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TUBERCULOSIS OF HOGS



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Tuberculous hogs, infected by working over a pile of manure
from tuberculous cattle

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FARMERS' BULLETIN 781

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Animal Industry
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TUBERCULOSIS occurs among hogs in the United States to a serious extent and appears to be increasing. Nine per cent of all hogs slaughtered under the Government meat inspection during the fiscal year 1916 were found affected with this disease in some degree.

Tuberculous cattle are the main source of tuberculosis in hogs. The disease is most commonly conveyed by feeding hogs on unpasteurized skimmed milk and by allowing them to follow tuberculous cattle in the feed lot and feed upon the undigested grain in the droppings. It is very significant that tuberculosis is most common among hogs in sections where the disease is also most prevalent among cattle and where the feeding practices above mentioned are commonly followed. Hogs also contract tuberculosis from feeding on tuberculous carcasses of various animals, including fowls, and on uncooked garbage and slaughterhouse offal.

Prevention lies in the pasteurization of milk fed to hogs, especially that from creameries, and in allowing hogs to feed behind adult cattle only when the cattle have passed the tuberculin test; also in thoroughly cooking all garbage, offal, or carcasses before they are fed to hogs.

Young steers or young beef animals as a rule do not spread tuberculosis among hogs. Therefore no change need be made in the very profitable practice of allowing hogs to follow feeders and stockers, unless these cattle are not healthy.

When tuberculosis already exists in a drove of hogs all the affected animals, whether hogs or cattle, should be removed from the premises. The hogs should be sent to market for slaughter at an abattoir under Federal inspection. The tuberculin test should be applied to all cattle on the place, and those reacting should be properly disposed of. The pens and stables should be thoroughly cleaned and disinfected before restocking.

Hog raisers should be well posted as to the nature and prevalence of hog tuberculosis and how to prevent and get rid of it, so that financial losses may be avoided. This bulletin contains such information.

TUBERCULOSIS OF HOGS.

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PREVALENCE AND ECONOMIC IMPORTANCE OF THE DISEASE.

Tuberculosis in the human family has been lessening materially during the past 15 years, but reports from the various meat-packing centers of the country fail to show the same encouraging condition regarding tuberculosis in hogs. Reports from several localities during recent years show a decrease in the number of tuberculous swine sent to market, but the country at large shows an increase rather than a decrease in the number affected.

The swine industry of the United States has recently received great encouragement and stimulation from continued high prices paid for hogs. The average farm valuation of the hogs of the country for the decade 1900-1909 was \$6.46, or \$1.28 higher than during any decade in recent times, while the valuation since 1909 has been unprecedentedly high, ranging from \$8 (in 1912) to \$10.40 (in 1914). The small amount of money required to begin hog raising and the quick returns on the capital invested make this industry attractive to the small farmer. The hog will make a pound of gain on less feed than most live stock, and will profitably utilize waste food products.

Tuberculosis of hogs is closely associated with the same malady in cattle. The reason for this is apparent when one considers the close relations of these two species of domestic animals upon nearly every farm. Tuberculous cattle are the principal source of tuberculosis in hogs, the disease being transmitted readily by feeding hogs on unpasteurized dairy products and by allowing hogs to follow such cattle in the feed lot and feed upon the undigested grain in the droppings. Because of the early age at which hogs are slaughtered, they do not propagate the disease among their own kind to any appreciable extent. It is significant that tuberculosis of hogs most frequently occurs in localities where the disease is common in cattle.

NOTE.—This bulletin is a revision of Bureau of Animal Industry Circular 201, and is intended to assist hog-raisers in exterminating a dangerous disease.

The prevalence of tuberculosis among swine can be judged only from abattoir statistics. Of the hogs slaughtered during the fiscal year 1916 at establishments under the Federal meat inspection, 9 per cent were found to be affected with tuberculosis in some degree.

Records of the Bureau of Animal Industry show that some sections of the country contribute a far greater proportion of diseased animals than others. Hogs from Arkansas, Oklahoma, and Texas are remarkably free from this disease, owing probably to the method of caring for them, or rather the lack of caring for them. They are not confined in feed lots as in the sections where the disease is mostly found, but are allowed to roam over large areas of pasture and to shift for themselves, and when they are found affected the majority show very slight lesions. Furthermore, no prolonged feeding is practiced in narrow bounds as in the corn belt, and there are relatively few dairies or tuberculous cattle in these sections. The hogs are carried from birth to maturity on some form of pasture, as alfalfa, oats, corn, cowpeas, sorghum, rape, and peanuts, all the year round. There can be no doubt that swine fed entirely on vegetable feed, such as corn and roughage, are proportionately less affected than those fed on uncooked dairy products or behind diseased cattle.

A great many hogs in Texas are raised on alfalfa supplemented with corn, and the result is clearly shown in the bureau statistics, which indicate that during the fiscal year 1915 only 2.4 per cent of the 451,478 hogs slaughtered at Fort Worth showed tuberculous lesions. In striking contrast to this may be given the percentages for the same period of four cities in one of the leading dairy States, which show 9.0 per cent, 10.9 per cent, 12.1 per cent, and 25.1 per cent, respectively, of the hogs slaughtered to be affected with tuberculosis. There are a large number of cooperative creameries in the territory contiguous to the four cities alluded to, and the raw skimmed milk is taken home by the patrons for their hogs. Samples of separator slime from the two creameries in the town showing the largest number of tuberculous hogs were injected into guinea pigs, and in one instance virulent germs of tuberculosis were recovered.

From bitter experience the hog buyers for packing houses are gradually becoming familiar with these conditions and are avoiding certain regions known to be badly infected. Some packers are taking self-protective measures so as to have the feeder of diseased hogs bear the burden, and many of the smaller establishments in the Central West are buying hogs subject to post-mortem inspection.

It is very likely that many of the farmers who have sold tuberculous hogs have done so without suspecting that they were unsound, for few of these diseased hogs ever show the presence of tuberculosis by outward symptoms. In fact, the hogs that disclose the affection after slaughter are frequently the finest appearing animals in the

drove. If indications of tuberculosis are present before slaughter they usually consist of marks of general unthriftiness, such as are also present in many other diseases, and therefore do not afford any very definite indication of the presence of tuberculosis. It is therefore important that hog raisers should know the facts about hog tuberculosis and how it may be prevented. The suppression of this disease would save the country many millions of dollars annually.

METHODS OF INFECTION.

The most frequent infection of hogs with tuberculosis occurs, no doubt, through the digestive tract, and in this mode of infection tuberculosis of cattle is very intimately concerned. In those instances in which a marked increase in the number of tuberculous hogs from a certain locality has been noticed and investigated it has too frequently been found that the hogs in question had been fed upon unpasteurized skimmed milk or that the carcass of some animal succumbing to tuberculosis had been thrown to them for final disposal. The certainty with which either of these two conditions will lead to the infection of the hogs has not heretofore been fully appreciated. Another source of infection for swine exists in the practice of allowing them to run behind tuberculous cattle and feed upon the undigested grain in the droppings. The tuberculosis germs discharged with the feces by such cattle may readily infect the hogs. Infection of a litter of pigs by a tuberculous sow presents another source of danger. There are a number of other methods of infection which will be mentioned later, but they should be considered of minor importance and must not detract attention from the leading factors in the production of the vast majority of cases of hog tuberculosis, which are unquestionably the milk and feces of tuberculous cattle. When once these are controlled tuberculosis of swine will forthwith be greatly reduced.

INFECTION THROUGH MILK OF TUBERCULOUS COWS.

Numerous experiments conducted by many scientists in various countries are in accord relative to the ease with which hogs may contract tuberculosis from being fed on milk of tuberculous cows. When hogs were fed on tuberculous milk for only 3 days the post-mortem examination held 107 days later showed that 83.3 per cent of the animals had become tuberculous. When hogs received tuberculous milk for 30 days and were allowed to live 50 days longer, 100 per cent of the animals had developed generalized tuberculosis.

That similar experiences occur under natural conditions on the farm has been proved by tracing certain shipments of tuberculous herds to the farm where they were raised and fattened. In one in-

stance a shipment of 74 hogs showed tuberculosis in 61, and investigation brought out the fact that the swine had been fed on the skimmed milk of a creamery in a near-by town. The separator slime from two of the creameries in this town was obtained for experimental purposes, and the inoculation test showed that one of these samples produced tuberculosis in all the guinea pigs inoculated.

Centrifugal separators have come into general use. In the process of separating the cream from the milk the rapid revolutions of the shaft and disks of the machine deposit at the base of the shaft dirt, hair, manure, and other impurities, and, mingled with this mass, great numbers of bacteria, including at times the germs of tuberculosis.

The charge has been repeatedly made that the germs of tuberculosis are scattered by means of the common practice of distributing the separated milk or other by-products among the farmers who constitute the patrons of the creamery. To test this point careful search has been made of samples of the separator sediment from a number of creameries located in widely removed dairy regions to see if they really harbored virulent tuberculosis germs. When first received at the laboratory this material is examined microscopically. Following this examination all samples, whether showing the presence of suspicious bacteria or not, are injected into guinea pigs, where the presence of living tuberculosis germs is soon determined by the development of tubercular lesions. As a result of such an examination of the products from 15 creameries it has been definitely shown that 5, or 33 $\frac{1}{3}$ per cent, of the samples examined contained virulent germs of tuberculosis.

There are no doubt many creameries to which no infected milk is delivered and from which the separated milk when divided among the creamery patrons is a safe and valuable article of food for calves and pigs. But there are, unfortunately, others, as above indicated, which receive milk daily from one or more cows so affected with tuberculosis that they give off the germs of that disease, and these germs find their way in large numbers into the cans of separated milk which are returned to the farmers from these creameries. In this way a single cow with a tuberculous udder may spread the disease to numbers of hogs, and may also infect many farms in a large section of country that have never been contaminated before with this destructive disease. This particular means of spreading tuberculosis could be absolutely prevented by cooking the milk, yet in the majority of cases this simple precaution is not taken.

In one State a lot of hogs which contained 36 per cent of tuberculous animals was traced to the farm of the raiser, and the State authorities were notified. They made a tuberculin test of the cattle

producing the milk, with the result that about 22 per cent of them reacted. This infected milk had been separated on the farm with a hand separator and the skimmed milk fed to the hogs. It will thus be seen that creameries are not alone at fault, but the skimmed milk from the hand separator, if it comes from a tuberculous herd, is equally dangerous. The buttermilk produced at the creamery from the infected separated cream is likewise capable of carrying tuberculosis germs and infecting the animals which consume it.

The one great advantage from a hygienic standpoint which the milk from a hand separator has over the milk from a public creamery is that in the former case the milk from an infected herd is usually fed to only one lot of hogs. On the other hand the skimmed milk from the creamery is generally all mixed together in a vat and each farmer takes back with him his proportionate share of skimmed milk, which is most likely to be produced by several herds of other people's cattle. Hence the skimmed milk of but one tuberculous herd is liable, as a result of this practice, to contaminate the entire product of the vat into which it is placed. For this reason it behooves hog raisers to see that their skimmed milk has been properly heated before they feed it. Legislation making such heating by creameries compulsory affords a simple and easy way of greatly reducing hog tuberculosis.

INFECTION BY FECES OF CATTLE.

A very important source of infection of hogs with tuberculosis, and one which closely rivals tuberculous by-products from public creameries, is to be found in the feces of tuberculous cattle. It is a very common practice to allow hogs to accompany cattle about the feed lot, and while doing this they thoroughly work over the feces and feed upon whatever portions of food have passed undigested through the digestive tract of the cattle. (See illustration on front page.) In herds that are healthy this manner of feeding may be commended because of the economy, but wherever there are tuberculous individuals among the cattle the danger of passing the infection on to the hogs by means of the feces becomes very great.

In a series of investigations by the bureau it was found that the feces of tuberculous cattle are often loaded with tuberculosis germs. Tuberculin-tested hogs were placed in isolated pens where a few shovelfuls of such feces were thrown daily while the hogs were fed upon other feed which was free from tuberculosis. The result was the infection of 25 per cent of the first lot of hogs and 100 per cent of the second lot that were exposed. The tuberculous condition of the cattle was shown only by the tuberculin test, as they were apparently healthy, having no cough or any visible indications of disease.

A striking instance of probable infection of hogs by cattle feces came under observation. Of 34 hogs which were marketed in one

lot 23 were found diseased, and upon investigation it was ascertained that the owner had a herd of dairy cows, the stable manure from which was thrown into the hog yard. The hogs were given no milk, nor were they permitted to mingle with the cattle, but were pastured and fed on corn and what they could gather from the cow manure. In fact, the latter form of exposure was the only plausible explanation of infection, and this was later accepted when the tuberculin test of the herd revealed 19 out of the 27 cows diseased. This test was confirmed when the cattle were slaughtered and found to be tuberculous, some in an advanced stage.

INFECTION THROUGH FEEDING ON TUBERCULOUS CARCASSES OR SLAUGHTERHOUSE OFFAL.

It is an all-too-prevalent custom in some sections for hog raisers to buy up all carcasses of animals that have died from various unknown causes and feed them uncooked to their hogs. This is a fertile source of infection with parasites and with any infectious disease that may have caused the death of the animals. Several instances of tuberculous hogs being traced to such an exposure have been found.

An equally dangerous source of infection is likewise observed in the methods which obtain among some of the small country slaughterhouses. It is not unusual for these houses to get rid of their blood, intestines, viscera, and other inedible parts by feeding them uncooked to hogs, a herd of which is usually kept on the premises. This custom is dangerous and is another method of spreading various infectious and parasitic diseases, and particularly a disease like tuberculosis. The feeding of offal, etc., to hogs on the premises of abattoirs having Government inspection is not permitted. As the slaughterhouses where hogs are fed in this manner have no Government inspection, this department has no records as to the number that become infected. Such hogs are killed by the butcher on the premises where they are fed, and are marketed as healthy meat.

TANKAGE DOES NOT PRODUCE TUBERCULOSIS.

It has been claimed that the increased use of tankage for hogs was the cause of the increase in the number of tuberculous hogs condemned at the abattoirs. The writers sent out inquiries to State experiment stations where tankage had been fed to hogs experimentally, to see if any case of tuberculosis had developed as a result of such feeding. Experiments were also carried on by this bureau along the same line. In no case could tuberculosis be shown to have arisen from the consumption of tankage, and it must therefore be freed from all blame in the spread of this disease, and may be looked upon as a safe and valuable article of food for use in raising and fattening swine.

Tankage, meat meal, and other animal food products are valuable for supplying the protein in a ration for swine, and have attracted attention from farmers because of the prevailing high prices of other foodstuffs. Tankage, or digester tankage as it is commonly called, is rich in protein and has proved a satisfactory substitute for skim milk as an adjunct to corn. It is made from the trimmings, inedible viscera, and other parts of the carcass, all of which are placed in the tanks and thoroughly cooked under pressure, so that the resulting product comes out sterile. The grease is removed from the surface and the residue is dried out at a high temperature, then ground, screened, and placed in 100-pound bags.

INFECTION FROM FEEDING UNCOOKED GARBAGE.

The feeding of uncooked city garbage to hogs is undoubtedly a factor in the development of disease. While there are no broad statistics obtainable concerning the prevalence of tuberculosis among garbage-fed hogs, there are records showing that animals fed upon such material contract diseases far more frequently than is the case with swine fed upon cooked garbage or other ordinary feeds. The most frequent sources of infection in garbage are tuberculous dairy products, sputum from tuberculous people, and the offal of tuberculous poultry.

At an establishment near Jersey City about 2,000 hogs are raised each season entirely upon garbage from hotels of New York. They are fed on cooked garbage exclusively, with the exception of a partial diet of dry or stale bread for a certain period before slaughter. In addition to the hogs thus raised and fed on the premises the firm slaughters a comparatively large number of hogs purchased from outside sources, either in odd lots from neighboring farmers or in car lots from shipping centers. These hogs do not come in contact with the hogs fed on the premises. When examined after slaughter they are found to be affected with tuberculosis in about the same proportion as is shown by the average of hogs inspected elsewhere. On the other hand, among the hogs raised exclusively upon sterilized garbage no indication of tuberculosis has been found when they were inspected at the time of slaughter.

The same firm has been engaged in this business for several years, and they state that after feeding the cooked garbage for some time they noticed a remarkable freedom from disease in the animals thus fed as compared with animals obtained from outside sources. Originally, their main object in cooking the garbage was the recovery of the valuable grease obtained therefrom, but they realize now the greater importance of the cooked product from the standpoint of the health of the animals fed upon this food.

From a sanitary standpoint there is no particular objection to the feeding of garbage to hogs provided that it is not accumulated and allowed to stand until putrefactive changes have taken place, and provided further that it is sterilized before it is used and that the containers are always kept clean. Sterilized garbage can be fed to swine with safety and is of great economic value. Piggeries where sterilized garbage is prepared and fed should be so constructed that they may be readily cleansed.

INFECTION BY TUBERCULOUS ATTENDANTS, TUBERCULOUS FOWLS, ETC.

The fact has been well established that hogs may contract tuberculosis through eating the sputum of consumptives. Proper precautions in selecting caretakers for farm animals will prevent the occasional infections from this source.

The Bureau of Animal Industry has investigated a case in which a large proportion of the hogs shipped from a certain ranch were found to be tuberculous when examined at the packing house, while at the same time it was learned that practically all the poultry on the farm had the disease to a serious degree. It was learned that it had been the custom at this place to throw all of the dead hens over into the hog yard, where they were greedily eaten. A pair of tuberculous hens from this affected farm were shipped to the bureau laboratories and were fed to a pair of healthy pigs 2 or 3 months old. The result was that both pigs became tuberculous. The frequent association of pigs and fowls makes it desirable to eradicate the disease from among the fowls, should it exist, before attempting to clean up the hog quarters.

Tuberculosis may be transmitted from hog to hog, especially from a tuberculous brood sow to her pigs, but this manner of infection is quite infrequent compared with the number of cases that can be traced to tuberculous cattle.

SYMPTOMS OF TUBERCULOSIS IN HOGS.

Where the disease has progressed to an advanced stage various symptoms may appear. Intestinal tuberculosis is frequently accompanied by general disturbance of the digestive functions, and constipation or diarrhea may be shown. Advanced tuberculosis of the lungs will be shown by a persistent, dry, harsh cough, and by rapid breathing, especially on exercise. This cough is similar to that caused by lungworms and can not be distinguished from it.

Interference with both respiratory and digestive functions may be seen when the disease is widely generalized, and the numerous alterations will be shown by progressive emaciation and weakness. Localized centers of the disease in bones or joints may produce lameness and other visible indications, but these are comparatively very rare.

In the majority of cases no intimation of the presence of the disease will be given until the animal is slaughtered, and the discovery of a number of tuberculous hogs in a drove of apparently prime, well-finished animals is often the cause of great surprise and disappointment to their owner. In such cases the lesions may be sufficient to prove the disease far advanced and the germs to be so widely distributed as to render the meat unfit for food.

In those cases where the disease is not characterized by prominent symptoms, but where the animals are suspected of having the disease, the tuberculin test is recommended. This makes it possible to slaughter the reacting animals in the early stages of the disease and thus get rid of the infection. This is especially important in holding over brood sows, as experiments have indicated that the milk of these sows may infect the young pigs.

THE TUBERCULIN TEST.

The intradermal method of applying the tuberculin test has been tried on hogs, and has given excellent results. Two drops of tuber-

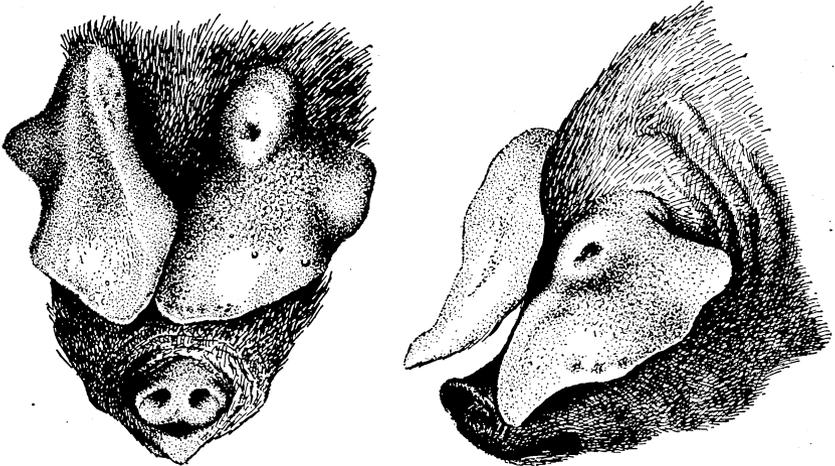


FIG. 1.—Tuberculin test for hogs, intradermal method, showing enlargement at seat of inoculation due to positive reaction. (After Moussu.)

culin prepared by evaporating away two-thirds of the volume of the tuberculin prepared by this bureau for the subcutaneous tuberculin testing of cattle, is injected into but not under the skin near the base of one of the ears of the hog. If the animal is not affected, no change in the appearance of the ear will result, but a positive reaction will at the end of 48 hours cause a swelling near the seat of injection, as shown in figure 1. This enlargement may remain visible for 10 or 12 days after the injection in case the animal is affected with tuberculosis.

LESIONS.

The vitality of hogs or their powers of resistance to disease are necessarily lowered by the unnatural conditions which frequently obtain in hog raising, namely, the forced feeding for fattening and the small feeding pens in vogue in certain districts. When the enormous growth of a hog is considered, when it is realized that in the short space of 8 to 10 months its development is frequently 250 to 300 pounds—a proportionate increase of weight unknown to any other species of domestic animals—the great changes which must necessarily occur can be appreciated. Such rapid development is very likely to take place at the expense of the disease-resisting powers of the animal.

When tuberculosis results the lesions usually observed are distinct and of a chronic type, as manifested by lime-like deposits and fibrous walls. It is not infrequent, however, that a more extensive and spreading disease is seen, and the lesions indicate a severe infection and rapid diffusion of the germs or bacilli, which in these animals may quickly follow the initial attack. And whether the disease assumes an acute, subacute, or chronic type, tuberculous growths may soon be found attacking lymph glands in widely separated parts of the body.

As a general rule, the lymph glands become enlarged, and a cheese-like change occurs at several points where the tubercles had started, causing numerous small yellowish areas often surrounded by a reddened, inflamed zone. These areas are composed of broken down gland substance, and are sometimes intermingled with pus; at other times they are of a cheesy consistency, and more frequently gritty through the deposit of limelike particles.

As the disease is produced essentially by feeding, the glands and tissues associated with the digestive tract are the most frequent seats of infection. Indeed, the throat glands (in almost all cases the submaxillary gland) are nearly always affected, as at the post-mortem examinations held by bureau inspectors over a consecutive period on 120,000 tuberculous hog carcasses, 93.3 per cent were found to contain lesions in these glands. Next in importance are the bronchial glands, of which 27.2 per cent were diseased, while the chain of liver glands was involved in 21.6 per cent of the cases. In all these cases the lesions may involve the entire lymph structure, or only the central or several irregular points, and may be either cheeselike, limelike, or both. The intestinal lymph glands showed lesions in 18.1 per cent of the carcasses examined.

The liver was affected in 9.2 per cent of the cases and showed either yellowish points, which were cheesy and scattered, not only on the

surface but also within the organ, or the larger, irregular nodules, varying from a hemp seed to a hickorynut in size. They are at

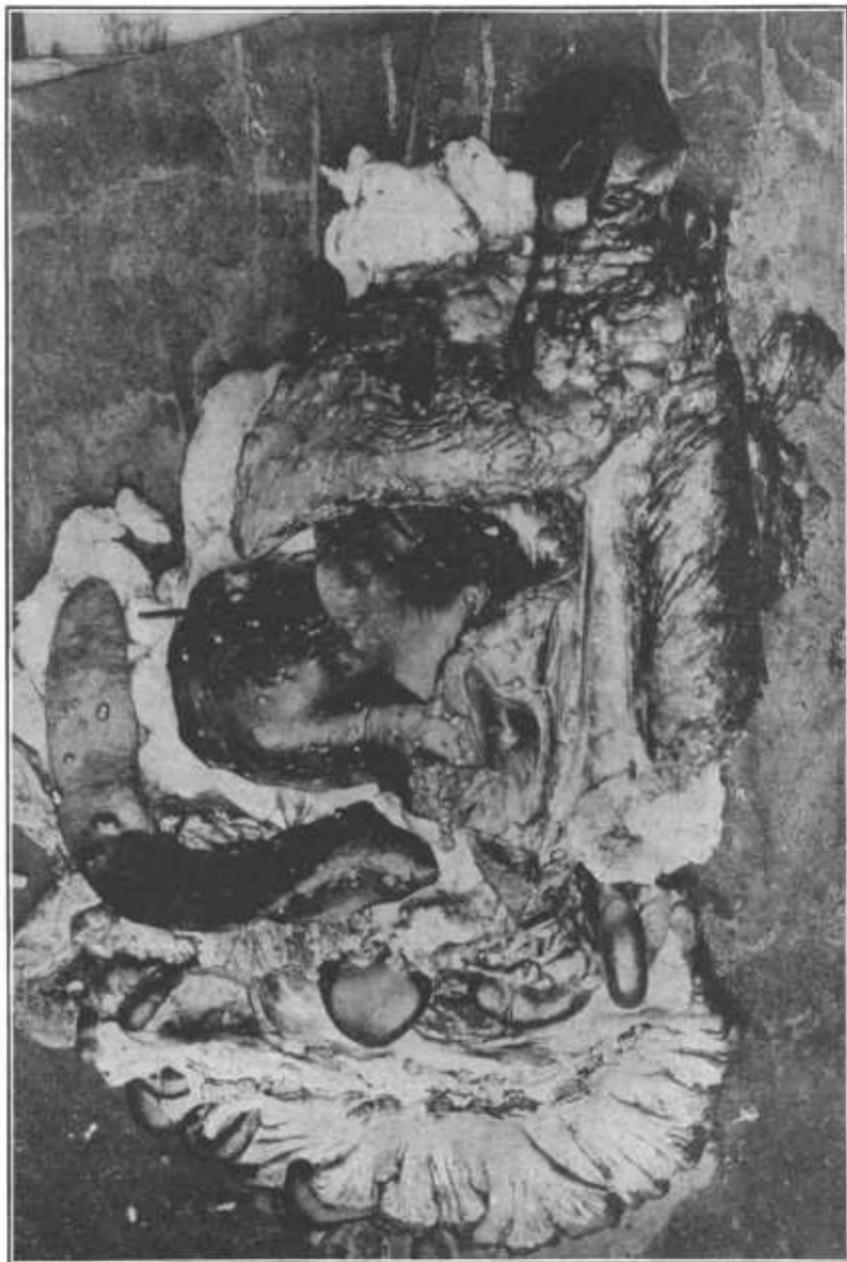


FIG. 2.—Tuberculosis of hog, involving the lungs, liver, spleen, and intestines.

times quite fibrous in consistency and may contain a cheesy center, or limelike deposits may occur as the disease advances and the lesions

become more considerable. The lungs are the next tissue to be most frequently affected, as is represented by 7 per cent of the carcasses

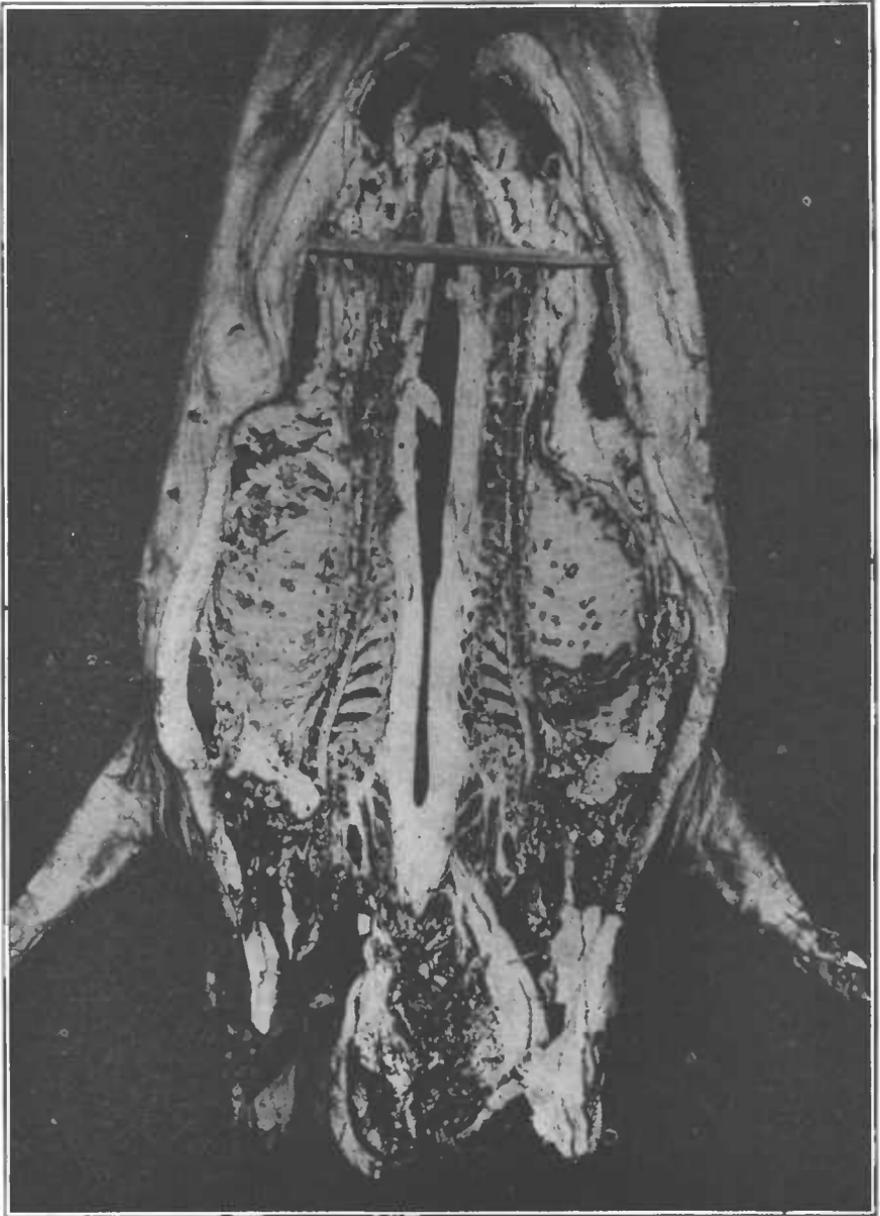


FIG. 3.—Tuberculous hog carcass, showing tuberculous nodules on the ribs.

above recorded. There may be tuberculous pneumonia involving large areas of the lungs, causing collapse of the borders. There may

be irregular-sized grayish or yellowish areas, as is so often seen in cattle; but not infrequently there are observed large numbers of shot-like areas, showing evidence of general disease.

The spleen showed lesions in 3.8 per cent of the carcasses above mentioned. The spleen is usually darker in color and the surface is quite rough and nodular, depending upon the number and size of the tubercles. Unlike the spleen of a tuberculous cow, these nodules not often occur on the outside membrane. They vary from the size of a half pea to as large as a hickorynut. The external pale or light-red nodules are raised above the surface of the organ and frequently show fibrous tissue bands radiating from the center.

Occasionally lesions similar to those found in other glands are noted in the mediastinal and sublumbar glands. In occasional cases the membranes lining the body cavities may show an eruption of tuberculous nodules. The generative organs are rarely affected. The bones are sometimes attacked. Tuberculosis of the muscles has been noted, but not so frequently as of the bones and joints. These lesions are usually rather limited to one region. The extreme rarity of lesions in the kidney is shown by the finding of but 3 cases in the 120,000 tuberculous carcasses.

Occasionally also ulcers and tuberculous nodules are noticed on the lining of the small intestines, especially of young pigs, but these likewise are rare, and when found usually accompany numerous lesions elsewhere in the body.

PREVENTIVE MEASURES.

REMOVAL OF AFFECTED ANIMALS.

The first step to be taken in preventing the further spread of tuberculosis is to remove all affected animals, whether hogs or cattle, from the premises, as these will only serve as sources of infection so long as they are allowed to mingle with healthy animals. In dealing with affected herds of cattle it has been found best in most cases to apply the tuberculin test to the entire herd as a means of selecting the tuberculous animals, but with a drove of hogs in which tuberculosis has spread there can be no doubt that the best and surest method of procedure will in nearly every case be found in the slaughter of the entire drove as soon as they can be put in a marketable condition. They should be slaughtered at an abattoir under Federal inspection, so that proper disposal may be made of affected carcasses. A farm may be stocked rapidly with healthy swine after the total slaughter of a tuberculous lot. The early age at which the sow may be bred, her capacity for breeding twice a year, and the plural number of her

offspring are forceful arguments for the total destruction of every diseased drove of hogs and the breeding up in clean, healthy quarters of a sound, healthy drove in its stead.

As tuberculosis seldom attacks the hogs of a farm except through tuberculous cattle, the tuberculin test should be applied to all of the cattle on the place, and all tuberculous animals among them should be isolated or destroyed at the time of disposing of the hogs.

In case the disease has only recently been introduced among the hogs it would be advisable to apply the tuberculin test to them so that the affection may be detected in the early stages. By slaughtering only the reacting hogs and saving the healthy ones the hog raiser may clean up his herd with as little loss as possible.

DISINFECTION.

With the hogs all removed from the place and no tuberculous cattle remaining, attention should next be given to disinfecting the premises, so that no center of infection may be left to contaminate future purchases of live stock. The disinfection of pens and stables may be accomplished by thoroughly cleaning them, scrubbing the floors with hot water, brushing down all loose dust from the walls, and tearing out all woodwork which has become partly decayed. The interior of the pens or stables should then be carefully covered with a coating of lime wash containing 4 or 5 ounces of compound solution of cresol (U. S. P.) to each gallon of the lime wash.¹ The yards should be carefully cleaned at the same time, especial attention being given to the removal of all rubbish and litter from the dark, shady corners. Lime, or a 3 per cent solution of carbolic acid, may then be sprinkled upon these dark portions of the yards. In all of the open portions of the yard the action of the direct rays of the sun will very quickly destroy the life of the scattered tuberculosis germs.

The premises now being cleaned, healthy foundation stock may be procured, and if proper attention is given to keeping the cattle of the farm free from tuberculosis and to supplying the hogs with suitable food, the owner may feel every reasonable assurance that he has seen the last of tuberculosis among his swine. The trouble, time, and expense required will be more than repaid by the advantages gained.

Tuberculosis can not develop spontaneously in swine but must be acquired from some outside source, and the farmer whose yards and stables have been thoroughly freed from the disease need fear no reappearance of the disease, except when introduced from some outside point of infection.

¹ More detailed information is given in Farmers' Bulletin 345, "Some Common Disinfectants," and Farmers' Bulletin 480, "Practical Methods of Disinfecting Stables," issued by the United States Department of Agriculture.

PASTEURIZATION OF ALL MILK PRODUCTS USED FOR FEED.

The heating of all milk when received at public creameries to 145° F. for 30 minutes or to 176° F. for a moment will be found most effective in preventing the spread of tuberculosis to the animals consuming the by-products of such creameries. Denmark was one of the pioneers in this movement, having in 1898 passed a law requiring all skimmed milk and all buttermilk to be warmed to 185° F. before it could be distributed from any creamery to its patrons for feeding purposes. It was found, however, that this degree of heat was harmful to the product, and in 1904 the required temperature was reduced to 176° F., experiments having proved that no tuberculosis germs could withstand this amount of heat. In practically all of the Danish creameries from this latter date the whole milk has been heated to the required point, thus assuring butter that is free from tuberculosis germs, as well as by-products that are safe for use in feeding hogs or calves. The result of these regulations has been most satisfactory. The spread of tuberculosis to farms previously free, through the skimmed milk or the buttermilk from creameries, has been very markedly checked and suppression of the disease in hogs has been plainly noticeable.

Treating of creamery milk as a cause of the spread of tuberculosis among hogs, Moussu, a French investigator, makes the statement that cooking the by-products of creameries and cheese factories results in the disappearance of tuberculosis of an intestinal origin among the hogs fed with them, and the hog owners no longer fear losses from this disease.

Borgeaud has cited an instance in which a serious outbreak of tuberculosis among hogs in Switzerland was overcome by boiling all of the separated milk before feeding it to the subsequent litters of young pigs.

LOCATING AND REMOVING CENTERS OF INFECTION.

The Bureau of Animal Industry is endeavoring to locate infected farms, or at least infected localities, and to ascertain the direct cause of the spread of the disease in these districts. Owing to the number of hands through which hogs go before reaching the abattoirs this is not easy, but it can be and is being accomplished. Already, through cooperation with the State authorities, a large number of infected farms have been definitely located. The conditions on these farms have been investigated, the source of the disease determined, and methods for its suppression recommended. Both the bureau and State officials have been working with these ends in view. When hogs have been found to be tuberculous when slaughtered under the

Federal meat inspection and the farm from which they came has been located, the State veterinarian is notified. In most States this officer is empowered by law to quarantine any farm when he suspects the presence of a contagious disease thereon. He then applies the tuberculin test to the cattle on the farm and otherwise looks for the source of infection. This frequently results in finding the cattle tuberculous.

This cooperation with the State is of great value, and the results would be greater if State legislation were enacted compelling the tagging of all hogs going to slaughter, so that these animals if found tuberculous could be immediately traced to their point of origin and the source of infection removed.

SPREADING INFORMATION AMONG FARMERS AND DAIRYMEN.

While pamphlets, popular articles, and public notices would be extremely useful in eradicating tuberculosis in swine, it would probably be more satisfactory to explain to the hog raiser by word of mouth the methods to be followed. The veterinarian is the best equipped man available for the work. The State might also assist by employing veterinarians to give public lectures in towns and townships, as is being done at present in Sweden. There is now absolute knowledge that the vast majority of cases of hog tuberculosis are produced by—

1. Raw milk and slime from creameries.
2. Hand-separated milk from tuberculous cattle.
3. Feeding behind tuberculous cattle.
4. Feeding tuberculous carcasses of various animals, including fowls.
5. Feeding slaughterhouse offal.
6. Feeding uncooked garbage.

It therefore behooves veterinarians to educate their clients as to the proper method of preventing this disease, as they would recommend a proper feeding ration or proper construction of a stable. Hog raisers should (1) scald all raw products returned from the creamery; (2) have their cattle tested with tuberculin if a hand separator is used on the farm, or, in the absence of such a test, to scald the skimmed milk; (3) let the hogs feed behind healthy cattle only, or those which have passed the tuberculin test; (4) feed carcasses of animals that have died from any cause, or offal from the slaughterhouse, or garbage of any character, only after the meat, offal, or garbage has been thoroughly cooked.

Sooner or later the packer and slaughterer are going to buy hogs subject to the post-mortem inspection, as they are at present doing in some of the large packing centers with certain classes of female

cattle; and the hog raiser who continues to fatten his hogs with tuberculous material should be made to sustain the losses arising from his lack of knowledge, skepticism, or indifference. The innocent purchaser, who can not be familiar with the methods of feeding on the farms of the different breeders, should not be expected to bear such losses, nor should the intelligent hog raiser who produces healthy hogs by carrying out minutely the known and proved methods of prevention be obliged to bear a portion of the burden caused by the careless hog raiser, as is the case at present. To-day the hog buyer must make his purchases with the absolute knowledge that a certain proportion of his purchase will be condemned for tuberculosis, and as the post-mortem examination is the only key to the extent of the disease, the careful breeder must suffer equally with the careless one. This is not equitable. When the packer buys subject to the post-mortem results the intelligent hog raiser will get more for his healthy hogs than he does now, and the careless breeder will get less for his tuberculous hogs, which is as it should be.

Extermination of hog tuberculosis is practicable, relatively easy, and should be attained without delay before the disease has gained too much headway.

**LIST OF PUBLICATIONS OF U. S. DEPARTMENT OF AGRICULTURE
RELATING TO HOGS.**

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

- Pig Management. (Farmers' Bulletin 205.)
Hog Cholera. (Farmers' Bulletin 379.)
Feeding Hogs in the South. (Farmers' Bulletin 411.)
Hog Houses. (Farmers' Bulletin 438.)
Boys' Pig Clubs. (Farmers' Bulletin 566.)
Breeds of Swine. (Farmers' Bulletin 765.)
How to Use Anti-hog-cholera Serum. (From Farmers' Bulletin 590.)

**FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING
OFFICE, WASHINGTON, D. C.**

- Chemical Composition of Carcasses of Pigs. (Bureau of Chemistry Bulletin 53.) Price, 5 cents.
The External Parasites of Hogs, being articles on Hog Louse (*Hæmatopinus Suis*), and Mange, or Scabies, of Hogs. (Bureau of Animal Industry Bulletin 69.) Price, 5 cents.
The Etiology of Hog Cholera. (Bureau of Animal Industry Bulletin 72.) Price, 25 cents.
The Bacteriolytic Power of the Blood Serum of Hogs. (Bureau of Animal Industry Bulletin 95.) Price, 10 cents.
Filtration Experiments with *Bacillus Cholerae Suis*. (Bureau of Animal Industry Bulletin 113.) Price, 10 cents.
The Roundworms of Domestic Swine, with Special Reference to Two Species Parasitic in the Stomach. (Bureau of Animal Industry Bulletin 158.) Price, 10 cents.
Relative Proportions of the Sexes in Litters of Pigs. (Bureau of Animal Industry Circular 112.) Price, 5 cents.
The Danish Hog Industry. Price, 5 cents.
Embryonal Adenosarcoma of the Kidney in Swine. Price, 5 cents.
Inheritance of Fertility in Swine. (In Journal of Agricultural Research, March 20, 1916.) Price, 15 cents.
The Control of Hog Cholera by Serum Immunization. Price, 5 cents.
Field Tests with Serum for the Prevention of Hog Cholera. (In Bureau of Animal Industry Report, 1908.) Price of entire volume, cloth, 70 cents.
New Facts Concerning the Etiology of Hog Cholera. (In Bureau of Animal Industry Report, 1903.) Price of entire volume, cloth, 50 cents.
Pasture and Grain Crops for Hogs in the Pacific Northwest. (Farmers' Bulletin 599.) Price, 5 cents.
The Boys' Pig Club Work. (Yearbook Separate 667.) Price, 5 cents.

