jull from the government poultry farm. These eggs were used because it was believed the government flock was free from the disease, and would thus give a check on the University flock, which had not been tested over a period of years. These eggs were from several different varieties.

The Incubators.—Force draft incubators with approximately 100 cubic feet of air space each were used. These machines were loaned by the manufacturers for the study. They were located in the basement of the poultry building at the University, in different rooms separated by two doors and a hall. The operator was required to follow out a strict procedure of sanitation in managing the machines.

The Brooders.—All chicks were brooded for two weeks and daily mortality records kept. Three rooms, separated by double doors and a hall, were used. This was necessary to reduce as much as possible the danger of spread in the brooder room. The attendant was required to change clothes and disinfect his shoes before going from room to room.

PRELIMINARY STUDIES

1. Chicks from reacting hens were examined just before hatching to see if the disease germ was present in the egg fluid and on the down. It was found that chicks hatching from eggs that contained white diarrhea were literally bathed in a fluid which contained the organism. The body of the chick was found to be covered with the organism. This suggested the necessity, first, of having to disinfect the chick before it dried off and the down began to fly; and, second, of raising the humidity in the incubator in order to prolong the period necessary for the chick to dry. It also suggested the frequency with which it would be necessary to disinfect the incubator in order to keep the floating chick down free from the organism.

2. Air samples were drawn from the machine during the hatching period after it had been previously disinfected. This showed that when the wet bulb reading was 90° the incubator air remained free from living organisms for a period of ten to twelve hours. After this period the air rapidly became contaminated with flying chick down which carried live organisms. This again suggested the necessity of frequent disinfection of the machine during the hatching period if the spread of disease was to be prevented.

3. Baby chicks of various ages were placed in bell jars on wire screen floors. A fluid containing bacillary white diarrhea was sprayed into the bell jar in order to study the effect of the organism on chicks when breathed by them. Previously we had thought that possibly the chick would have to pick up the organism by eating the substance on which disease germs were present. The tests showed that every chick exposed to bacillary white diarrhea in the manner described was affected. All the very young chicks so exposed died in a few days. The older the chicks the less damage was done, and the longer it took those injured to show symptoms of disease.

All chicks in this test were examined when they died or were killed for examination. In every case the organism of bacillary white diarrhea was found in the lungs, and, in some cases, in other organs. Yellow nodules were especially noticed on the lungs of these chicks that were forced to breathe the organism. These yellow nodules resemble those found in so-called cases of brooder pneumonia, and suggest that possibly most brooder pneumonia is nothing more than the result of the chick breathing bacillary white diarrhea into the lungs, which become affected and cause a delayed mortality after the usual period of white diarrhea mortality is passed. Further study of this problem should be undertaken.

RESULTS OBTAINED WITH FORMALDEHYDE GAS

The experiment showed that bacillary white diarrhea organisms are easily killed by formaldehyde under the conditions of heat, moisture, and air circulation in a force draft incubator.

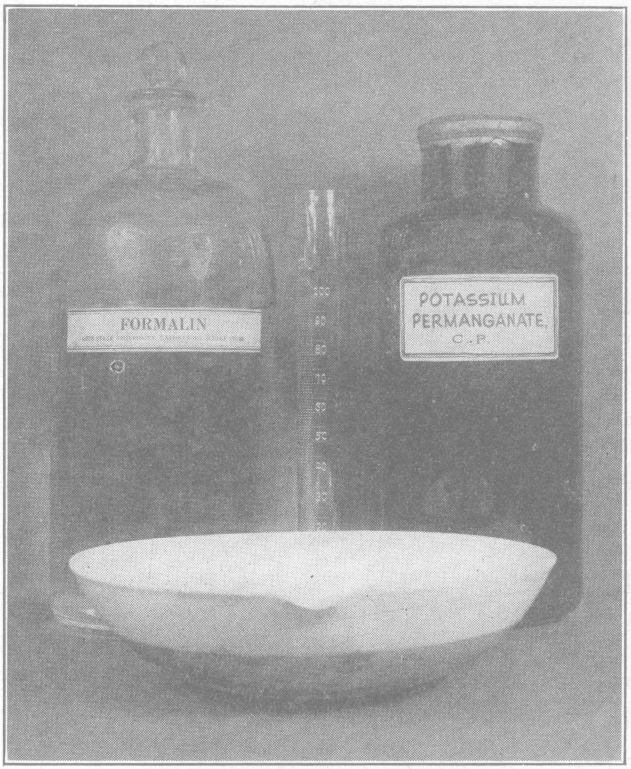
Ten hatches were run in each of two separate incubators. One incubator was fumigated, the other was not. This latter incubator was kept as clean as machines are kept in commercial practice.

Eggs from free hens and reactors were set in both machines each hatch. Care was taken to distribute the eggs in each machine equally, the egg-for-egg method being used.

1. In the incubator not fumigated there was a total of 693 chicks hatched. The number that died before two weeks was 230, or 33.2 per cent. Of this number 89 were from free hens, and

36 (or 40 per cent) pure cultures were recovered from these 89 chicks.

2. In the disinfected incubator there were 682 chicks hatched. The mortality was 123, or 18 per cent. Of this number 41 were from free hens, and 4 (or 10 per cent) pure cultures were recovered from these 41 chicks. Thus the mortality was reduced from 33.2 per cent in the unfumigated to 18 per cent in the fumigated machine.



Apparatus used in making formaldehyde gas. The graduated cylinder is necessary for measuring the formalin. Pans should be of earthenware or porcelain.

The known spread was reduced from 40 per cent in the unfumigated to 10 per cent in the fumigated machine.

The supply of eggs was limited and the hatches were small. This feature of the experiment opens the results to criticism of the "practical man" who counts his chicks by the thousands. There is no known way by which the objection can be overcome. Careful work is essential, and this necessitates working with small numbers.

The application of the principle here presented is up to the chick producers. If for any reason it fails to produce desired results, the experimental tests still stand as evidence that under the conditions of the experiment the spread of white diarrhea in force draft incubators was largely controlled by the use of formaldehyde gas. Like any new idea, application and practice will point the way to improvements and obstacles which were not apparent in the experimental tests.

PROCEDURE FOR DISINFECTING INCUBATOR WITH FORMALDEHYDE GAS

Since this is not a technical bulletin only those studies and procedures are reported which are believed to be of assistance to the practical incubator operator in undertaking the problem involved and in carrying out the suggested means of control.

The following procedure is recommended. Great care must be taken to follow directions implicitly; otherwise, you will be in the experimental field and experience will soon convince that this is not a task in which great latitude for individual methods of application can be followed without a thorough understanding of the possible dangers of damage to the chicks in the incubator:

1. For the first time apply the disinfectant to a small number of chicks. This may be done between hatches or just following a hatch. It must be remembered that if the chicks are more than "day old," damage will be done.

2. The timid should practice on an incubator with only hatching eggs. This may be done between hatches. There is very little danger of injuring the eggs.

3. The humidity of the incubator should be high at the time of the application. The wet bulb thermometer should read not less than 90°. Write the incubator manufacturer if you have trouble getting it that high.

4. The incubator doors should be closed as tightly as possible. Our work was carried out with all intakes closed. Tests at the Kansas State Agricultural College and by one of the incubator companies show that this is not essential. The gas evidently works quickly and before it has a chance to escape.

5. If a capable bacteriologist, veterinarian, or medical man can be engaged to assist in the first few administrations, it will prove a safe precaution against gross errors, and may save the operator from disappointment.

6. A quantity of potassium permanganate and of formalin should be secured.

7. The cubic contents of the incubator must be known.

8. A graduated cylinder reading in cubic centimeters and a number of containers large enough to hold the required amount of formalin and potassium permanganate are essential. These will vary with the size of the incubator. The containers may be earthenware or porcelain. Pans with rounded bottoms and sides are preferable. They should be two to three inches deep.

9. The amount of chemicals necessary to disinfect each incubator can be calculated on the basis of 20 grams of potassium permanganate crystals, and 40 cc. of formalin for each 100 cubic feet of incubator content. Tests showed that 35 cc. of formalin and 17 grams of potassium permanganate were effective. It is very important, however, that no increase in amount be made.

10. The required amount should be divided into as many equal portions as there are fans in the incubator. This requires measuring the chemicals and placing them in different containers.

11. Pour the required amount of formalin in each container* and place in the incubator as far away from the hatching trays as possible. In one make of incubator this means placing the containers above the fans on the fan rack. In another type it means placing the containers either in the intake pipe or on a pedestal under the fans, one for each fan. The reason for this precaution is to insure proper mixing of the gas with the air in the incubator before it comes in contact with the chicks.

12. If the containers are set in a shallow pan of water, it will insure against the danger of fire from the boiling over of the mixture.

13. When all the containers with the measured amount of formalin have been placed in their required position, add the previously measured and required amount of potassium permanganate crystals to the formalin*. Do not rush, but work with precision. Close the doors to the incubator as soon as possible after the chemicals have been added.

14. Hold your watch in your hand and at the end of ten minutes, no more, open all doors to the incubator in order to hasten the escape of the gas. The incubator room should be aired out to facilitate the escape of gas from the room. Tests show that less time than ten minutes is required to kill the organisms. Not less than five minutes nor more than ten should be given.

15. The incubator should be first fumigated just as the chicks begin to hatch, before more than 10 per cent are out of the shell, and before any have dried off.

16. After twelve hours the process should be repeated.

17. All chicks that are dry, or nearly so, should be removed from the incubator immediately following this second treatment. Place them in clean, new boxes or sanitary brooders. There is nothing to be gained by leaving them in the incubator and subjecting them to more gas and danger of possible contamination.

* If large quantities are to be used it may be better to measure the potassium permanganate into the containers and pour the formalin over it.

18. After twelve hours the third treatment is given and again all chicks that are dry should be removed.

19. At the completion of the hatch, clean the incubator trays and incubator room as described earlier in this bulletin.

CAUSES OF FAILURE

In anticipation of possible failure by inexperienced operators in administering the disinfectant the following explanations may prove helpful:

1. Too much formalin for the amount of space in the incubator will injure the chicks. There is no danger from using too much potassium permanganate — it is just wasted.

2. An insufficient amount of potassium permanganate will not liberate all the formalin and the proper results will not be secured. The chicks will not be injured, but neither will the bacteria.

3. An insufficient amount of formalin will not kill the bacteria. The prescribed amount should be used.

4. Too long an exposure will injure the chicks. We killed the chicks in two hatches by over-exposure.

5. If the humidity of the incubator is below 90° the effectiveness is reduced.

6. If the fans are not running, the gas will not be diffused and the treatment will fail.

7. If the containers are not properly located, or if located too close to the hatching trays, damage will result.

8. If the containers are too small the mixture will boil over and not be effective.

COMMON DISINFECTANTS*

Disinfectant	Strength Used	Purpose	Cautions
Formaldehyde	5 per cent	Interior of houses, coops, etc. Incubators	Irritating to mucous membranes. Hardens the skin.
Formaldehyde gas	1½ lbs. potassium permanganate, 3 pts. formaldehyde, 1000 cu. ft.	Poultry houses. Hatchery room.	Tight house, temp. 60° or above. Sufficient moisture.
Formaldehyde gas	40 cc. formalin, 20 grams potassium permanganate to 100 cu. ft.	Force draft incubator.	99° to 100° temperature 90° wet bulb reading.

* Adapted from F. R. Beaudette.

COMMON DISINFECTANTS *(Continued)*

Disinfectant	Strength Used	Purpose	Cautions
Bichloride of mercury	1–1000	Soil, 1 gal. to each 10 sq. ft.	Never use on metals. Do not allow to stand a long time in wooden containers. Do not use to disinfect albuminous material. After use on soil keep fowls off run for 1 week.
	1–6000	Drinking	Containers should be of earthenware, never metal or wood.
Silver nitrate	10 per cent solution	Mouth, nasal cavity, wounds, vent.	Never make solutions with tap water. Do not use in presence of chlorides. Not a general disinfectant.
Argyrol	10 to 15 per cent solution	Eyes particularly, also mouth, nasal cavity.	Not a general disinfectant.
Unslaked lime	Sprinkled on soil	Poultry runs, filthy puddles, manure.	Sprinkle with water after placing on soil. Keep fowls off runs for 1 week.
Whitewash	Slake 4 lbs. lime with 1 qt. water and dilute to proper consistency.	Interior of houses.	Use freshly prepared.
Sulfur	Burn 5 lbs. to every 1000 cu.ft. of space.	Poultry houses.	House must be tight, temp. over 60°; sufficient. Attacks metals, therefore should not be used in incubators.
Iodine	Tincture	Wounds	Never use as a general disinfectant. Do not use on metal.
"Chlorinated lime"	20 per cent solution	Droppings, filthy pools, dropping boards. Wash drinking vessels. Good deodorant.	Not often used as a general disinfectant.
Liquor Cresolis and Crude carbolic acid	2 to 5 per cent solution	Interior of poultry houses. Incubators.	Used as a general disinfectant.
Carbolic acid	5 per cent	Washing drinking vessels. Wounds.	Too costly for general disinfectant.
	1–1000	Drinking water.	
Potassium permanganate	1–500 to 1–1000	Drinking water. Wounds.	Never used as a general disinfectant.

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