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WHITE DIARRHEA OF CHICKS.[a]

With Notes on Coccidiosis in Birds.

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INTRODUCTION.

Poultrymen affirm that where white diarrhea prevails it kills from 60 to 75 per cent of all chicks hatched. Hence the necessity for painstaking research that the cause may be demonstrated and prevention or cure found. To this end many and extensive investigations have been instituted; great poultry plants have furnished material, their own experts making careful study of the technique of hatching and rearing chicks; agricultural colleges and experiment stations have faithfully experimented with poultry methods; bacteriologists, with their microscopes and culture media, have lent their aid. Thus the cause has been sought and supposedly found in the barometric conditions of incubators, in the temperature of incubator nurseries and brooders, in the organism of the chick itself, the unabsorbed yolk, in dietetic errors and digestive disturbances, and in the ever-present bacteria. But, unfortunately, cases of white diarrhea persisted when none of these conditions obtained. As a single instance in point, the writer has often laid out a string of chicks dead from this disease and demonstrated that only about one-half of the number had unabsorbed yolks

When more than a year ago Dr. John R. Mohler, chief of the Pathological Division, placed the writer in charge of investigations in poultry diseases, and suggested immediate study of so-called "blackhead" in turkeys, the writer demonstrated in the intestines of all turkeys so affected the presence in large numbers of a protozoan or-

[a] Drawings explanatory of the pathological lesions and of the developmental stages of the parasite causing the disease have been prepared and will be published at the conclusion of the investigations, together with a detailed study of the disease.

ganism, *Coccidium tenellum*, thus establishing as a basis for the study of avian diseases the existence in this country of a microscopic parasite long recognized in Europe as most virulent and destructive for birds as well as mammals.

As time passed on there was received material from numerous epizootics among turkeys, chickens, ducks, pigeons, and various species of wild birds in captivity, exhibiting the lesions usually diagnosed as gastro-intestinal or intestinal catarrh, of nonbacterial but probably of dietetic origin, all of which revealed the presence of a considerable number of *Coccidium tenellum*, accomplishing their damaging work upon the lining membrane of the intestines. In the early summer cases of "white diarrhea of chicks" began to come into the laboratory, and microscopic examination of the contents and walls of the greatly distended and necrosed ceca, or blind intestinal pouches, brought to light the destructive invasion of the lining cells by this minute but malignant micro-organism.

Accurate researches in subjects of such wide-reaching import necessitate much time in experimentation in order to establish all points involved in a successful war against so subtle a foe. However, the Pathological Division is receiving, from both scientists and poultrymen, numerous letters asking for the fundamental facts of our investigations, and it hardly seems just to withhold this knowledge pending the carrying out of experimental studies, many of which could be undertaken on a far larger scale by poultry plants and experiment stations. Hence this preliminary report.

DESCRIPTION OF THE DISEASE.

White diarrhea (typhlitis coccidiosa) of chicks is an inflammation, of varying severity, of the ceca, or blind intestinal pouches, caused by the presence of *Coccidium tenellum*, an intracellular parasite belonging to the class Sporozoa, of the phylum Protozoa, the lowest division of the animal kingdom.

This disease claims as its victims mostly chicks between 2 and 5 weeks of age. The symptoms are dullness and weakness, accompanied by a white, pasty, fecal discharge. In this discharge may often be detected by the microscope large numbers of circular, sometimes slightly oval, cysts 12 to 25 microns in diameter containing granular matter which may fill the cyst or may be contracted to occupy only a small portion of the cavity. These are the permanent cysts of *Coccidium tenellum*. Post-mortem examination reveals the blind pouches, or ceca, remarkably distended and packed with a yellowish-white cheesy material, which sometimes exudes into the abdominal cavity through perforations in the cecal wall. Examination of this necrotic material shows these same permanent cysts, and in the scrap-

ings from the inner wall of the cecum, placed under the microscope, are to be found epithelial cells markedly distended by the invasion and development within them of this parasite. This invasion of the cell results in its final destruction and separation from the wall of which it forms the lining; it then becomes a constituent element of the pasty catarrhal exudate which characterizes the feces in this affection. In many cases the lungs show the same necrotic change, in some instances the entire lung being transformed into a solid, yellowish-white cheesy mass. This appears to be the so-called brooder pneumonia.

Coccidium tenellum is frequently found in the intestines (especially the ceca) of chickens of all ages. Thus the droppings contain the permanent cysts which require only warmth and moisture for their development into sporozoites by which the disease is transmitted to other birds. When received by chickens into their digestive tract in food or grit soiled with infected droppings, the cyst wall bursts or is dissolved and the sporozoites are set free. These penetrate into the epithelial cells, where they grow to great size as schizonts, causing thus the destruction of the cell.

TREATMENT.

Treatment of coccidiosis in chicks is almost futile. An attempt might be made by the use of calomel, one-tenth of a grain, or a few drops of castor oil containing 1 to 3 drops of turpentine. Along with this, 5 to 10 grains of sulphate of iron (copperas) should be dissolved daily in 1 gallon of drinking water.

PREVENTION.

The essential work in battling with this disease consists in prevention. This must begin with the eggs used for hatching. These should be thoroughly and antiseptically cleansed by wiping in 95 per cent alcohol. If artificial incubation is used (and in this method lies the great hope of success), the incubator, if used before, should, previous to receiving the eggs, be carefully washed with antiseptic solutions and exposed to the sun. The egg tray should be scalded or flamed. The floor of the nursery should be movable, so that it may be taken out and sterilized, and if made of burlap the old piece should be torn off and a new piece mounted on the sterilized frame. The same precautions should be used with the brooders. The soil to which the chicks have access should be well covered with lime, dug up, and exposed to the drying effects of sun and air. With all the foregoing precautions, absolute freedom from the disease can not be guaranteed without further experimentation. At least one German investigator

has found the coccidia in the white of the egg and in the shell, which had gathered them up in the passage of the egg through the cloaca.

If natural incubation is practiced, the hen for a week or two before being set should be treated with one-quarter to one-half grain doses of sulphate of iron daily, with occasionally an active purgative, such as calomel, 1 grain, or castor oil, one-half teaspoonful containing 5 to 10 drops of turpentine. The eggs, cleansed as directed above, should be placed in a perfectly fresh nest, which may be sprinkled from time to time with a little lime. After hatching, the hen with her chicks should be placed upon ground that has been thoroughly sterilized, as described above, and at least every few days moved to fresh ground which has been treated in the same way and from which all chickens have been debarred.

The foregoing brief notice of this great drawback to chicken raising, well denominated by Eckhardt "coccidiosis intestinalis internationalis," must now be followed with a brief survey of the same affection as it occurs in other classes of poultry and in other species of birds.

INTESTINAL COCCIDIOSIS OF ADULT CHICKENS.

This disease has been diagnosed by the writer in several flocks. It is characterized clinically by dullness, sleepiness, weakness, diarrhea, emaciation in spite of a frequently good appetite and a plentiful supply of good food, finally exhaustion and death. Bacteriologic investigation is either negative or results in the cultivation from heart blood and viscera of such intestinal inhabitants as *Bacterium ærogenes*, *B. sanguinarium*, *Bacillus pyosceaneus*, *B. coli* and *B. proteus;* cases with apparently identical lesions giving different organisms. Failure to examine the intestinal or cecal contents microscopically results in a false diagnosis. The cases bacteriologically negative are diagnosed—and reasonably so—by the intestinal catarrh and often thickened intestinal walls as chronic indigestion. A change of food is ordered and the disease persists, or, perhaps, sometimes improves temporarily. The false impression thus produced obtains until a relapse occurs, other birds sicken, worms are suspected, and microscopic examination of the feces of sick birds or of the intestinal contents of dead birds reveals the cause in the presence in large numbers of *Coccidium tenellum*. Administration of a brisk purgative followed by 10 grains of sulphate of iron (copperas) to the gallon of drinking water, together with thorough disinfection of all runs, results in marked improvement.

During the progress of the above chronic form there will frequently occur exacerbations of the disease in the form of sudden deaths simulating the fulminant form of chicken cholera. In these cases there will be no emaciation and often no preliminary symptoms.

The poultryman tells you that his birds went to roost apparently in perfect health and in the morning he found three, five, or a dozen on the ground dead. Microscopical examination of the cecal contents reveals the permanent cysts, and histologic sections of the walls reveal the infected epithelial cells; sometimes these may be detected in the smears from the intestinal contents.

In connection with this subject the writer wishes to state that every case of "limberneck," and every case of "leg weakness," and many of the cases popularly denominated "going light" that have come to hand for autopsy in this laboratory during the past fifteen months have shown the existence of a strong invasion of *Coccidium tenellum*.

INTESTINAL COCCIDIOSIS OF DUCKS.

This has been demonstrated in all cases of so-called "leg weakness" in ducklings. "Weak germs," "inbreeding," "too early mating of young stock," etc., our too common refuge when confronted with otherwise unaccountable fatalities among young stock, may play their part in furnishing weak constitutions, but the immediate cause in a large number of these fatalities will be quickly recognized as coccidiosis upon microscopical examination.

INTESTINAL COCCIDIOSIS OF TURKEYS.

Affecting mostly the young poults, it is, like the same affection in chicks, largely a disease of the ceca, or blind guts. Quite frequently, too, the liver is much enlarged and studded with necrotic areas. The ceca are sometimes enormously distended with a yellowish, pasty necrotic material. Popularly, but unfortunately, known as "blackhead," it was first studied by Theobald Smith, at that time chief of the Division of Pathology in the Bureau of Animal Industry. Smith named it "infectious entero-hepatitis" and ascribed its origin to a protozoan parasite discovered by him and which he named *Ameba meleagridis*. Lucet, in 1896, studied the same disease, calling it infectious perityphlo-hepatitis, in view of the intestinal lesions being limited to the ceca. He found the body described by Smith, but was inclined to consider it a degenerated tissue structure. However, Lucet furnished no clew to another cause.

Since finding *Coccidium tenellum* constantly present in smears and scrapings from cecal contents of diseased turkeys and also in the histologic preparations preserved in this laboratory, the writer has hunted through the literature and finds that Doflein and von Prowazek (1903), Neumann-Macqueen (1905), and Kaestner (1906), had called in question the specific nature of *Ameba meleagridis* Smith, and had expressed the opinion that the disease is a coccidiosis. Work is

in progress in this laboratory with the object of showing whether the immense mass of necrotic material evolved in this disease is the result of the coccidium alone or depends upon the presence of another associated necrosis-producing organism.

Treatment of this disease has been successful by the administration of half-grain doses of sulphate of iron in pill form every morning and 2 to 3 grain doses of salycilate of soda every evening to poults that had been exposed to the disease or that had shown the dullness, weakness, and watery fecal discharges so characteristic of the onset of the disease. This treatment was practiced in the midst of infected flocks. It has several times been observed by poultrymen and experimentally demonstrated by Curtice that attempts to raise poults on ground used by chickens results in the development of "blackhead" among the young turkeys.

Intestinal coccidiosis of peafowl has been in several instances demonstrated in this laboratory to be identical with the above.

INTESTINAL COCCIDIOSIS OF PIGEONS.

This disease has proven itself in the writer's experience a veritable pigeon plague in and around Washington, D. C. The disease exhibits the same clinical phenomena as that of chickens. It may with murderous effect wipe out a large loft in the short space of a few days, or it may worry the owner by steady unaccountable losses. It may exercise an almost absolute veto power on squab raising. There have been received at this office during the past year what may be termed chronic, acute, and peracute cases. The chronic form, as in chickens, is to all appearances a case of intestinal catarrh or dyspepsia. The acute cases, succeeding one another rapidly, give the impression of an active epizootic of bacterial origin. The peracute, as stated above, simulate in a most striking manner the fulminating cases of hemorrhagic septicemia or pigeon cholera.

At post-mortem examination we find subcutaneous hemorrhages often quite marked in the cervical region, all organs congested and the intestines distended with either gas or catarrhal exudate. The writer has never seen any intestinal necrosis similar to that which obtains in the ceca of turkeys and chicks affected with this disease. The difficulty attending squab raising in the presence of this plague was well illustrated recently. The owner of several lofts brought in some squabs from an infected loft and stated that the record for this last lot of squabs was eighteen raised against twenty-six dead.

Intestinal coccidiosis has also been diagnosed in this laboratory in wild ducks, swans, pheasants, quail, finches, and canaries. In all these the clinical phenomena were those of marasmus, exhaustion, and death.

CONCLUSION.

Although the name *Coccidium tenellum* has been used throughout this article it must be understood that its use has been only tentative and without prejudice to any other name that priority may justify or to any other variety that may be recognized in the course of the investigations now in progress. This name has been generally viewed as including all the forms found in the intestinal disease in birds.

White diarrhea of chicks, although forcing itself upon the breeder's attention as a definite disease, should really be regarded by the farmer and poultryman as but one manifestation of a positive poultry pest. It is the evidence exhibited among the weakest of the flock that coccidiosis has invaded the farm; that the causative agent *Coccidium tenellum* has located itself in the intestines of the adult fowls. He must remember that it lodges on the eggs that leave the cloaca of infected hens; that it infects the droppings; that the roosts, the nests, the floors of the houses and scratching pens, contaminated by these droppings, are all sources of further invasion; that the soil of the runs or even of the farm where the fowls range at liberty is another and subtle source of invasion, holding moisture and warmth of sun for the development of the invading sporozoites within the permanent cysts; that the incubators harbor the parasite, the egg tray being infected by the soiled eggs and the nurseries by the droppings of the infected chicks; that he can no longer hope to be successful in raising turkeys; that if he lets loose his pigeons his chances for squab raising are diminished; that "leg weakness" will sweep away his ducklings; that the intestines thus denuded of their epithelium have become an easy port of entry for the bacterial agents of virulent infections; and, finally, that in spite of the best rules for egg production most scrupulously carried out the almost complete suppression of absorption activities will diminish his egg yield to a minimum. And when he realizes that this organism has to be grown in the laboratory in solutions so strongly antiseptic as to kill all bacteria, the poultryman is forced to appreciate that it is no mean foe with which he has to battle.

Approved:

JAMES WILSON,
Secretary of Agriculture.

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