BRUCELLOSIS IN SWINE
[Traum's Disease or Infectious Abortion]

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An infected sow may farrow a healthy litter and give no visible signs of harboring the disease. If the disease is suspected, a serum agglutination test of all animals in the herd is recommended.

UNIVERSITY OF ILLINOIS
COLLEGE OF AGRICULTURE: AGRICULTURAL EXPERIMENT STATION AND EXTENSION SERVICE
Circular 435
THE CAUSE of brucellosis in swine is a microorganism, or germ, known as *Brucella suis* (Traum). It is closely related to, but not identical with, the microorganism that causes infectious abortion in cattle and goats. Heavy losses from premature birth of pigs are traceable to this disease.

**Spread.** The disease has been observed most frequently in herds of purebred animals. It is probably spread by apparently healthy gilts, sows, and boars which have been purchased from infected herds.

**Diagnosis.** Isolation of *Brucella suis* (Traum) from aborted fetuses or afterbirths, or from discharges of infected animals, and positive reactions to agglutination tests are the only reliable methods of diagnosing the disease. Not all infected sows or gilts abort. Consequently a record of normal breeding is not conclusive evidence of the absence of brucellosis.

**Control.** All animals in an infected herd should be tested and reactors placed in the fattening pen. Suspected animals and newly purchased animals should be kept in quarantine until freedom from the disease is proved by repeated tests.

**Herd accreditation.** Herds under supervision of accredited veterinarians and enrolled in Project 1046 of the University of Illinois Agricultural Experiment Station, and which give two annual or three semiannual negative tests, are accredited free from brucellosis by the State Department of Agriculture.

**Communicable to man.** Brucellosis of swine is communicable to man. The disease in man is known as undulant fever. Persons handling infected animals or aborted materials from infected animals should use every possible precaution to avoid acquiring the infection.
Brucellosis in Swine
[Traum’s Disease or Infectious Abortion]

By ROBERT GRAHAM, Chief in Animal Pathology and Hygiene, and VIOLA M. MICHAEL, First Assistant in Animal Pathology

BRUCELOSI$S$, brucelliasis, infectious abortion, contagious abortion, abortion disease, and Traum’s disease—all are names that have been applied to a specific infectious disease frequently causing heavy losses in livestock. This disease, characterized chiefly by premature birth of the young, has been recognized in practically every domestic animal, especially in cattle, swine, and goats, and is caused by a group of closely related microorganisms known as Brucella. Of the Brucella group, the only member that naturally infects swine is \textit{Brucella suis} (Traum). This microorganism usually invades the placenta and causes changes which interfere with the oxygen supply, nourishment, or normal development of the fetus. Abortion often follows, altho many sows harbor the infection but give birth to apparently normal litters.

The terms “infectious abortion” or “contagious abortion,” popularly applied to this disease, are somewhat misleading, since the act of abortion is merely one manifestation of swine brucellosis. Not all infected sows abort. The disease unaccompanied by abortion may be manifested by sterility, lameness, stiffness, and unthriftiness. Furthermore, not all abortions in sows are associated with \textit{Brucella suis}. Streptococci have been isolated from the discharges of aborting sows as well as from aborted fetuses. Experimental evidence regarding the abortifacient properties of streptococci isolated from aborted fetuses does not, however, definitely prove their relation to the act of abortion. Altho sporadic outbreaks of streptococcic abortion probably occur, this type of abortion is not widespread.

Abortion in swine may occur as a result of causes entirely apart from either streptococci or \textit{Brucella suis}; it may follow injury from


2The genus Brucella is named after Major Bruce, an English investigator who first described the infection in goats (1887). Dr. Bang of Denmark first described the cause of this disease in cattle (1896). In the United States the causative factor was first described by McNeal of the Illinois Agricultural Experiment Station (1910). His work was followed by that of Dr. Traum, of the U. S. Bureau of Animal Industry, who first described the cause of the similar disease in swine (1915). Thus Traum's disease refers to Brucella infection in swine and Bang's disease to similar infection in cattle.
rough handling, or it may be brought about by such diseases as hog cholera, hemorrhagic septicemia, or influenza. It has also been considered possible that nutritional disturbances have caused abortion in some herds.

Prevalence of Brucellosis in Swine

Brucellosis, or Traum's disease, in swine, accompanied by premature birth of young, has been reported from nearly every hog-raising section in the United States. It was first definitely recognized in Illinois in 1920, when agglutination tests of blood samples from Illinois hogs at a Chicago slaughter house revealed 5.6 percent positive reactions among 1,011 sows tested. During the years from July 1, 1931, to June 30, 1934, evidence of brucellosis was encountered in twenty-six herds in twenty-two different counties in Illinois (see page 12).

Since no special attempt has been made to test a large number of swine (only 1,236 during 1931-1934), brucellosis is probably more prevalent than the map indicates. Its actual extent cannot be estimated accurately from information at hand. That it exists in various localities is known from results of specimens examined in the University of Illinois Laboratory of Animal Pathology and Hygiene. Brucella microorganisms have been found in some aborting herds, while in others the presence of the disease has been detected only by the agglutination test. The most serious losses have occurred in purebred herds; often the source of the disease has been traced to the purchase of infected purebred sows, gilts, or boars. During outbreaks of brucellosis on some farms as high as 30 to 40 percent of the bred sows aborted.

History of an Outbreak

The history of brucellosis in one herd may be of interest to owners who suspect the disease in their animals.

The fifteen sows shown in Fig. 1 aborted in January, February, and March. These aborting sows were from one to five years old. Forty sows of the same herd farrowed normally. Nine of the fifteen, or 60 percent, farrowed normal litters at the first farrowing following abortion. Three of the fifteen aborted two consecutive times. One sow farrowed normally in the first pregnancy following abortion and then aborted during the second pregnancy. Two that aborted failed repeatedly to conceive and were regarded as nonbreeders.

The results of the agglutination test of 1,011 blood samples taken from sows revealed 5.6 percent positive. Of 975 samples taken from gilts, 4.41 percent proved positive; and of 1,034 samples from barrows, 3.38 percent were positive.
Each of the fifteen aborting sows gave one or more positive reactions to agglutination tests made monthly after the abortions. Five of the nine sows that farrowed normally at the next farrowing following abortion gave positive agglutination tests; the other four sows showed a questionable or suspicious reaction at the time of normal farrowing. *Brucella suis* was isolated from the dead fetuses of an aborting sow that later farrowed six healthy and four weak or dead pigs.

Some sows farrowing normal litters after having previously aborted gave positive agglutination tests for as long as ten months after aborting, and at the time of the test healthy litters were being suckled. In other sows the monthly agglutination tests made from the time of abortion thru the succeeding farrowing period showed a gradual tendency to a negative reaction at farrowing time. Of two non-breeding sows, one was positive to the test for ten months after aborting.

The Brucella microorganism which causes abortion in swine may remain in the nonpregnant womb or in the ovaries of infected sows for several months. There is also evidence that this microorganism may be present in the milk of breeding sows, in the mammary glands of non-breeding sows, and in the testes and accessory glands of the reproductive organs of infected boars.

**No Reliable Symptoms to Distinguish Brucellosis**

The prevalence of brucellosis in a herd cannot be determined on the basis of the number of sows that abort, for infected sows may farrow healthy litters and give no visible signs of harboring the disease. On the other hand, as stated previously, not all abortions are due to infection with *Brucella suis*. The disease doubtless exists in many herds without the owners' knowledge, and often the purchase of bred sows from supposedly clean but actually infected herds has been the means of spreading the disease from herd to herd. In fact attempts to judge the presence or absence of the disease on the basis of the number of
abortions in a herd probably have played an important part in the introduction of infection into healthy herds.

Brucella microorganisms may be the cause of abortion as early as 26 days following conception, but since the aborted fetuses are often eaten by the sows, abortions in the early stages of the gestation period may escape attention. Close observation of sows, however, will usually reveal when an abortion has occurred, for during a few days following the act of abortion a whitish vaginal discharge may be observed. Whether abortion has been caused by Brucella infection or other circumstances is not indicated by the character of the discharge.

In one severe outbreak of brucellosis it was noted that the sows aborted from the third to the thirteenth week of pregnancy (Fig. 2). Many infected aborting animals, however, later gave birth to normal litters.

**FIG. 2.—A PIG FETUS ABORTED AT NINETY DAYS**

Whether an abortion is due to *Brucella suis*, as in this case, or to some other cause, can be determined only by bacteriological examination or by an agglutination test of the blood of the aborting animal.

Lameness may occur as a manifestation of brucellosis. Brucella microorganisms frequently inhabit the joints and marrow of the long bones of the legs or the bones of the vertebral column, where they cause localized abscesses. When the bones, joints, or tendon sheaths in the legs become infected, the animal shows symptoms of lameness and stiffness. Examination may show abscesses in the ends of the long bones of the legs if the stiffness is due to Brucella infection (Fig. 3).
BRUCELLOSIS IN SWINE

FIG. 3.—BRUCELLOSIS OF BONES AND JOINTS

The spongy tissue of the front leg bone of the pig in the picture at the upper left (A) has become inflamed as a result of Brucella infection. The painful lesions cause the animal to walk or rest on its knees, supporting part of its weight by its head. A longitudinal section of a bone of the front leg of this pig (B) shows the inflamed condition in the end of the bone. The arrows point to abscesses. The cross-section of the end of this bone (C) gives another view of the abscesses. The inflamed ankle joint (D) of another pig infected with brucellosis shows a soft swelling which fluctuated on palpation. Autopsy showed pus in the joint and roughened areas on the ends of the bones.

Finding of Brucella Microorganisms or Agglutination Test
Only Sure Basis for Diagnosis

While the aborting of several sows in an otherwise healthy herd suggests the presence of the infectious type of swine abortion, a positive diagnosis is dependent upon finding Brucella suis in the aborted fetuses, afterbirth, vaginal discharge, or colostrum (first milk), or upon obtaining a positive reaction to the blood serum agglutination test. The blood test is much simpler than the isolation of Brucella suis and may be made by a local veterinarian equipped for this work (Fig. 4).
A positive agglutination test means that the animal is or has been infected with *Brucella suis*. A negative reaction does not, however, always mean freedom from the disease, for animals incubating the disease may react negatively. It is therefore necessary to retest negatively reacting animals in infected herds after an interval of 30 to 60 days, when the infection, if present, will have had time to develop far enough for the blood serum to give a positive agglutination test. Blood samples taken from infected sows just before or immediately after they farrow or abort may also give negative reactions. When this happens, a retest should be made in one to two weeks in order to make certain whether the disease is or is not present.

**Fig. 4.—Rapid Agglutination Test for Brucellosis**

The agglutination test is made by mixing definite amounts of clear blood serum from the animal to be tested with a definite amount of antigen, which is a physiological salt suspension of Brucella microorganisms. If the microorganisms clump, as shown in the first two samples, marked "Pos.," the test is positive for brucellosis. If there is no clumping, as shown in the samples marked "Neg.," the test is negative. In order to make sure that the microorganisms are not self-agglutinating, an antigen control (A.C.) is always made.

**Boars May Be Infected**

Boars as well as sows should be tested when the disease is suspected in a herd. That boars become infected has been shown by the serum agglutination test and by the finding of Brucella microorganisms in the testes and accessory glands of the reproductive organs. Sometimes swelling of the testicles is evident. One case has been reported in which the testicles weighed 14 pounds each. This animal lost weight rapidly (200 pounds within approximately two months), and became progressively worse until he was unable to get up without help. Autopsy showed no disease except infection with Brucella.

**Young Pigs Resistant to Brucellosis**

It has been suggested that infectious abortion may be responsible, in some degree, for baby pig mortality during the first five to ten days of life, but no evidence has been obtained to show definitely that any significant number of pigs die from abortion infection after having been healthily farrowed, even in herds where the disease is known to
exist. Pigs nursing dams that harbor abortion bacilli in the mammary gland have been found to be highly resistant to the disease.

The danger of causing abortion or of establishing permanent carriers by exposing young pigs to infection is apparently insignificant. In fact female pigs injected subcutaneously at weaning time with virulent swine abortion bacilli apparently overcame the infection, as proved by the farrowing of normal litters, the absence of *Brucella suis* in the colostrum and afterbirth, and by negative serum agglutination tests at and following farrowing.

**Modes of Transmission**

Swine brucellosis is usually contracted thru the alimentary tract. Susceptible sows may become infected by eating fetuses and afterbirths from reacting sows; or pigs drinking colostral milk of infected sows may, thru their droppings, contaminate the feed and water of susceptible animals. There is also the possibility that infected boars may spread the infection to sows at time of breeding.

**Protecting Healthy Herds Against Brucellosis**

To protect a healthy herd against the introduction of brucellosis, all newly purchased breeding stock, even tho apparently healthy and from nonaborting herds, should be quarantined until a negative blood test is obtained. Carriers of the disease, as well as animals actively infected, can be eliminated in this way. The spread of the disease thru public and private sales can be prevented or greatly reduced by applying the agglutination test to all animals purchased at sales and withholding positive reactors from the herd.

All newly purchased bred sows should be kept in quarantine until after they farrow and prove negative to two agglutination tests for brucellosis. Nombreeding sows should also be isolated until at least two negative tests at 30- to 60-day intervals prove that they are free from the disease.

One hundred twenty-two veterinary practitioners in Illinois have been accredited for preliminary testing of herds. Accreditation of herds enrolled in Project 1046 of the Illinois Agricultural Experiment Station is handled by the Chief Veterinarian, State Department of Agriculture. Accredited veterinarians make all preliminary tests, but final tests of each herd preceding accreditation are checked by the University of Illinois Laboratory of Animal Pathology and Hygiene. Herds that give two annual negative tests or three semiannual negative tests may qualify for brucellosis-free certificates.
To Eradicate Disease From Infected Herds

The successful control and eradication of brucellosis in infected herds requires the destruction of infection in hog houses, the isolation of aborting and nonaborting sows which harbor the disease, and the burning of aborted materials. Nonaborting infected animals may act as carriers of the infection and escape the owner's attention unless the agglutination test is applied to normally breeding animals as well as to aborting animals.

Houses and pens where abortions have occurred should be thoroughly cleaned and disinfected with a 3-percent compound cresol (U.S.P.) solution or its germicidal equivalent. Infected sows should be fattened for market, but if it is not practical to market valuable breeding animals which have aborted and which have been proved by the agglutination test to be infected, they should be kept in isolation and not be bred until the vaginal discharge subsides.

A boar should not be used to serve both infected and noninfected sows. Infected boars should be castrated.

Pregnant gilts should not be allowed with old sows which have aborted or with sows or boars which react positively to the serum agglutination test.

Medicines, vaccines, bacterins, and serums have not proved of sufficient value to warrant their use. In fact, vaccines may be dangerous and should not be used except under unusual conditions and with careful supervision.1

Valuable assistance in taking blood samples for the serum agglutination test and in applying sanitary measures for the control of this contagious disease may be obtained from a competent veterinarian.

1Living vaccines have been administered to female pigs two months old in herds that were known to be infected. The results observed in one herd seem to show that no immediate or direct injury is caused by the treatment, but convincing evidence that vaccines are of any practical value was not obtained. In one experiment extending over a period of three years (to test the value of living-culture vaccine in an infected herd) no abortions occurred among the vaccinated animals, whereas from 12 to 25 percent of the unvaccinated animals aborted. Notwithstanding the fact that vaccines properly administered before breeding age may reduce the abortion rate, the potential danger of vaccinated pigs becoming carriers of the disease precludes the use of abortion vaccines in control measures until further evidence of its value is obtained. The objective in controlling swine brucellosis is to stamp it out. The potential danger of introducing this infection into a herd by vaccination is recognized. Furthermore pigs from infected purebred herds that supply stock for breeding purposes might, if vaccinated, carry the disease to healthy herds.
Relation of Cattle Abortion to Swine Abortion

It has not been established that swine can contract brucellosis from infected cattle, but it is known that cattle can be infected with \textit{Brucella suis}. Every possible safeguard should therefore be employed to prevent the disease from being passed from swine to cattle. Pregnant cows should not be allowed in lots or fields with an aborting herd of swine. Pregnant swine should not be fed milk from aborting herds of cattle, even tho experimental evidence indicates only slight danger in this practice.

\textbf{Brucella Suis and Undulant Fever in Man}

\textit{Brucella suis} is the cause of many cases of brucellosis (undulant fever) in man. During the five years 1929 to 1933, 6,708 cases of undulant fever were reported to the United States Public Health Service, every state except Utah reporting four or more cases. The highest numbers of cases were reported in the following states: New York, 969; *Iowa, 595; *Missouri, 533; California, 515; Ohio, 480; *Illinois, 407; *Kansas, 346; *Minnesota, 295.

Of the above states, the five starred have hog populations of over three million each. It would thus appear that there may be a significant relation between the incidence of undulant fever in man and the size of the swine population.

Infection of man with \textit{Brucella suis} usually occurs by way of the skin, rarely by mouth. Veterinarians, workers in packing plants, butchers, farmers, and stock breeders—any individuals who handle infected animals—are subject to infection with this microorganism. The fetuses, afterbirths, and uterine discharges of animals are special sources of danger. The majority of reports indicate that when exposure to infective material takes place, the persons exposed develop either active immunity or active infection. Interhuman transmission of the infection appears to be negligible, as the disease seems never to be removed more than one person from the animal.

Recognition of the disease depends upon close observation of clinical symptoms, a positive agglutination test, and isolation of \textit{Brucella} microorganisms from blood or body discharges.

\footnote{Dr. F. J. Jirka, Director of the Illinois State Department of Public Health, states: "Today upwards of 4,000 cases [of undulant fever] are reported annually in the United States. Since 1926, the recognized incidence in Illinois has climbed from five to more than 100 cases annually." (\textit{Jour. Amer. Vet. Med. Assoc.} 86, n.s. 39, 524, 1935.)}
No specific remedy for undulant fever has been developed, altho various types of vaccines and dyes have been tried and good results have sometimes been reported. Rest and symptomatic treatment appear to be the only universally accepted methods of treatment. The prevention of the disease in man appears, therefore, to depend upon the eradication of brucellosis in animals, proper sterilization of animal products, and the observance of hygienic principles in handling animals, their products and discharges. For further information concerning undulant fever see Health Educational Circular 49, Illinois State Department of Public Health, Springfield.

Fig. 5.—Brucellosis is widely distributed in Illinois swine herds
This disease lays a heavy tax on swine production. The shaded counties indicate those from which the Laboratory of Animal Pathology and Hygiene at the University of Illinois has received swine blood specimens giving a positive agglutination test for brucellosis (July 1, 1931, to June 30, 1934). The disease doubtless occurs in many of the unshaded counties also.