PART 2

Important General Diseases Common to Several Species

Tuberculosis and Its Eradication

BY A. E. WIGHT, ELMER LASH,
H. M. O'REAR, AND A. B. CRAWFORD [1]

PRACTICALLY ALL animals are subject to tuberculosis, particularly cattle, hogs, and poultry. Human beings, especially children, can get it from cow's milk. Here is a careful account of the disease in livestock, including the results of the relentless campaign of eradication that between 1917 and 1942 has reduced the number of tuberculous cattle in the United States from 1 animal in every 20 to less than 1 in 200.

TUBERCULOSIS is one of the oldest of the recognized diseases of man and animals. Examination of Egyptian mummies and of the earliest historical writings furnishes evidence that this disease undoubtedly existed at least from the time men began to live in compact social groups. The ancient Mosaic laws as written in the Talmud classed any animal carcass showing adhesions between the lungs and the pleura as unsatisfactory for edible purposes. Since pleural adhesions often accompany tuberculosis of the lungs, the possibility of transmission of the disease from animal to man may have been recognized at that time.

CAUSE—THE TUBERCLE BACILLUS

In 1882, the eminent German scientist Robert Koch, making use of improved methods of preparing culture media for growing bac-

[1] A. E. Wight is Chief, Elmer Lash is Assistant Chief, and H. M. O'Rear is Senior Veterinarian, Tuberculosis Eradication Division, and A. B. Crawford is Assistant Director of the Animal Disease Station, Bureau of Animal Industry.

teria and staining them so they might be seen clearly under the microscope, definitely proved that a germ could be obtained from a tubercle and grown artificially, that this germ on being inoculated into another animal would reproduce tuberculosis, and that an identical germ could be recovered from tubercles in the inoculated animal. This organism was at first called the Koch bacillus and later the tubercle bacillus. It is now known technically as *Mycobacterium tuberculosis.*

After this extremely important discovery tuberculosis received the attention of research workers throughout the world, and additional facts were disclosed in rapid succession. It was shown that practically every species of animal could be affected and that the disease in each species was very similar in character, always ending in slow wasting of the body tissues. It was at first believed that only one kind of tubercle bacillus was involved in tuberculosis in all species, but later it was shown that the kind found in man could not produce progressive disease in many animals, that the tubercle bacillus in cattle was different from the human type, and still later, that a third type existed in poultry. The three kinds of tubercle bacillus were classed as the human, bovine, and avian (bird) types.

The tubercle bacillus is a rod-shaped organism varying in size from 1½ to 4 microns long, which means that it would take 6,000 to 16,000 laid end to end to measure 1 inch. The bacillus has a waxy capsule which is not readily penetrated by the various stains used in bacteriological studies. Micro-organisms of the genus *Mycobacterium* are acid-fast, which makes them very difficult to stain, but once they are stained the dye cannot be removed by acid treatment as it can from most other germs. Thus, if the micro-organisms in a sample are stained with a red dye and then treated with acid and counterstained with a blue dye the tubercle bacilli will show red, while the other (non-acid-fast) organisms show blue.

The tubercle bacillus grows very slowly on culture media. On the first culture, it may be 1 month and sometimes 2 months before a colony growth can be seen by the unaided eye. Most other organisms show colony growth in 24 to 48 hours.

On a culture medium the three types of tubercle bacilli, human, bovine, and avian, produce colony growths different from one another. The growth of the human type appears thick and wrinkled; that of the bovine type, sparse, rough, and dry; while that of the avian type is heavy, smooth, moist, and glistening.

METHOD OF TRANSMISSION

Tubercle bacilli usually gain entrance into the body by way of the mouth in contaminated food or water, or they may be breathed into the nasal chambers and the back of the mouth and swallowed. Some scientists believe they may also be breathed directly into the lungs. A cow becomes a spreader when the tuberculous excretion from the lungs, reaching the mouth, is washed into the water trough when the cow drinks, subjecting other cattle using the trough to the most dangerous kind of exposure. When the tuberculous sputum is swal-

lowed, the tubercle bacilli in it are passed through the intestines unaltered, and the dung is extremely infectious. Stagnant pools into which cows drop their dung thus offer means by which the disease may be perpetuated and spread, as tubercle bacilli in such pools may remain alive for a year and sometimes longer. Small streams may likewise become contaminated with tubercle bacilli. Around hayracks dung may become mixed with particles of hay. A single feeding of milk from a dam with a tuberculous udder may result in a calf's becoming tuberculous.

PARTS OF THE BODY AFFECTED

Tuberculosis exists in many forms, depending on the part of the body in which the organism lodges or becomes localized. Human beings may have lupus, or tuberculosis of the skin; scrofula, or tuberculosis of the lymph nodes; bone and joint tuberculosis; tuberculosis of the linings of the brain, or tuberculous meningitis; and so on. In animals, however, the organ most commonly affected is the lungs, and it is tuberculosis of the lungs in most species on which the spread of the disease, from man to man or animal to animal, depends. In poultry, the liver and spleen are most commonly affected, and tuberculosis is spread from the birds' droppings. In cows the udder may become infected when the disease is chronic, and tubercle bacilli in large numbers may be given off in the milk.

All organs and sections of the body have specialized glands called lymph nodes which filter out bacteria from the lymph stream and thus hinder the spread of infection to another part of the body. These lymph nodes are often the site of the first localization of tubercle bacilli. The nodes in the throat and neck have the first opportunity to become infected, next the mesenteric nodes, which drain the intestines, and next the lungs and their adjacent lymph nodes. Tubercles in other sections of the body are usually the result of the spread of infection from a primary center, or focus.

FORMATION OF TUBERCLES

When tubercle bacilli lodge in any part of the body, certain blood cells are attracted to the site and attempt to ingest them. Its waxy capsule renders the bacillus very resistant to destruction. Other blood cells congregate around the area and form a protective wall against the spread of the tubercle bacilli. Thus a tubercle, or morbid nodule, is formed. If the wall, or encapsulation, becomes dense on all sides, the tubercle remains stationary and is called an arrested lesion. Calcium salts may be deposited in the tubercle, transforming it into a gritty or calcified lesion. If the lesion is very small, it might even be absorbed. If the tubercle bacilli are not checked, the tubercle enlarges on the outside, developing into what is known as a proliferative, or spreading, lesion. Bacilli may escape from this mass and cause the formation of new tubercles, either adjacent to the old tubercle or remote from it. During the growth of a tubercle in the lungs, a terminal branch of a bronchus, or air channel, may

be surrounded. The poisons secreted by the bacilli tend to soften the inner portions of the tubercle, and they may be expelled into a bronchus, thence to the trachea, and then coughed up. A tubercle thus broken down is known as an exudative type of lesion.

Tubercles vary in number and character in different individuals, according to the resistance offered. After localization of tubercle bacilli in the body, the resultant tubercle may completely disappear in a few weeks or months, or it may cause the fulminative type of the disease, which spreads rapidly and results in death within a few weeks or months. Usually the tubercle remains in the body as a walled-off, or encapsulated, tumor, and it may remain as such for the life of the host. At any time, however, such a tubercle may become active owing to lowered resistance and be a focus for the spread of the disease to other parts of the body.

The time elapsing between exposure to tubercle bacilli and the development of a tubercle is called the period of incubation. The length of this period is quit variable. In the first place, tubercle bacilli multiply very slowly in the animal body, and infection develops only when these germs have multiplied to a certain number in the spot where the tubercle is formed. Depending on various conditions, it may be one to several months before the disease can be detected by the tuberculin test (to be explained later). When tubercle bacilli once gain a foothold, the disease is usually very slowly progressive, and it may be months or even years before the general physical condition becomes noticeably impaired.

SYMPTOMS

Tuberculosis may be suspected when an animal shows a gradual loss of weight and condition. In cattle affected with tuberculosis of the lungs, a chronic cough develops. It is remarkable, however, that cattle that appear to be in prime condition may be grossly tuberculous and spreading the disease.

Poultry may be suspected of being tuberculous when some of the flock show lameness, thinness, especially in the breast muscles, and paleness of combs and wattles.

In swine the disease may not be suspected owing to the fact that the great majority of the animals are marketed during their first or second year of life and that the disease only rarely spreads from hog to hog. It is in older animals that the condition usually becomes apparent by a gradual loss in weight and condition or by enlargement of joints.

SUSCEPTIBILITY OF ANIMALS AND MAN

Some animals are susceptible to infection with one type only of the tubercle bacillus, others may be susceptible to two types, and still others to all three.

Cattle are the chief hosts and likewise the chief disseminators of the bovine tubercle bacillus. Only rarely do they develop lesions

or visible tubercles as a result of exposure to infected poultry or a tuberculous human being.

Horses and mules are very resistant to all three types.

Chickens are susceptible only to the avian tubercle bacillus.

Sheep and goats are commonly reported in the press as being immune, or practically so, to tuberculosis, and the post mortem records of the Bureau of Animal Industry indicate that such reports are substantially correct. A few flocks of goats and, rarely, a sheep or two have been found to be infected with the bovine organism, and sheep that have been in close contact with infected poultry have in a few instances shown lesions caused by the avian organism. As a whole, however, these two species are very resistant to tuberculosis.

Swine may be infected by all three types of the tubercle bacillus. The bovine type causes the severest disease, but in the United States probably nine-tenths of the tuberculous lesions in swine are caused by the avian organism. Lesions in swine caused by the human tubercle bacillus are not of the progressive type and usually remain localized in lymph nodes of the head or intestine. The feeding habits of swine provide for ample exposure to all three types: To the bovine type in cattle-feeding lots, where the swine eat cow dung; to the avian type on farms where there are tuberculous chickens which may soil the ground or where the farmer may throw his dead chickens to the hogs; and to the human type from uncooked garbage or from the sputum of a tuberculous attendant.

Dogs may become infected with human tuberculosis, the usual source of exposure being a tuberculous owner, but they are only slightly susceptible to bovine tuberculosis.

Cats are more susceptible to the bovine tubercle bacillus than to the human type. Tuberculosis in cats is usually a result of their being fed contaminated cow's milk.

Domesticated rabbits are susceptible to both the bovine and avian types of tubercle bacilli but are very resistant to the human type. Guinea pigs, on the the other hand, are susceptible to both bovine and human tubercle bacilli, but not to avian. The rabbit and guinea pig thus are useful to the investigator in determining the type of infection in various tuberculous specimens submitted for examination.

Man is, of course, susceptible to the human type of tubercle bacillus and is slightly so to the bovine, but he is very resistant to the avian type. Human tuberculosis still continues to be one of the leading death-causing diseases, although great strides have been made by public health agencies, medical commissions, and other interested groups in preventing exposure, detecting early cases, and hospitalizing affected persons. The dangerous person is one who has an open lung lesion. A careless individual so affected may spread thousands of tubercle bacilli daily as possible sources of infection to others in expectorating and coughing openly. In coughing, hundreds of tiny droplets, which may contain tubercle bacilli, are expelled, and these may be inhaled by other persons or may fall on food to be eaten. Drinking cups and eating utensils may be sources of exposure unless properly sterilized.

Though man is much more resistant to the bovine tubercle bacillus than to the human, if exposure is sufficiently severe and often enough repeated, tuberculosis may be produced in human beings by the bovine organism in every form that is produced by the human type. This is attested by the statistics of many European countries where a relatively large proportion of cows are tuberculous.

Children, especially infants, are much less resistant to bovine tuberculosis than adults. Before 1917 vital statistics of various States showed that hundreds of children died annually of tuberculous meningitis and miliary (rapidly developing) tuberculosis contracted from cow's milk, and many others became affected with scrofula and tuberculosis of bones and joints.

Unpasteurized milk of tuberculous cows is practically the only source of the bovine type of infection in children. The bovine tuberculosis-eradication program has not only resulted in a marked decrease in tuberculosis in livestock but has also prevented hundreds of children from dying or becoming hopeless cripples as a result of this disease.

Only 35 cases of tuberculosis in man reputed to be caused by the avian type of tubercle bacillus have been reported from all over the world, so it is quite apparent either that man is very resistant to this type of infection or that sufficient exposure is lacking. The meat of poultry is not eaten raw. In some instances, eggs from tuberculous hens contain tubercle bacilli, but as a rule diseased hens lay few or no eggs. Furthermore, eggs are usually cooked, so that very few virulent tubercle bacilli are thus consumed. Poultry tuberculosis is prevalent in some sections of this country, however, and the possibility that repeated exposure might cause disease in persons handling such flocks should be a further reason why an owner should take steps to eradicate this disease from his poultry.

In résumé, it may be stated that both man and animals show more or less resistance to tuberculosis, but there are marked contrasts among species in resistance and susceptibility to the various types of tubercle bacilli, and curiously enough, exceptional individuals within a species may react differently to the various types. The degree of exposure also has a bearing on whether or not tuberculosis develops. Some individuals might withstand a moderate but not a massive or repeated exposure. The rapidity of the spread of infection within the body likewise depends upon the resistance of the individual and the degree of exposure. For instance, an adult human being might drink infected cow's milk several times without becoming infected, whereas an infant drinking the same amount of such milk would be much more likely to develop the disease. In the United States, where the incidence of tuberculous infection in cattle is now less than 0.5 percent and pasteurization of milk is extensively practiced, there is practically no recently acquired tuberculosis in human beings resulting from the drinking of cow's milk. In marked contrast, in one European country, where fully 25 percent of the cattle are tuberculous and pasteurization is not extensively practiced, it has been estimated that over 5 percent of all deaths in man from tuberculosis of the lungs and 25 percent of the deaths from nonpulmonary forms are due to bovine tuberculosis.

DIAGNOSIS

In many infectious diseases the body becomes sensitized, or allergic, to the infecting germ and its products. This phenomenon is very marked in tuberculosis. Tubercle bacilli may be grown in a broth medium and the broth filtered from the tubercle bacilli and concentrated, making a product called tuberculin. If tuberculin is injected into an animal having tuberculosis, a reaction to the substance takes place. The injection of tuberculin subcutaneously, or under the skin, is followed within a few hours by a rise in temperature, or fever, which gradually subsides. Injection made intradermically, or into the skin, causes a reddened swelling at the site of injection 24 to 72 hours later. If tuberculin is dropped on the eye (applied ophthalmically) a milky discharge from the eye appears within a few hours. The degree of infection has no relation to the extent of the reaction, for a lesion of tuberculosis so small that it can hardly be seen with the naked eye may develop a sensitization to tuberculin as marked as that caused by a lesion a hundred times larger. All three tests are almost equal in efficiency, but the intradermic test is preferred for cattle testing and is the only one used for human beings. Diagnosis may be made also by animal inoculation or culture of diseased processes or exudates, and in man by X-ray photographs.

PREVENTION AND CONTROL EFFORTS

In 1917 about 1 cow in every 20 in the United States, on an average, had tuberculosis. In 1940 the official tests showed that less than 1 in every 200 cows was affected. This decrease in infection is due chiefly to the slaughtering of infected animals, but some credit, especially for the prevention of the spread of the disease to other herds, is due to the education of stockmen regarding additions to their herds. Cattle should be admitted to a herd only if they react negatively to the tuberculin test, and they should preferably be obtained from a herd certified to be free from tuberculosis.

Some farmers buy separated milk from creameries for feeding hogs or calves. This is an undesirable practice unless the milk is pasteurized (heated to 145° F. for 30 minutes) or heated for a few minutes at the boiling point and then cooled before being fed.

Small, slow-flowing streams which pass through or drain an infected farm present a hazard to livestock having access to such a stream lower down. Such a stream should be fenced off.

Community pastures are also a hazard unless it is known that all cattle grazing on the pasture have been tuberculin-tested and found to be negative to the test.

The shipment of cattle by rail, especially if they are loaded or unloaded in public stockyards, and to or from fairs or sales, may result in exposure to tuberculosis. Such cattle should be tested with tuberculin 3 months after being returned to the home premises.

There is no cure for tuberculosis. In man, the disease may be arrested by hospitalization and complete rest, but in domestic animals a comparable procedure is not effective, nor would it be practical if it

were effective owing to the cost involved in comparison with the value of an individual animal. Since practically all tuberculosis in domestic animals may be traced to cattle and poultry, freeing all livestock from this disease is a matter of eradicating tuberculosis from cattle and poultry.

Since 1917 the Bureau of Animal Industry has had in operation a Federal-State program for the eradication of bovine tuberculosis based on the test-and-slaughter plan with payment of indemnity for animals destroyed. The details of this campaign are explained later in this article. All States are now in the modified accredited status, that is, there is infection in less than 0.5 percent of the cattle in any State. With continued follow-up testing the disease should gradually approach the vanishing point (fig. 1). When tuberculous

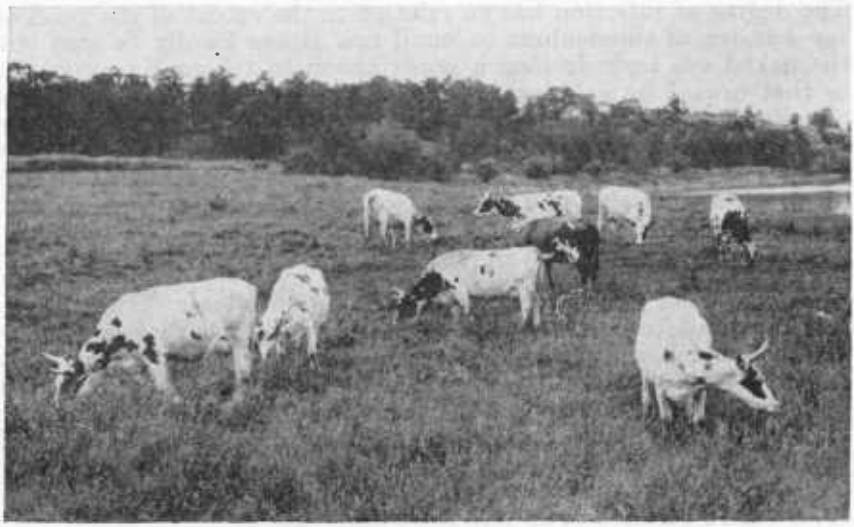

FIGURE 1.—A tuberculosis-free accredited herd. Periodic tuberculin tests either determine that the herd is still free from the disease or detect any tuberculous animals before they become seriously affected and spread the disease.

cattle are removed as a result of a positive tuberculin test, the infected premises should be carefully cleaned and disinfected. The removal of manure is especially important. Direct sunlight kills the tubercle bacillus within a few minutes, but when the germs are covered with manure or soil they many remain alive for weeks or months.

Owing to the low cost of individual birds and the immense amount of labor involved in establishing a Federal program of eradication for poultry based on the test-and-slaughter plan, control work on avian tuberculosis has been chiefly educational. The county agricultural agent frequently participates. The subject of tuberculosis in poultry is being treated separately in this article, including a résumé of what the Federal Government has been able to accomplish in its control.

THE BOVINE TUBERCULOSIS ERADICATION CAMPAIGN

The campaign to eradicate bovine tuberculosis in the United States was inaugurated in May 1917. The principal course of action was the testing with tuberculin of all the dairy and breeding cattle of this country. On November 1, 1940, about 23½ years after the inauguration of the program, the last two remaining nonaccredited counties were officially declared to be in a modified accredited status. As a result, all of the 3,071 counties in the United States, and the Territories of Puerto Rico and the Virgin Islands, are now rated as modified accredited areas, signifying that bovine tuberculosis among the cattle in such areas has been reduced to less than 0.5 percent.

This accomplishment required approximately 232 million tuberculin tests and retests and the slaughter of about 3.8 million tuberculous animals discovered by these tests.

Although the disease was not evenly distributed throughout the country, it was found to be present to some extent in all States, with the greatest incidence in areas furnishing milk to the larger cities, particularly in the northern half of the country. During the testing by areas the disease was detected in 40 to 80 percent of the cattle in some of the badly infected areas, and in a few exceptional instances the incidence of tuberculosis approached 100 percent of all the cattle in the area.

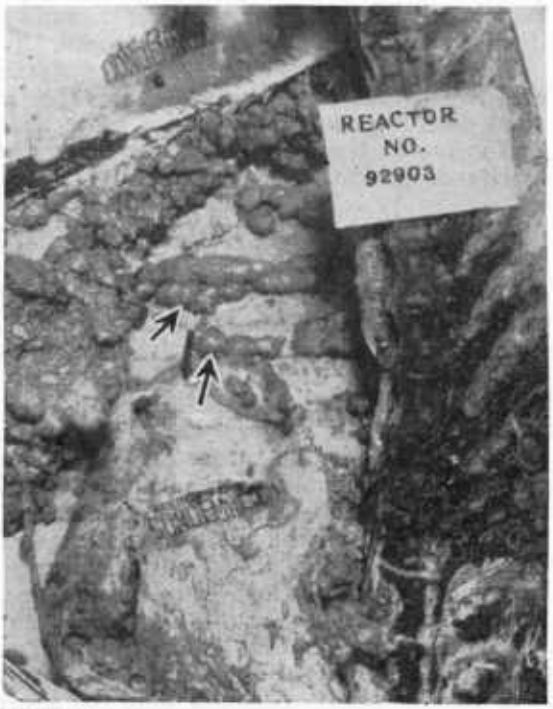

FIGURE 2.—Portion of cattle careass showing numerous tuberculous lesions (indicated by arrows). Such carcasses are condemned and destroyed under Federal meat inspection.

The effectiveness of bovine tuberculosis eradication is further reflected in the records of the Meat Inspection Division of the Bureau of Animal Industry, which reveal that, in 1917, of all the cattle slaughtered on regular kill in establishments maintaining Federal inspection, 49,214 carcasses, or .0.53 percent, were condemned or sterilized on account of tuberculosis (fig. 2). In 1940 this number

was reduced to the condemnation and sterilization of 1,998 cattle, or 0.02 percent.

Incidentally, in 1918 there was a human tuberculosis mortality rate of 150 per 100,000 population. At present the human mortality from this insidious disease is considerably below 50 per 100,000 population. The eradication of bovine tuberculosis must be recognized as a factor contributing to this improved condition.

Since tuberculosis among cattle is now at a low point, all cattle must be regarded as highly susceptible to the disease, and for this reason, further protection of the livestock industry depends largely on maintaining adequate control until the disease has been completely eradicated. An inadequately protected, highly susceptible cattle population would afford ample opportunity for a rapid spread of the disease should it again gain a foothold.

The slaughtering establishments operating under State and Federal supervision furnish those in charge of tuberculosis eradication work with reports of cases where tuberculosis has been found in cattle and swine on the regular kill, and these reports have been of much assistance in locating centers of infection.

TUBERCULOSIS IN POULTRY

The poultry industry is facing a serious menace in the Central and North Central States because of the many flocks in that area that are extensively affected with tuberculosis. In some counties this disease exists on more than 75 percent of the farms and is causing great losses annually.

Tuberculosis in poultry was first recognized in this country about the beginning of the present century, but it was not known to be so widely distributed until about 1920, when veterinarians assigned to eradicating tuberculosis in cattle found many diseased flocks on the farms they visited in their routine work of testing cattle. This discovery resulted in a survey to determine the extent of the disease in various parts of the United States, and it was found to exist to an alarming degree in the Corn Belt, as shown in figure 3, while in the Eastern States and on the west coast, where poultry raising is practiced on a large scale, little tuberculosis was found.

A further study disclosed that the average farm flock was often heavily infected, whereas the large commercial flocks were comparatively free from the disease, even in the Central and North Central States. The investigations were continued to ascertain the reason for this, and it was found that on most of the farms where tuberculous chickens were discovered it was the practice to keep a large number of the hens until they were 2, 3, or 4 years of age, and in some instances much older, whereas in the commercial flocks few, if any, hens were kept for egg or meat production after they were 18 months old. It was also determined that hen hatching was practiced on many farms, while the commercial flocks were incubator-hatched.

Congress has made funds available with which to employ suitable personnel to assist farmers in freeing their flocks of tuberculosis, and

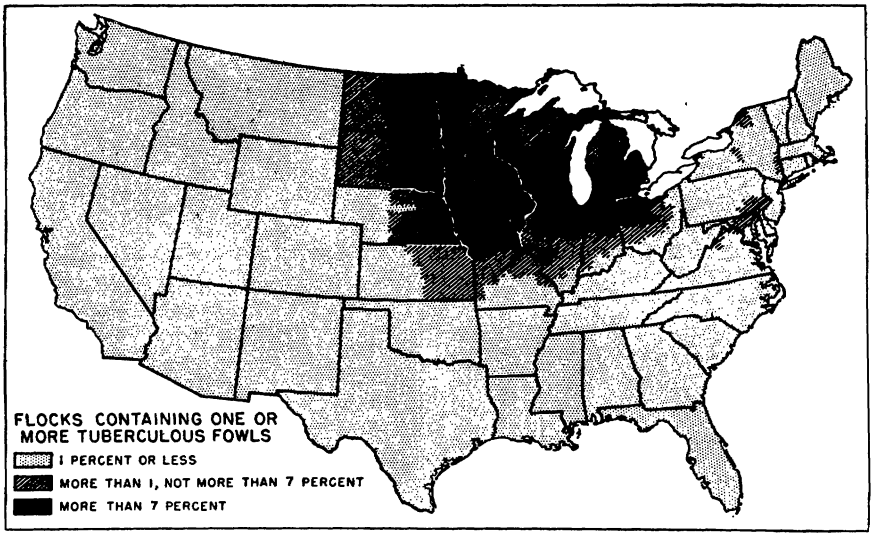

FIGURE 3.—Approximate extent of avian tuberculosis in the United States on January 1, 1941.

progress is now being made in reducing the number of diseased flocks.

The disease is spread from flock to flock largely by the exchange of infected fowls. There is little danger of spreading it through the exchange of eggs.

The disease organism is taken into the body in feed and water. It may affect any part of the fowl, but in almost all that are extensively affected—and these are the source of the continued spread of the disease—the liver, spleen, and intestinal walls are involved, with the result that millions of the tubercle bacilli are present in the excretions. As flocks of chickens usually range over a comparatively small area, the yards and runways become polluted, especially near the poultry house.

No medicinal remedy is effective. In the management of a flock such as is maintained on the average midwestern farm for meat and egg production, it is advisable to follow a plan of raising a new flock on clean grounds and disposing of the old birds at the end of the laying season or when they are about 18 months of age. Since tuberculosis is only slowly progressive, a large majority will not have become spreaders if disposed of when they are 1 to 1½ years old. The disease may thus be materially reduced and even eradicated in a few years by this method of control. Since the tubercle bacillus may remain alive and virulent in a moist and dark protected place for as long as 2 years, sanitation plays a very important part in control and eradication. The poultry house should be thoroughly cleaned and disinfected and, if practical, moved to a new location. Where this is not possible, the runways should be used only 1 year, then plowed up and planted to some crop before being used again for chickens. A well-designed poultry house with

suitable equipment serves a valuable purpose in combating this disease.

In purebred breeding flocks, the sale of hens for slaughter at about 18 months of age is not a feasible practice. However, in such flocks all birds over that age that are kept should be subjected to an annual test with avian tuberculin if the flock is located in an area where tuberculosis is prevalent. This is done by injecting a small drop of tuberculin into one wattle with a small needle and syringe (fig. 4, *A*). The inoculated wattle becomes thickened within 48 hours if the bird is tuberculous (fig. 4, *B*). All reacting birds should be disposed of immediately and the proper sanitary measures applied. Where infected poultry have the run of the entire farm, avian tuber-

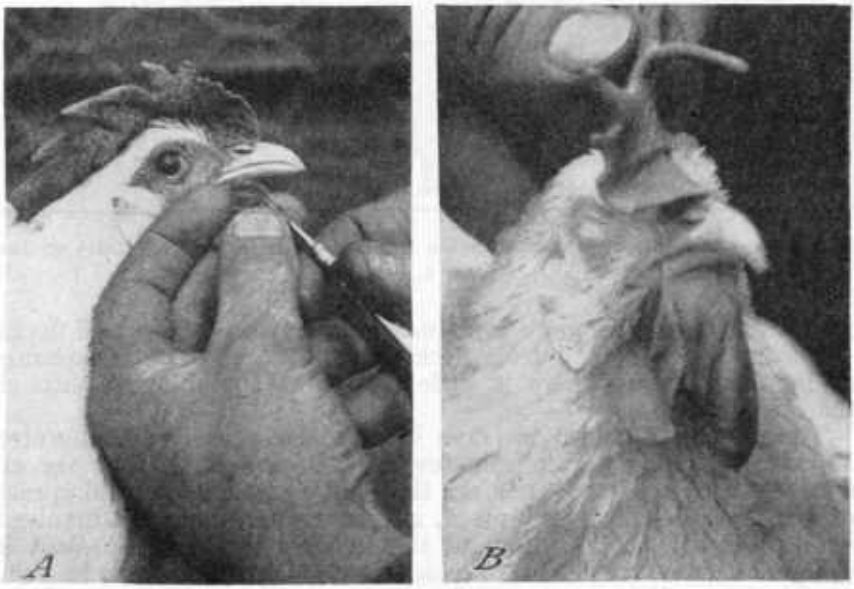

FIGURE 4.—Detection of avian tuberculosis by the tuberculin test. *A*, Injecting the tuberculin into the right wattle. *B*, The swelling of the wattle indicates the presence of the disease. If the bird is healthy no swelling occurs.

culosis may be spread to other animals, especially swine, and this results in considerable loss to the owner through condemnations in the packing house. Many hatcheries offer a higher price for incubator eggs from flocks free from tuberculosis, which is an added incentive for disposing of reacting birds.

TUBERCULOSIS IN SWINE

The losses due to tuberculosis in swine have been reduced by the cooperative campaign to eradicate tuberculosis in cattle. However, considerable losses are still caused by the condemnation of swine carcasses and parts affected with the avian type of the tubercle bacillus.

Numerous reports are received from field stations on the extensive losses of swine due to infection acquired from poultry. The following case is typical: A large percentage of a lot of swine slaughtered in a midwestern establishment under Federal supervision were found to be affected with tuberculosis. The swine were traced to the farm on which they were raised, but tuberculin tests of all the cattle on the farm were negative, indicating that the cattle were not affected with tuberculosis. A tuberculin test was also applied to all the breeding swine on the farm, and all were classed as negative to the test. Seventy-five head of poultry were then injected with tuberculin, and 32 reactors were revealed. The owner was surprised to find that his poultry were so heavily infected and asked to have one of the birds killed so that he might learn more about the disease. The post mortem examination of the fowl revealed an extensive case of tuberculosis. The owner cleaned and disinfected his place and restocked with pullets raised on clean ground.

Tuberculosis in swine is not spread from animal to animal unless the udder of the sow is infected, which is seldom the case. The control and eradication of the disease in swine therefore depend on eradicating tuberculosis in the cattle and poultry on the premises. Sanitation should be practiced, and feed lots should be rotated at least once each year. In purebred breeding herds tuberculin tests with avian and mammalian tuberculins may be used to determine which animals are diseased and the reactors to such tests should be slaughtered under veterinary supervision.