To minimize the danger of the introduction and spread of hexamitiasis into your flock, do these things:

Dispose of all breeding stock and other mature turkeys at least 2 weeks before starting your first brood of poults, or else keep the mature stock on a distant part of the farm that has its own equipment and caretaker, so traffic between the two operations is unnecessary.

Have your feed house so arranged that men delivering supplies need not enter buildings or yards occupied by your turkeys or handle equipment that your birds use.

Have feeders and watering devices so constructed that they stay free of droppings.

Start each brood with houses and equipment scrupulously clean.

Keep litter clean and dry always.

Isolate all sick birds, quarantine all affected pens, and bury or burn all birds that die. Always take care of clean stock first, pens having shown sick birds next, and isolation quarters last of all.

Move birds on the range frequently to avoid excessive contamination of the ground. As far as hexamitiasis is concerned, plots may be reused safely 2 to 3 weeks later, but if blackhead or coccidiosis also are present that should not be done.

Some growers have had satisfactory results with the use of Aureomycin (chlortetracycline) administered at levels of 180 to 200 grams per ton of ration.

Other growers have preferred to administer the medicant in the water, because birds will sometimes drink after they no longer feed. They use 10 grams of soluble Aureomycin for 50 gallons of water. In either instance, the drug may constitute only a small part of the preparation available on the market, so the mixture must be made to contain the stated amount of the active ingredient. If the drug is effective, improvement usually is noted in 2 or 3 days.

Frequently other disorders accompany or follow hexamitiasis. If control measures or treatment fail after 3 or 4 days, a second diagnosis may be necessary for the situation may have changed.

Everett E. Lund is a parasitologist in the Department of Agriculture.

Pullorum Disease of Chickens and Turkeys

J. E. Williams, Paul B. Zumbro, and A. D. MacDonald

Pullorum Disease of Chickens and Turkeys

J. E. Williams, Paul B. Zumbro, and A. D. MacDonald
Pullorum disease of chickens and turkeys more than 1 month old. The infected adults usually show no outward evidence of infection.

Once commonly known as bacillary white diarrhea (B. W. D.) of chicks, pullorum disease for more than a half-century has been recognized as one of the worst of all poultry diseases.

Great strides have been made toward eradicating it through a national program of blood testing adult breeding flocks, supplemented with the widespread practice of sound sanitation.

The main reservoirs of pullorum infection are the egg-producing organs of the infected hen. The disease is transmitted from her to the chick or poult directly through the egg.

The infection may be spread among the brood through breathing or consuming contaminated dust, down, or other material in the incubator, shipping box, brooder, or pen. The disease is transmitted also through consumption of litter, feed, or water contaminated with infected droppings. One infected chick or poult at hatching time may be responsible for transmitting the disease to the entire brood. The infection is usually spread during the first few days. Unsanitary conditions, improper heating or ventilation, and the occurrence of other diseases hasten the spread.

Infected chicks or poults that do not die of the disease may grow to maturity and remain lifetime carriers. Infected hens may lay infected eggs that may hatch diseased chicks; thus the cycle is repeated. Transmission sometimes happens among adult fowl through consumption of infected droppings or broken eggs.

The symptoms exhibited by infected chicks and poults are by no means specific but may lead one to suspect the disease. Losses may start in the incubator or shortly after hatching, when infected eggs are the source of the disease. As a general rule, however, several days elapse before heavy losses start. Losses tend to decline during the third and fourth weeks.

Pullorum-infected chicks and poults show symptoms of extreme depression, huddling together with closed eyes and with drooping heads and wings, ruffled feathers, frequent passages of liquid feces, which results in pasty vents, shrill chirping, and loss of appetite.

When the infection reaches the lungs, the birds may breathe with difficulty and extend their heads in an effort to breathe. Surviving birds may be runts.

Listlessness, a lack of appetite, diarrhea, increased water consumption, and a paleness of the comb may be observed when the infection is acute among adults.

Postmortem findings in chicks and poults are usually observed in the liver, spleen, heart, and lungs as a generalized infection. Those organs are enlarged and often covered with streaks of hemorrhage or minute white spots, in which the organisms are centered. Larger areas of infection in the form of abscesses—lumps—may occur in the heart wall and through the lungs. The lumps may be observed also along the intestines and in the muscle of the gizzard. The sac covering the heart may be thickened and cloudy. The contents of the yolk sac often are dry and cheesy. The blind sacs (ceca), located toward the end of the intestinal tract, frequently contain a dry core.

The findings in maturing and adult birds that die of acute pullorum infection are like those in young birds. The more frequently observed lesions of adults are in the chronic carrier. On postmortem examination, one generally finds the most clear-cut lesions in the ovary of the chronic carrier. The ova are thickened, misshapen and discolored, and filled with a cheesy or watery material. Diseased ova may be clustered among normal ova or suspended on stemlike extensions from the main body of the ovary. Ovarian lesions are suggestive of pullorum disease. Other lesions in chronically infected adults include abscesses on the heart wall, thickening of the heart sac,
and generalized infection of the abdominal cavity, with an accumulation of fluid and pus.

For accurate diagnosis, bacteriological tests must be made in a laboratory, because the symptoms and post-mortem findings merely suggest the infection.

Adult or maturing birds that react suspiciously to the pullorum blood test and chicks and poults that show symptoms of acute pullorum disease should be submitted to a State diagnostic laboratory for examination.

This service is available at most State agricultural colleges. The laboratory culture tests are essential in distinguishing pullorum disease from fowl typhoid and paratyphoid infections, which are also eggborne diseases closely related to pullorum. Birds infected with fowl typhoid react to the pullorum test. Occasionally birds infected with certain paratyphoid types, as well as other micro-organisms, may react to the test. After the organisms have been isolated in the laboratory, their biochemical activity can be determined and a detailed report can be issued on the exact type of infection involved. This information is often useful in guiding the pathologist in making recommendations regarding treatment and control.

When an acute disease outbreak occurs, it is usually best for the owner to take several live birds and several dead ones to the laboratory for examination. The laboratory procedures for pullorum diagnosis generally take 48 to 96 hours to complete.

Control and eradication of pullorum disease must be based on breaking the cycle of transmission. That is done by detecting and eliminating adult carriers, because the disease is largely eggborne. Such a procedure makes the owner reasonably sure that only noninfected eggs are set and noninfected chicks and poults are hatched. Blood testing of adult chickens and turkeys in breeding flocks is done throughout the United States. The agglutination test, used in detecting pullorum carriers, is conducted by one or more of the three officially recognized methods; namely, the tube agglutination test, the rapid whole-blood plate test, and rapid serum plate test.

Each test is based on the fact that infected birds carry in their blood stream immune substances (antibodies), which will clump (cause to stick together in a compact mass) a liquid suspension of killed-pullorum organisms (antigens) when the test suspension is mixed with the serum or the whole blood of the infected bird. The clumps are visible to the unaided eye and indicate that the living organisms and the antibodies that they stimulate are present in the bird. The blood of noninfected birds does not contain any antibodies, and therefore no clumps form when the whole blood or serum of such birds is mixed with the antigen.

The rapid whole-blood test has been most widely used for testing chickens. The test is easily conducted in the field by anyone trained in its use.

State agricultural colleges for years have held schools to train poultrymen in conducting blood tests and practicing other procedures for controlling pullorum disease.

The three agglutination tests mentioned as being used for diagnosing pullorum disease are described in The National Poultry Improvement Plan and National Turkey Improvement Plan and Auxiliary Provisions. This publication is available from the Agricultural Research Service, Washington 25, D. C.

A variant type of pullorum disease was recognized in Canada in 1941. Outbreaks occurred in chicks in flocks that tested negative to the standard agglutination test and were maintained on uninfected premises. The outbreaks had the same history and symptoms as typical pullorum disease. Cultures were isolated and studied. All were identical to Salmonella pullorum, except that they varied in their antigenic makeup from the official pullorum strains that were used.
A comparison of the serious effects of uncontrolled pullorum disease and the results of the use of the agglutination test and the disposal of reactors.

to produce antigens (liquid testing fluids containing killed-pullorum organisms). These usual or so-called "standard" antigens often did not react in the presence of serum from the outbreaks noted. This new form of pullorum disease was designated "variant type." It has been found in many sections of the United States.

In order to detect both the standard (usual) and the variant forms of pullorum infection, a polyvalent-type whole-blood antigen has been widely used in testing. The polyvalent antigen consists of a mixture of both standard and variant-type cultures of *Salmonella pullorum* organisms; the standard antigen contains only standard-type cultures. Both standard and polyvalent whole-blood type antigens are available commercially.

A polyvalent-type tube agglutination antigen has been used occasionally to test chickens and turkeys in flocks where the variant type of pullorum disease has been encountered or is suspected. Most diagnostic laboratories can determine if the variant form of pullorum disease is present in a flock by analysis of cultures isolated on postmortem tests.

The key to the control of pullorum disease is to get healthy chicks and poults. Because most chicks and poults raised in the United States are bought from hatcheries, the first step in the control of pullorum disease for most poultrymen is to buy from a hatchery that produces clean stock.

The identification of such sources is an important function of the National Poultry Improvement Plan (NPIP) and the National Turkey Improvement Plan (NTIP), both of which are administered by the Department of Agriculture and an official agency in each State.

Hatcheries participating in the plans follow a systematic program of pullorum-typhoid control. They use eggs from participating flocks only. They are inspected by a representative of the official State agency and must be kept in sanitary condition.

Flockowners participating in the National Poultry Improvement Plan and National Turkey Improvement Plan must test their flocks annually for pullorum disease. To qualify, the flock must have no reactors. The testing is done by trained men. The flocks are subject to inspection and qualify either
as U. S. Pullorum-Typhoid Passed (no reactors on the last official blood test prior to producing hatching eggs) or U. S. Pullorum-Typhoid Clean (no reactors on two consecutive official blood tests). Turkey flocks and chicken flocks acquired from participating sources qualify as Pullorum-Typhoid Clean if no reactors are found on the first or any subsequent official test.

Lists are published annually giving the names and addresses of hatcheries and dealers participating in the National Poultry Improvement Plan and the National Turkey Improvement Plan and the pullorum-typhoid classification of their products. The chicken hatcheries are listed in ARS 53-6 and the turkey hatcheries in ARS 53-8. These publications are available upon request to the Agricultural Research Service, Department of Agriculture, Washington 25, D. C.

TREATMENT of pullorum disease is advisable only as a salvage or preventative measure and for chicks and poults that are not to be kept as a source of hatching eggs.

Sulfamethazine, sulfamerazine, and sulfaquinoxaline have been used successfully to reduce the death losses in chicks and poults.

Furazolidone, a chemical derivative of furfural, checks losses in acute outbreaks. It may be incorporated in the feed at a low level for continuous feeding to prevent outbreaks and spread of the infection.

We have little evidence that the antibiotics are effective or practical for the control of pullorum disease. Bacteria are of no value in the prevention or treatment of the disease.

Sanitation and disinfection are important, especially with regard to the hatching and the brooding operations. *S. pullorum* is rather easily destroyed by the common disinfectants, heat, and direct sunlight, but the organisms may survive for months in soil, manure, and sheltered places.

After each hatch, incubator egg trays and the other readily removable parts should be taken out, washed free of dirt and foreign matter, and then scrubbed with a 2-percent lye solution or other acceptable disinfectant, such as a 3-percent solution of cresylic acid. Lye is caustic and the operator must take precautions against exposure in using it.

Incubator rooms should be cleaned by periodically brushing and washing down dust and cobwebs from ceilings and walls and from around windows and doors. Debris and miscellaneous stored material should not be allowed to accumulate.

Formaldehyde gas is good for disinfecting incubators during incubation or following the removal of the hatch. In using formaldehyde gas, one should follow the recommendations of the manufacturer of the incubator being used. Chick brooders, brooder rooms, feeders, waterers, and similar equipment should be cleaned frequently by washing and disinfecting with an approved disinfectant.

Following removal of reactors to the blood test, poultry houses and equipment should be cleaned and disinfected. An empty pen in each house will facilitate these operations. Since yards in which infected birds have been kept should be considered unsafe for new stock, clean ground should be provided for replacements.

Feedbags, shipping cartons, and the egg crates preferably should be new. Otherwise they should be cleaned and disinfected properly. Trucks, in which the chicks or poults are transported, should be kept clean and sanitary. They always should be disinfected immediately after being used to haul any material that may be contaminated.

The persons who handle shipments should take precautions to insure freedom from contact with any source of contamination to newly hatched chicks or poults. Hatching operations in general should be off limits to visitors and unsupervised persons. Workers assigned to field jobs or other hatchery business where they come into contact with adult birds and other animals, which may or may not be known to be

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Fowl Typhoid

WALTER J. HALL

FOWL TYPHOID, a septicemic disease, may be acute or chronic, depending largely on the pathogenicity of the causative organism, Salmonella gallinarum. It is primarily a disease of pullets and mature chickens, but it may attack young chickens and turkeys, ducks, guinea fowl, pheasants, and some other birds.

It occurs throughout the United States and throughout the year but is most common in summer.

Symptoms are not distinct enough to be diagnostic. There is fever, loss of appetite, increased thirst, and usually a yellowish-orange diarrhea. Paleness of the head and shriveling of the comb are usual.

The changes seen inside birds dead of fowl typhoid are variable. Few abnormalities may be noted in the more acute cases that die at the beginning of an outbreak. Later, especially in young chickens, a marked swelling and redness of the liver, spleen, and kidneys are commonly observed. The more chronic cases may develop grayish spots on the heart muscle, with swelling and a bronze or dark-green coloring of the liver. The ovary may show flaccid, angular, or hemorrhagic ova, as in pullorum disease.

Rupture of the diseased ova frequently cause peritonitis (infection of the abdominal cavity), and salpingitis (infection of the oviduct). This infection disturbs the functioning of the oviduct, so that there is a loss of motility, resulting in the dropping of some yolks into the abdominal cavity, and the stagnation and hardening of those that enter the oviduct, with consequent cessation of laying.

Fowl typhoid should be differen-