

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE  
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# Tuberculosis of Poultry

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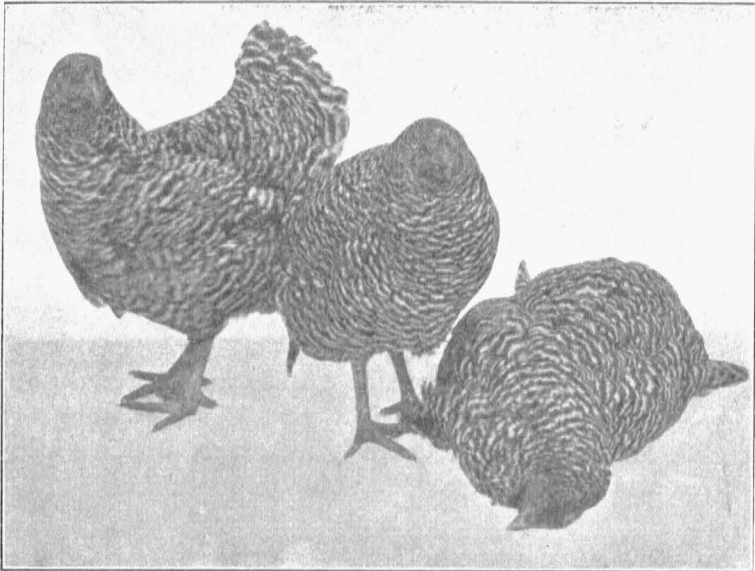


Fig. 1.—A group of birds affected with tuberculosis. Notice the shrunken condition of the comb and the droopy appearance of the live birds. All of these birds showed generalized lesions of tuberculosis on postmortem examination.

COLUMBIA, MISSOURI

## SUMMARY

1. Tuberculosis is of frequent occurrence in Missouri poultry flocks, and is most prevalent in the northern part of the state.
2. Hogs are susceptible and readily contract the disease from affected chickens.
3. Eggs from tuberculous flocks are so seldom infected that they are not a source of danger.
4. Birds over one year of age are most commonly affected with the disease.
5. In affected flocks the birds die at irregular intervals. There is never a great mortality within a short period of time as in most of the acute infectious diseases.
6. In old birds the symptoms of the disease may be one or more of the following: emaciation, chronic diarrhea, lameness, weakness, and ruffling of feathers.
7. Pigeons are commonly affected and may be dangerous spreaders of the disease.
8. Definite blood changes may occur in young birds artificially infected with tuberculosis.
9. The liver, spleen, and intestines, in the order given, are the organs of chickens that most commonly show changes.
10. There is no cure for tuberculosis. Eradication and prevention are the only successful measures.
11. Tuberculin testing of chickens is recommended when valuable breeding stock is involved.

## ACKNOWLEDGMENTS

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# Tuberculosis of Poultry

A. J. DURANT

Fowl or avian tuberculosis has been known for years. It is of common occurrence, and wherever birds are found this disease will also be found. Pernot,<sup>1\*</sup> in 1900, was the first in this country to detect it by bacteriological examination, though it has been reported previously. Since then the relation of avian tuberculosis to other forms of the disease in animals and man has been definitely established by a long series of careful investigations.

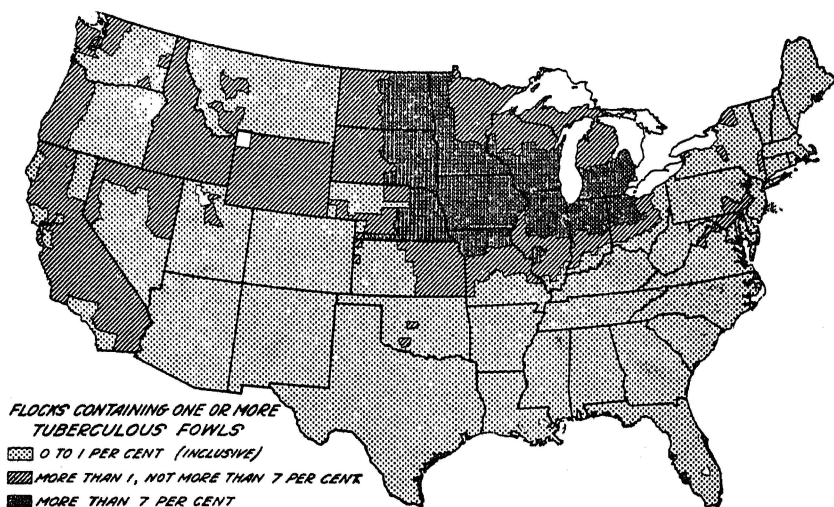


Fig. 2.—Extent of avian tuberculosis in the United States, based on a survey made in 1928 by the Bureau of Animal Industry, U. S. Department of Agriculture.

The map showing the extent of avian tuberculosis in the United States (Fig. 2) indicates that the disease is more common in the northern half of the country, and that it is much more prevalent in the northern tier of counties of Missouri than further south, though it exists in practically all parts of the state. The greater frequency of the disease in the northern half of the state may be partly accounted for by the fact that the larger number of fowls are raised in this section.

## CAUSE

This disease is caused by an organism known as *Bacillus tuberculosis* (*Mycobacterium avium*). The germ is found in infected birds or

\*Superscript numerals refer to "References," Page 22.

hogs, in soils, and in grounds where infected poultry have been running. The disease is usually contracted by birds and animals picking up the germs with their feed. All birds are susceptible to this disease, especially when confined.

The avian or fowl type of tuberculosis does not naturally occur in humans, nor in domestic animals other than the hog, and occasionally sheep.<sup>2</sup> Hogs readily contract the disease by feeding on the dead tuberculosis carcasses of birds or by taking up the infection with their food from infected grounds. It is also reasonable to assume that the organism may be spread from hog to hog in case the disease exists in a herd.

Van Es<sup>3</sup> and Martin of the Nebraska Experiment Station conducted extensive investigations which showed conclusively that approximately three-fourths of the total number of hogs infected with tuberculosis were suffering from the poultry type of the disease instead of the cattle type. These workers made surveys of 16 farms from which tuberculous hogs originated. When the swine were tested in the field they gave positive reactions to avian more consistently than to bovine tuberculin. These observations were confirmed by laboratory examination. The avian type of bacillus only could be detected in the swine of 15 farms. On the 16th farm the swine were infected with the bovine type. This emphasizes the importance of including hogs in any plan for the eradication of avian tuberculosis.

### **EXPERIMENTS SHOW THAT HOGS ARE READILY INFECTED WITH FOWL TUBERCULOSIS**

The susceptibility of swine to avian tuberculosis was confirmed by the author and associates in 1924. The experiment consisted in securing six shoats, weighing 60 pounds each, from a tuberculosis-free herd. They were tested for tuberculosis by the intradermal test and all gave a negative reaction at the beginning of the experiment. Three of the hogs were put in a pen with a concrete floor which had been thoroughly washed and sterilized with a strong disinfectant. The other three, which were used as controls, were put in a similar pen which also had been sterilized. One of the groups of three pigs was fed, over a period of two months, varying amounts of infection from livers, intestines, and other infected organs, and in some cases infected carcasses of birds dead of tuberculosis.

At the end of the period both groups were tested for tuberculosis. All three of the group which was fed the infection gave a strong positive reaction to the test for tuberculosis. Two of the three hogs showed positive lesions or changes due to tuberculosis on postmortem examination. No lesions or changes due to tuberculosis were observed in the other, though it is very probable that some were present but were so slight they were not easily detected. All three of the group fed no infection



showed a negative reaction to the test for tuberculosis. They appeared to be perfectly healthy and showed no change indicating tuberculosis on postmortem examination.

This experiment illustrates clearly that if hogs are allowed to run with an infected flock of chickens or are fed offal from this flock they are almost certain to develop the disease themselves.

### SEASONAL VARIATIONS OF AVIAN TUBERCULOSIS IN MISSOURI

According to investigations by this department tuberculosis is reported most frequently during the month of April, as is shown by the chart in Fig. 3. It will be noted that during the season of highest egg production tuberculosis occurs most frequently. It is possible that the lowered resistance brought on by high egg production may explain to some extent the reason for the high incidence of the disease at that period.

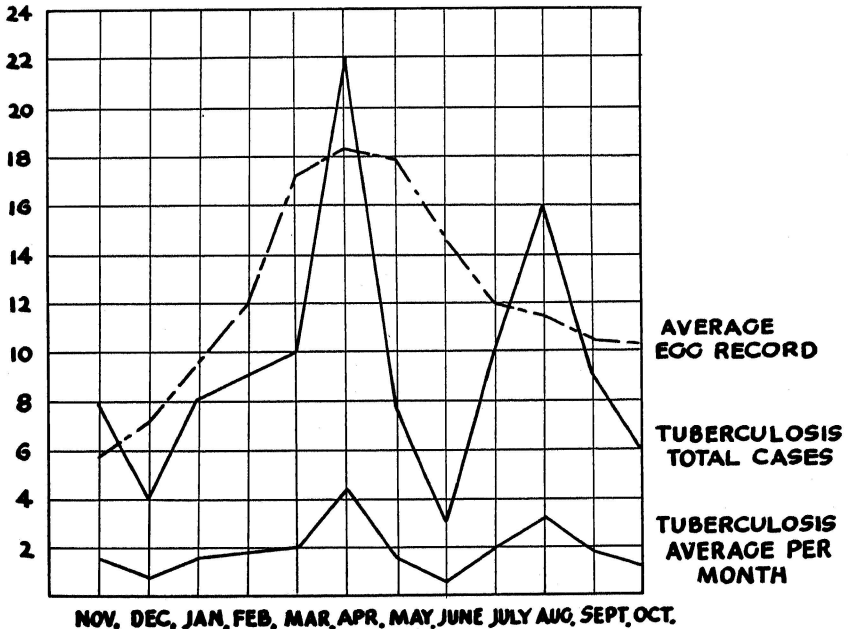


Fig. 3.—The seasonal variation of tuberculosis of fowls in Missouri, and its possible relation to egg production and culling. It will be noted that April was the month that the disease was most frequently reported.

## NO DANGER OF TUBERCULOSIS FROM EGGS

The question is often asked, may tuberculosis be transmitted by eggs from a tuberculous flock? The answer is, there is practically no danger. It is very rare that the germs are actually present in the eggs laid by a hen affected with tuberculosis. If this should occur most of the embryos would die in the shell or would die soon after hatching. Fitch, Lubbehusen and Dikmans,<sup>4</sup> and Fitch and Lubbehusen,<sup>5</sup> at the Minnesota Experiment Station, have carried out some excellent work on the transmission of tuberculosis in naturally infected eggs. Their conclusions are: "As a result of this study and that previously reported, we must view the danger of the transmission of tuberculosis through naturally infected eggs as of little consequence."

## OLD BIRDS MOST COMMONLY AFFECTED

Tuberculosis of fowls (Fig. 1.) usually affects the older birds. It has been shown, where postmortem inspection is practiced, that about 20 pounds out of every 100 pounds of fowls that are killed and dressed in packing plants, are condemned for tuberculosis, while in young birds, less than one year old, only about one pound out of every 100 pounds is condemned.

"A tuberculin test<sup>6</sup> was run on 31 flocks of chickens containing a total of 6,985 head, including both young and old. Of the 31 flocks, 29 were found to be affected. Of the total number of mature chickens tested, 31 per cent were found to be infected. In the same test only 3/10 of 1 per cent of the spring chickens showed infection. This test is further proof that the young chickens will contract tuberculosis, also that the extent of infection found in young chickens is so small that it may be disregarded when compared with that found in mature birds."

More than 300 tuberculous birds have been autopsied in Missouri by the author, and only rarely (less than 1 per cent) were they under a year old. It is well to remember this fact in making a diagnosis of the disease.

## TUBERCULOUS BIRDS HAVE POOR APPETITES

Birds affected with tuberculosis seem to have a good appetite and when food is thrown out to them they appear to eat heartily, but what really happens is they eat practically nothing. They will peck at the food for a few minutes without taking more than a few grains and then leave. Farmers often report that the birds have a good appetite, when as a matter of fact they have very little, as an examination of the crop will reveal.

### **AFFECTED BIRDS USUALLY DIE SLOWLY**

The disease is usually of a slow, chronic nature and the history of an infected flock is that one or two birds die at irregular intervals. Perhaps the owner of the flock will lose two or more a week and in other cases two or more a month. While the disease cannot be positively recognized by external symptoms, suspicion of the presence of avian tuberculosis should be aroused if any old bird shows steadily increasing emaciation; pallor of wattles, comb, and skin about the head; weakness, lameness, or ruffling of feathers, with some diarrhea. Infected birds gradually become emaciated to a point where they are practically skin and bone. The author knows of no other disease in which there is such extreme emaciation or thinness.

### **FAT HENS SOMETIMES DIE SUDDENLY**

Another form of tuberculosis which is sometimes observed in this state is cases of fat, healthy-looking hens being found dead under the roosts. One poultryman who sent tuberculous birds to this department for examination reported that some of them dropped dead from the roosts, with very little previous indication of disease. Examination showed that they died from rupture and bleeding, or hemorrhage, of the liver—the rupture resulting from enlargement and friability of the organ. These two conditions (enlargement and hemorrhage) were induced by the formation of many tiny tubercles in the liver known as Miliary tuberculosis. This form is not a common one but it does occur occasionally in Missouri. One should be careful in making a diagnosis not to confuse this form with fowl cholera, since the symptoms are similar in both diseases.

Another thing to be remembered in connection with this form of the disease is that the other organs are usually not involved to a sufficient degree to enable one to make a diagnosis.

### **LAMENESS IS OCCASIONALLY OBSERVED**

Lameness, usually in the right leg, is sometimes a symptom and as a rule is not due to enlargement and formation of tubercles in the leg joints as might be supposed, but rather to the enlargement of the liver. The organ becomes enlarged and in an effort to relieve the pain the bird will limp or hold up the right leg. In rare cases in Missouri a disease of the joints of the legs producing typical lameness is observed in chickens.

### **AVIAN TUBERCULOSIS OF PIGEONS**

Apparently the natural course of tuberculosis in pigeons is not as severe as it is in chickens and the effect on the general health of the bird is less pronounced. They may live for long periods of time and usually do not show the severe emaciation that is observed in chickens.

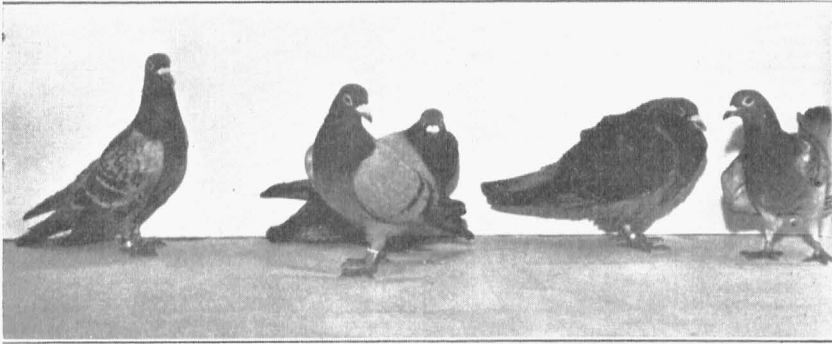


Fig. 4.—A group of adult pigeons affected with avian tuberculosis. Four of the birds reacted to the intradermal test with avian tuberculin. The second bird from the right which is showing physical signs of the disease—ruffled feathers, droopy and unhealthful appearance—did not react. The bird on extreme right shows an enlarged right wing joint, due to tuberculosis.

TABLE 1.—AUTOPSY OF 42 PIGEONS INFECTED WITH TUBERCULOSIS SHOWING THE DISTRIBUTION AND PER CENT OF MACROSCOPIC LESIONS IN THE BODY. IN ADDITION THE PER CENT OF LESIONS IN ALL BIRDS (42) AUTOPSIED ARE INDICATED IN THE COLUMN ON THE RIGHT

	Incidence of Lesions in Body	Per cent figured according to the	
		Frequency of Lesions	Number of Birds (42)
Liver.....	25	35.71	59.52
Lung.....	25	35.71	59.52
Wing Joint.....	6	8.57	14.28
Mesentery.....	3	4.28	7.14
Intestine.....	2	2.85	4.76
Sub. Cutaneous.....	2	2.85	4.76
Foot Joint.....	2	2.85	4.76
Gizzard.....	1	1.42	2.38
Oviduct.....	1	1.42	2.38
Spleen.....	1	1.42	2.38
Testicle.....	1	1.42	2.38
Pancreas.....	1	1.42	2.38
Total.....	70	99.92	

Evidence that tuberculosis may affect the joints of pigeons was obtained in observations made by the author and associate on an outbreak of tuberculosis in a flock of 118 pigeons (Figs. 4, 5, and 10). Table 1, however, shows that pigeons are affected in other organs of the body more frequently than in the joints. The assumption that the joint infection is common in pigeons is probably due to the fact that it is easily observed.

A study of Table 1 will show that the lesions confine themselves in pigeons chiefly to the liver, lungs, joints and less frequently in other organs. Only 2 out of 42 cases are recorded in which the intestines were involved, and only one case involving the spleen, which is entirely the contrary found in chickens. Of all pigeons autopsied only 4.76 per cent of lesions were found in the intestinal tract, whereas in chickens and

turkeys 75 and 45.65 per cent respectively occurred in this organ. A possible explanation of this difference may be found in their anatomical structures. Pigeons have only non-functioning rudimentary ceca compared to the rather large extensive ceca of chickens and turkeys.

It might be possible to prove experimentally that the difference in anatomical structure is responsible by comparing abligated<sup>7</sup> chickens with pigeons and suitable controls.

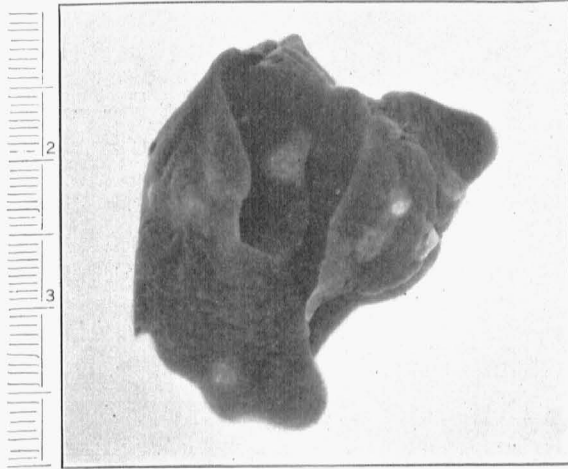


Fig. 5.—Al liver from one of the pigeons showed in Figure 4. Note the large tubercles distributed throughout this organ. These tubercles are not as distinct in the liver of a pigeon, and cannot be easily removed as is the case in chickens.

Another point of interest in connection with the observations on pigeons, which may have an important bearing on the future control of avian tuberculosis on the area plan is that pigeons commonly have open lesions and are active distributors of virulent tubercle organisms. This is well illustrated in the group of 42 pigeons which were autopsied. Seven of the 42 birds showed joint infection in varying degrees and two of the seven had open lesions (Fig. 7). A microscopic examination of the dried necrotic material which was being thrown off continually from the open lesions showed numerous virulent tubercle bacilli. Such lesions as are shown in Fig. 7 (right) are a particularly dangerous source of infection, especially when the bird is in flight. The tendency of pigeons to travel in wide areas uncontrolled would result in wide dissemination of avian tuberculosis.

TABLE 2.—BLOOD STUDIES OF TUBERCULOSIS IN CHICKENS. COLUMN ONE SHOWS THE BLOOD PICTURE OF THE INFECTED HEN, THE SOURCE OF THE INFECTIVE BLOOD, FOR BIRD NUMBER 3286. THE LAST COLUMN SHOWS THE AVERAGE OF FIVE NORMAL CHICKS. THE MIDDLE COLUMNS SHOW THE BLOOD PICTURE OF 3286 WHICH DIED OF TUBERCULOSIS.

Poultry Pathology TUBERCULOSIS											Date inoculated November 13, 1934
Recipient No. 3286 Br. Rock 47 Days Old											5 chicks
Received 1 c.c. of blood intravenously											
Donor Auxvasse W. Rock Hen Infected with tuberculosis											5,000 cell Average
Each count comprises 1000 cells											
Date	1934 11/13	1934 11/28	1934 12/10	1935 2/7	1935 2/15	1935 3/2	1935 3/9	1935 3/18	1935 3/26	1935 4/4	Br. Rocks Normal 62% 974.50
Breed.....	W. Rock	Br. Rock									
Bird.....	Donor	3286									
Haemoglobin.....	22%	88%	83%	60%	54%	44%	39%	42%	40%	40%	
R. B. C. Normal.....	930	982	962	935	933	933	912	902	891	871	
Poikilocyte.....	1				3	5		2	5	7	
Polychromatophilia.....											
(a) Primitive.....	17	2	1				9	3	26	21	
(b) Degenerative.....	5	1									
Anisocytosis.....											
(a) Microcyte.....						1	1	1		1	
White Cells.....											9.00
Lymphocyte.....	9	8	10	8	15	24	19	24	21	13	
Polymorphonuclear.....											
(a) Eosinophils.....											
(1) Rods.....	5	1	5	26	32	26	31	42	44	57	1.75
(2) Granules.....	7			1			3			1	
(b) Basophils.....				1	2		2	1	1		
Endothelial leucocyte.....							1	1			
Transitionals.....			1	3	1		4	1	1		
Mitosis.....	1				1				1	1	
Myceloblast.....										10	
Unclassified.....											
Mononuclears.....					4	1	1				
Polymorphonuclears.....	9										
Platelets.....	16	6	21	16	9	7	16	21	10	15	14.00
Basket cells.....						3	1	2		3	.75

**CHANGES FOUND IN TUBERCULOUS BIRDS**

If tuberculosis is suspected, a postmortem examination of one or more of the emaciated birds should be made. Birds affected with tuberculosis will usually be very thin and the breast muscle in many cases shrunk until there is very little of the flesh remaining. This, however, is not always true, since in acute tuberculosis the birds will sometimes be in fairly good flesh.

**BLOOD CHANGES DUE TO TUBERCULOSIS IN YOUNG BIRDS**

During the course of some studies on leucosis of fowls, observations were made on the blood changes incident to fowl tuberculosis. Tables 2 and 3 illustrate very clearly that there may be definite changes in the blood of young growing chicks when affected with this disease. These observations have probably never been reported under the same conditions and it seemed of sufficient importance to include the entire blood picture of one of the group of birds whose blood was studied.

The particular thing of interest in connection with the changes observed in Bird No. 3286 is the variation in two particular cell types, lymphocytes and polymorphonuclear eosinophils. It will be observed that the lymphocytes increase up to a certain stage in the disease, after which there is a definite decrease near termination. The cell count in this case ran from a low of 8 in a thousand to a maximum of 24, then it declined to 13 at death.

A most striking change in the blood picture is the great increase in polymorphonuclear eosinophils with rods which increase from 1 per thousand to 57.

There was a marked decrease in the haemoglobin content of the blood, from 88 to 39 per cent (Dare Haemoglobinometer).

TABLE 3.—A DIFFERENTIAL COUNT OF BIRD NO. 3286 AND THE AVERAGE OF FIVE NORMAL CHICKS THE SAME AGE. THE INCREASE IN POLYMORPHONUCLEAR EOSINOPHILS WITH RODS IS ENORMOUS WHEN COMPARED TO THE SAME CELL OF THE NORMAL GROUP

Poultry Pathology TUBERCULOSIS Differential count				
Bird Number 3286	Date April 4, 1935		Average of 5 Normal Chicks Same Age	
Count.....	Total	%	Total	%
Primitive red cells.....	52	17.33		
Polymorphonuclear				
(a) Eosinophils				
(1) Rods.....	172	57.33	55	18.33
(2) Granules.....	1	.33	2	.66
(b) Basophils.....			3	1.00
Lymphocytes.....	36	12.00	232	77.33
Myeloblasts.....	37	12.33		
Myelocytes, Basophilic.....	2	.66		
Endothelial Leucocytes.....			5	1.66
Transitionals.....			3	1.00

Another point of interest is found in the differential count. Fifty-two or 17.33 per cent of the total cells were primitive red cells, whereas none was found in the normal average of 5 chicks shown on the right.

It would seem that the count of lymphocytes in the normal average of 5 chicks in this case is high, 232 or 77.33 per cent. This, however, was the average count on the five healthy chicks used as controls and grown in confinement under the same conditions as chick 3286 of the experimental group.

### POSTMORTEM EXAMINATION

When a bird is opened for examination it may show changes due to the disease in many parts of the body and at times in practically all of

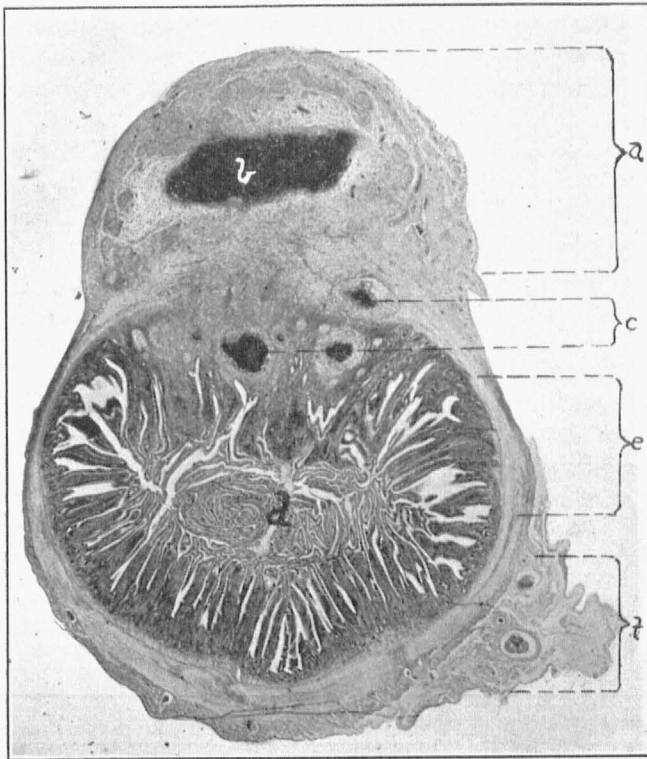


Fig. 6.—A photo-micrograph of a cross section of the intestine of a fowl affected with tuberculosis.

- a. The section was made through the center of a large tubercle occurring on the outer surface. Note the large necrotic center at (b) surrounded by dense fibrous tissue.
- c. Other smaller tubercles showing invasion of wall and adjacent mucosa partly destroyed.
- d. Center of intestine.
- e. (Within bracket) normal intestine.
- f. (Within bracket) fragment of mesenteric attachment with blood vessels.



the organs. Infection is indicated by the formation of little nodules or tubercles, hence the name tuberculosis, coming from the word tuber. The tubercles are grayish-white or yellowish in color and when cut into are tough and putty-like in consistency, with usually a dark brownish center. The tubercles in chickens never become calcified or "gritty" as in the bovine type of the disease.

#### LIVER MOST FREQUENTLY AFFECTED

The liver is the part of the bird most frequently affected. This organ is often considerably enlarged and studded with tubercles a quarter of an inch in diameter. The most characteristic thing about these tubercles is that they can be easily lifted out of the liver cells surrounding them. This condition does not occur in other diseases, which is helpful in differentiating them from tuberculosis. It is not unusual for some of these nodules or tubercles to be raised above the surface of the liver and they are usually found throughout the organ. There is a great variety in the size and kind of tubercles that may be found, but if nodules such as have been described are also found in the spleen and on the intestines, the diagnosis of avian tuberculosis can be regarded as even more certain.

#### SOME BIRDS DO NOT SHOW VISIBLE CHANGES IN THE LIVER

Sometimes chickens will be affected with tuberculosis and not show any tubercles in the liver, though stained smears from these organs,

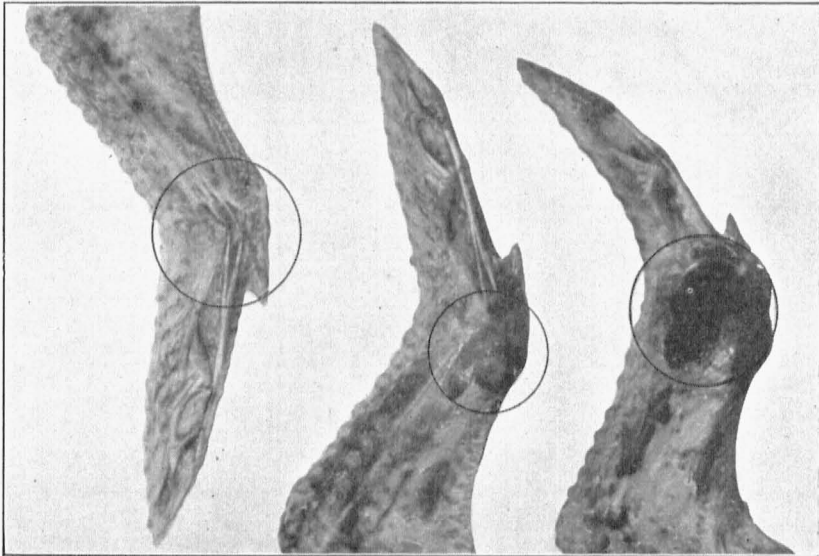


Fig. 7.—Three pigeon wings: left, healthy wing; center, tuberculosis of the joint; and right a tuberculous open lesion of the joint, a dangerous carrier of the disease.

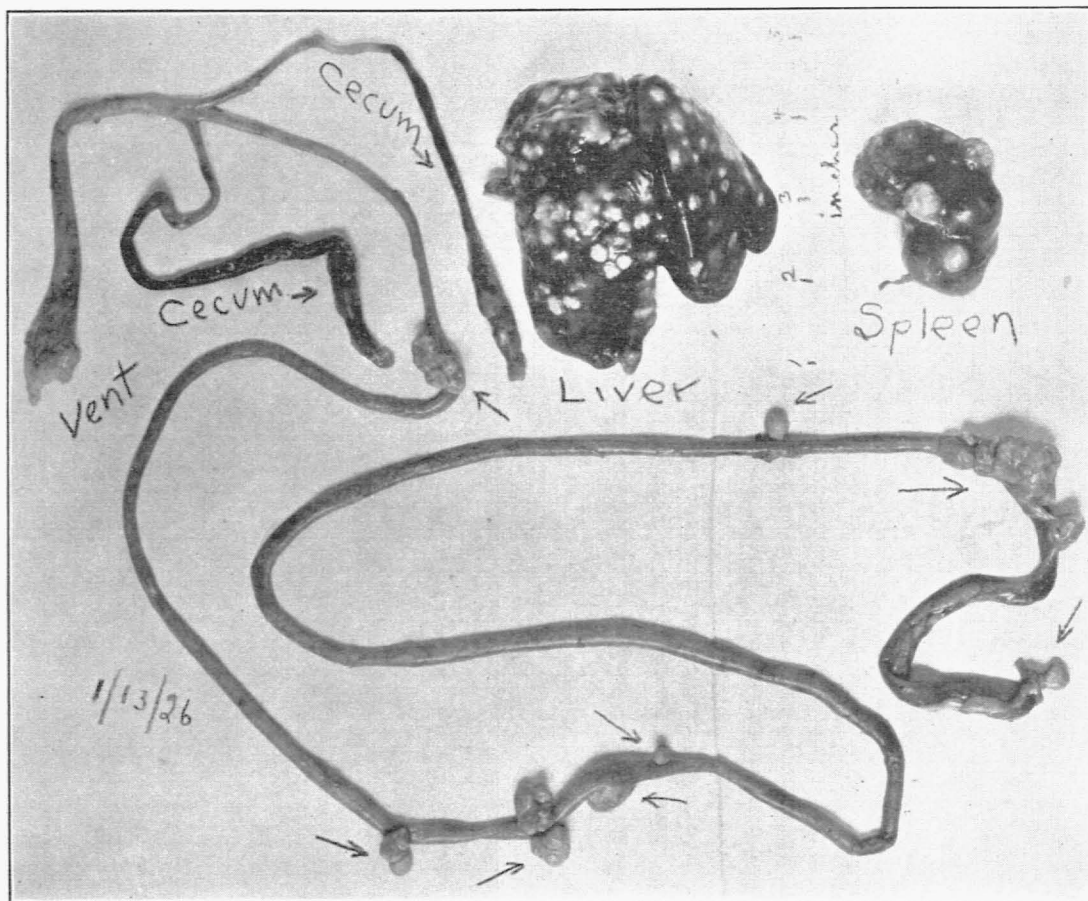


Fig. 8.—Organs most commonly affected with tuberculosis. The scale in inches between the spleen and liver indicates how greatly these organs may be enlarged from tuberculous infection. A normal spleen is approximately one-fourth of an inch in diameter. The arrows indicate tubercles along the intestinal tract. A bird with intestinal tuberculosis of this nature is a dangerous spreader of the disease.

when examined with a microscope, will show tuberculosis organisms in large numbers. This form is referred to as the "Yersin" type of tuberculosis, and is rarely encountered in Missouri. It can be diagnosed only by the use of a microscope.

The next organ of the body most frequently affected with tuberculosis is the spleen. This is located against the true stomach or proventriculus just in front of the gizzard. It is about a quarter of an inch in diameter and is dark red in color under normal conditions. When affected with tuberculosis it varies in size from about normal to four or five times its natural dimensions (Fig. 8). The enlargement is usually brought about by the formation of numbers of tubercles. The formation, size and arrangement of the tubercles in the spleen are similar to those of the liver, but they are not easily separated from the surrounding cells.

In order of frequency of attack in chickens, the intestinal tract, with an incidence of 75% (Bushnell)<sup>9</sup> is next to the spleen. In turkeys, according to Hinshaw,<sup>9</sup> lesions of the intestinal tract are 45.65 per cent of the total. In pigeons, as was shown in Table 1, only 4.76 per cent of the birds had lesions in this organ.

The most characteristic changes in this organ are the formation of tubercles or "knots" on the outside of the tract. These enlargements vary in size from the smallest visible lesions to large tubercles the size of one's thumb. In some cases they are attached to the intestines by a small neck, or pedunculated (Fig. 8). Not infrequently one may observe the tubercles on the outer surface of the gizzard.

#### GERMS ELIMINATED IN LARGE NUMBERS FROM THE DIGESTIVE TRACT

Birds with affected intestines eliminate germs through the droppings to the ground, and contaminate the soil. This is due chiefly to the fact that tubercles formed along the intestinal tract (Fig. 8) are often connected with the inner surface by a very small lumen or opening and the tuberculosis organisms are thus eliminated in large numbers into the digestive tract. Chickens which are found with lesions of this nature are in an advanced stage of the disease.

The other organs of the body are less frequently affected, but lesions of tuberculosis may be found in the lungs, kidneys, ovaries, oviduct, and, as has been mentioned, in the bones, skin, and joints. Of these organs the lungs are most frequently affected. If these lesions are typical they may be sufficient for a diagnosis but it is sometimes necessary to demonstrate the organism microscopically by means of stained smears. These may be taken from the suspected disease areas or tubercles, or from the liver of chickens which are affected with the "Yersin" type.

## CONTROL AND ERADICATION

There is no cure for this disease so it is best after tuberculosis has been definitely discovered on a farm to take immediate steps for its control and eradication. There are several procedures that are successful in the control of this disease and it will depend upon the individual case as to just which one should be followed.

The *first plan* is to dispose of the entire flock for meat purposes, that is all the birds that are fat and healthy. Sick birds should be killed and burned or deeply buried, and no new stock introduced on the farm for a year or more. In introducing new stock the best method is to purchase baby chicks from farms where the disease has never occurred. Raise the chicks in a house that has been cleaned and thoroughly sprayed with compound cresol (a teacupful or  $5\frac{1}{2}$  ounces to each gallon of water). Move the brooder house to ground on which adult birds have not ranged and on which their droppings or litter have not been spread. When the pullets have reached maturity they may be introduced with comparative safety into the permanent laying houses and yards.

The *second plan* is to dispose of all old fowls over two years old and keep only young, vigorous stock. Hatching should be early in the spring so that the young stock will be mature by cold weather. Since young birds are not affected to any extent by tuberculosis, an effective measure of control is to keep only young stock. It is seldom that one sees a bird under one year of age that is affected with tuberculosis, so the practice of disposing of all birds after they have finished their second laying season is an effective method of control. The infected birds are automatically culled from the flock. In serious cases, it is best to dispose of all birds after they have finished their first laying season.

The *third plan* is one in which valuable birds are involved and it is desired to perpetuate certain strains of fowls. In these cases all fowls should be given the tuberculin test and all reactors removed and a careful sanitary program carried out.

In any plan for the control of avian tuberculosis on the farm it is necessary to take into consideration the fact that hogs are susceptible and develop the avian form of the disease. All hogs which have been exposed to infected fowls should be tuberculin tested with avian tuberculin and those which are found infected slaughtered subject to inspection. All healthy hogs should be removed from the infected grounds to clean grounds.

## TUBERCULIN TESTING

In valuable flocks, in which it is desired to preserve certain strains or breeds of chickens in which tuberculosis occurs, it is possible to discover and remove from the flock birds that are affected with this disease

but do not yet show visible indications of the disease. The selection of recently infected birds can be accomplished by what is known as the tuberculin test, and is similar to the one which is used on cattle for the detection of bovine tuberculosis. The use of this test, however, is only practical in valuable flocks, since the expense of running the test, which must be done by a qualified veterinarian, is too expensive, as a rule, for practical purposes.

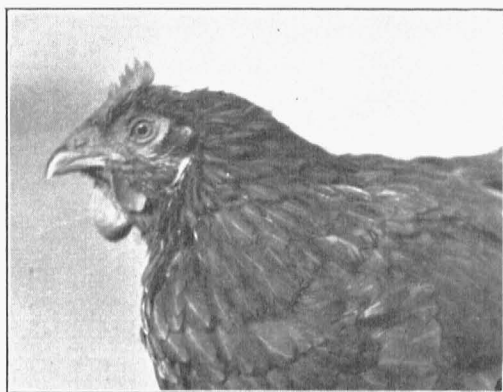


Fig. 9.—A positive tuberculin test. Note the swollen right wattle as a result of the tuberculin injection.

The test is made by injecting the tuberculin or test fluid into one wattle of a bird. The injection is made with a very fine needle and the tuberculin is injected in the skin of the wattle. The bird is inspected 48-72 hours later. If it is tuberculous or has the disease it will be indicated by a swelling of the injected wattle (Fig. 9). If the bird is healthy no swelling will occur. It is claimed by some authorities that the tuberculin test in poultry is as reliable as is the test for the disease in cattle.

#### TURKEYS SHOULD BE TUBERCULIN TESTED

Since individual turkeys are of much greater value than chickens, it is entirely practical to test these birds for tuberculosis. When there is indication of the disease in a flock they should all be carefully tested by a qualified veterinarian. All birds that react to the test should be slaughtered, subject to inspection, since many reacting turkeys will pass for food. The author has had considerable experience in testing turkeys for fowl tuberculosis and has successfully controlled the disease in flocks by this means.

The most reliable and convenient location for injecting tuberculin in the turkey is in the skin of the edge of the wing web.<sup>9</sup> This procedure

necessitates pulling a few feathers before injecting the tuberculin. The injection is made between the layers of the skin and enough tuberculin should be used to cause a swelling 3-5 millimeters in diameter. The birds should be examined at the end of 48-72 hours for evidence of a reaction to the test. An infected bird is indicated by a swelling which occurs at the point of injection. This swelling varies from a slight puffiness to a large swelling. Any swelling at the point of injection should be regarded as suspicious, regardless of how small. The reaction will remain for 72 hours from the time of injection and is a fairly sure indication of tuberculous infection. If the bird is healthy it will be with difficulty that the point of injection can be located, since all signs of injection will have disappeared at the end of 48 hours.

A flock of turkeys, where tuberculosis exists, should be tested about three times a year, and after each test all reactors removed. If possible, the healthy birds should be put on clean ground where turkeys or chickens have not been. By this system a flock may be freed of the disease in about a year.

#### TESTING PIGEONS FOR AVIAN TUBERCULOSIS

In the light of our investigations on tuberculosis in pigeons it would appear that with the tuberculins available (avian, bovine, and human) (Table 4) and injected intradermally into the eyelid, the test for tuberculosis in pigeons is unreliable. It is possible that if a tuberculin was produced from a strain of the tuberculosis organism obtained from

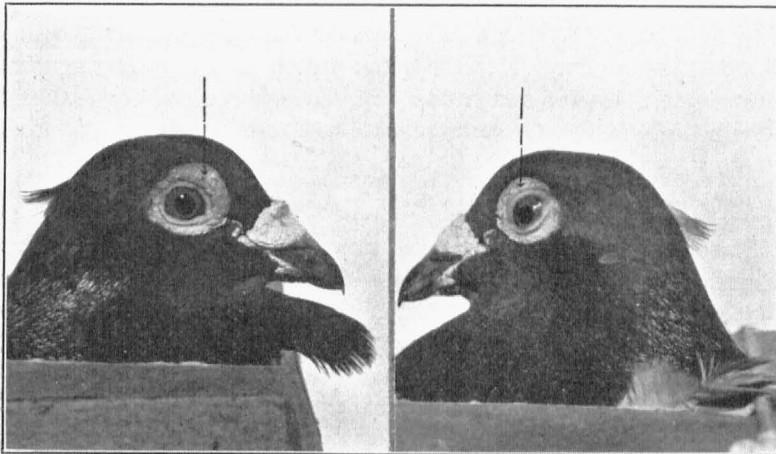


Fig. 10.—Two views of the head of a pigeon illustrating the tuberculin test. Note the swelling in the unfeathered area above the eye on the left. Compare this reaction with the uninjected eye on the right. Postmortem examination of this bird showed tuberculosis of the left lung and the second joint of the left wing.

TABLE 4.—STUDIES OF TUBERCULOSIS IN PIGEONS. THE REACTION OF AVIAN, BOVINE, AND HUMAN TUBERCULIN ON PIGEONS AND THE FINDINGS AT THE AUTOPSY ON THE BIRDS. IT WOULD APPEAR FROM THESE DATA THAT THE TUBERCULIN TEST IS NOT RELIABLE FOR DETECTING THE DISEASE IN A PIGEON

Pigeon Flock No. I			February 1936		
Bird Number	Avian Tuberculin	Bovine Tuberculin	Human Tuberculin	AUTOPSY	
284	—	—	—	—	Nine of the seventeen pigeons of this negative group showed lesions at autopsy.
286	—	—	—	—	
296	—	—	—	—	
297	—	—	—	—	
298	—	—	—	—	
299	—	—	—	—	
A6194	—	—	—	—	
X97182	—	—	—	—	
285	—	—	—	+	
287	—	—	—	+	
291	—	—	—	+	
292	—	—	—	+	
293	—	—	—	+	
294	—	—	—	+	
300	—	—	—	+	
3535	—	—	—	+	
283	+	—	—	—	
V3391	+	—	—	—	
B6506	+	—	—	—	
V3392	+	+	—	—	Ten of the 11 birds in this group showed lesions at autopsy.
276	+	+	—	+	
277	+	+	—	+	
278	+	+	—	+	
279	+	+	—	+	
289	+	+	—	+	
290	+	+	—	+	
V3389	+	+	—	+	
A6191	+	+	—	+	
B6501	+	+	—	+	
B6503	+	+	—	+	
280	+	+	+	—	One of the birds positive to all 3 tuberculins was positive at autopsy.
B6505	+	+	+	+	
33	—	+	—	—	Only 2 of the 8 birds positive to bovine tuberculin showed lesions.
173	—	+	—	—	
223	—	+	—	—	
256	—	+	—	—	
282	—	+	—	—	
V3394	—	+	—	—	
E6063	—	+	—	+	
295	—	—	+	—	One reacted to human tuberculin. No lesions at autopsy.
288	+	—	+	+	Both birds positive to avian and human tuberculin showed lesions at autopsy.
C-7401	+	—	+	+	

pigeons that a test as reliable as that for other fowls could be perfected. There is also the possibility that a different site for the injection of the tuberculin might increase the efficiency of the test. Experiments have shown that the injection of the tuberculin in the wing web<sup>9</sup> of turkeys is superior to other locations. The same may hold true for pigeons.

In our investigations the injection of the tuberculin was made on the outer surface of the upper eyelid in the loose tissues adjacent to the border of the lid. Great care was taken to inject the tuberculin intradermally or between the layers of the skin. An affected bird should show a swelling in 48-72 hours at the site of injection (Fig. 10), while negative birds should show no swelling.

### DISINFECT HOUSES AFTER AN OUTBREAK OF TUBERCULOSIS

Any old buildings that are difficult to disinfect probably should be torn down and the grounds cleaned up where the building stood. In cleaning and disinfecting houses that have been exposed to infection, one should first thoroughly clean the houses by removing all litter and loose material. This should be hauled out to a field where hogs or chickens will not have access to it and then plowed under.

After the houses have been thoroughly swept with a broom, scrub the floors and walls with cold lye water, using one can of lye to 12 gallons of water. When thoroughly dry, follow with a strong solution of another disinfectant, such as cresol. One should be sure that the disinfectant reaches all parts of the house. Compound cresol (liquor cresolis compositus) is the most reliable disinfectant, and it can be depended upon to kill the germs of tuberculosis. It should be used at the rate of a teacupful to each gallon of water or  $5\frac{1}{2}$  ounces to a gallon.

In applying the disinfectant it is very important to thoroughly soak or wet all parts of the building, since for the disinfectant to be efficient it must come in contact with all objects which may be infected with the germs of the disease. If one small spot in the chicken house is missed it may be the means of eventually causing an outbreak of tuberculosis.

### HANDLING INFECTED GROUNDS

If all of the birds on the farm are disposed of, and all hogs which have been running with the chickens are isolated, the farm should be thoroughly cleaned as far as is practical. Since it is recognized that the germs of the disease are distributed in large numbers from infected birds, one would expect to find a farm on which the disease occurs heavily infected. To get rid of these germs is the problem to be considered.

Naturally, it is not practical to disinfect all of the grounds and in most cases it is unnecessary, though it is well to point out that the problem of getting rid of tuberculosis is one which concerns the grounds surrounding the poultry houses. An investigator<sup>10</sup> who has had wide experience with avian tuberculosis has stated that the problem is one of infected grounds rather than of houses, even if the houses are properly cleaned and disinfected. If the area on which the chickens are running



is quite small it is practical to disinfect the grounds, otherwise one must depend on natural agencies for the destruction of all disease-producing germs. The tuberculosis organism is killed in a comparatively short time when exposed to the direct rays of the hot summer sun. The grounds therefore, should be cleaned of all rubbish and litter, and raked and swept clean. The rubbish should be hauled out to a field that will not be occupied by chickens or hogs and utilized for fertilizer. For grounds to become sterilized or free of the tuberculosis organism they should be left vacant for a year or more. In summer the grounds will become free of infection more quickly than during the winter months when there is little sunshine.

After the grounds have been thoroughly cleaned of all rubbish, raked and swept free of all litter, one of two procedures may then be followed. If the ground happens to be bare and exposed to the direct rays of the sun it is probably better not to plow. If this is not the case then one should turn the top soil under with a turning plow and seed the fresh ground heavily with wheat, oats, or rye, preferably wheat. The importance of sanitation for the control of this disease cannot be over-emphasized, and it is well to remember in any outbreak of tuberculosis that it is not a simple matter to get rid of the disease and that one should be very thorough in a clean-up program, otherwise disaster is likely to attend the next attempt to raise chickens on the same farm.

### **THE CONTROL OF TUBERCULOSIS IS A NATIONAL OR INTER-STATE PROBLEM**

A study of the map (Fig. 2) will show that avian tuberculosis is much more prevalent in midwestern and north-central states than in other parts of the United States. This table shows also that the northern third of Missouri is included in this badly infested area and that probably the disease spread from some of the northern states into Missouri. This would indicate that the control of tuberculosis is a national problem.

Another fact that makes the control of this disease more important both as a state and national problem is that hogs are susceptible to the avian form of tuberculosis, and that a large per cent of these animals that are found infected at the time of slaughter have the avian type of the disease. If open lesions in pigeons are as common as indicated by the investigations recorded in this bulletin successful eradication will not be accomplished unless these fowls are also taken into consideration.

If the area eradication plan of the government which is used for the eradication of bovine tuberculosis could be applied in the control of avian tuberculosis, and if regulations relating to inter-state shipment of adult fowls with the necessary quarantine, sanitary, and preventive

measures could be instituted, real progress in the control and eradication of this disease could be made. The Bureau of Animal Industry has already made some progress in Missouri in a study of the prevalence of tuberculosis in some of the counties. This would indicate that the government is already concerning itself with this problem and it is to be hoped that in time a comprehensive program by each state, in cooperation with the national government, will be started. Even if a definite program is instituted for the control of avian tuberculosis it will remain a state and national problem for years to come. The sooner some definite program can be instituted in Missouri the better it will be for our poultry industry.

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