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AGRICULTURAL
EXPERIMENT STATION

Infectious Abortion

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INFECTIOUS ABORTION
By A. M. Lee and L. H. Scrivner

INTRODUCTION

This is a report upon some preliminary experimental work that has been done at the Wyoming Agricultural Experiment Station upon infectious abortion in cattle during the past ten years. The extent of its prevalence in Wyoming and a general discussion of the disease, including the spread and control, is given. In this discussion the most important works of all the experimental workers in the country will be taken into consideration. All statements made are those which, in the authors' opinion, are substantiated by reliable and convincing research work done in the various parts of the world.

The disease was considered contagious in several mountain regions in England in the beginning of the last century, but it was not until 1896 that its cause was determined.

CAUSE OF THE DISEASE

Infectious abortion is a chronic infectious disease caused by a specific abortion organism with localization in certain organs in the body. The disease is also quite commonly called contagious abortion, abortion disease, and Bang's disease. The last name is the one recommended that it be called, because abortion frequently does not take place in the cattle that have the disease. The term comes from Doctor Bang, who discovered the organism that causes the disease. The name of the abortion organism is Brucella abortus. It is named after Doctor Bruce, who discovered a very closely related organism that causes Malta fever in man. The abortion organism is also commonly called Bacillus abortus, Bang's bacillus, and Brucella abortus. It is one of the smallest rod-shaped organisms known and can only be seen with very high magnification.

OTHER CAUSES OF ABORTION

There are other things which cause abortion in cattle besides infectious abortion. Such abortions due to other causes are rare. The percentage found in a large number of animals in numerous
herds over a long period of time has been between one and a half and four per cent when the herds are free from infectious abortion. Where animals are properly fed and cared for, the percentage may not be even this high. In one herd in Wyoming which has consisted of an average of ninety breeding cows, careful records show seventeen abortions in the past eleven years. Ten of these reacted to the test which showed that they had infectious abortion. So in reality in eleven years in a herd of ninety breeding animals there were seven abortions from causes other than infectious abortion. This is less than one per cent. In Wyoming range herds there will, of course, be a higher percentage of abortions than this even in clean herds. However, the percentage will not be great unless infectious abortion is present. Some claim that the eating of pine needles by cattle on the range is the cause of considerable abortion. This has never been proved experimentally, and feeding tests have given negative results in producing abortion from pine needles. Some abortions are encountered in range cattle found negative to blood tests, and these cattle have been known to eat a considerable amount of pine needles. It is possible that if an animal is eating a large quantity of pine needles, the range is poor and she is not getting enough food to nourish a foetus, an abortion of it may follow.

Efforts on the part of investigators over the country to produce abortion consistently by mineral and nutritional deficiencies have, in general, not met with success. Cattlemen, after having a

Fig. 1. *Brucella abortus*—the cause of infectious abortion in cattle (magnification 1300).
number of cows abort, have thought that the cause was a deficiency and have fed iodized salt, monobasic potassium phosphate, bone meal, and various other mineral preparations only to have the abortions appear the following year when feeding these minerals. Some believe that strong alkali water will produce abortion. There are no grounds for this belief.

The abortions in clean herds sometimes occur under conditions not well understood. Chronic infections of the uterus or womb existing at the beginning of pregnancy are occasionally the cause. These infections are due to other organisms. Spoiled feed and injuries produce a few abortions.

ANIMALS AFFECTED AND SUSCEPTIBILITY

Cattle are the only animals in which *Brucella abortus* is known to produce infectious abortion. Infectious abortion in hogs is thought to be produced by a very closely related organism, *Brucella suis*, and it is believed that swine do not contract abortion from cattle and cattle rarely contract the disease from hogs in Wyoming. Abortions in sheep and also in mares are probably different diseases with other causes. Some authors report that abortion in sheep has been produced by the organism causing the disease in cattle. Abortion in sheep is rare in Wyoming, and when it exists it is doubtful if it is caused by the organism that causes abortion in cattle.

All breeds of cattle are equally susceptible, although the percentage found diseased in dairy herds following several sudden abortions is higher due to the more confined conditions under which these animals are kept. The pregnant animal is most liable to infection, but any sexually mature animal may become infected. Calves from infected cows seldom have the disease from the time they are several months old until they are bred. There is an occasional calf which, if raised on milk from an infected cow, will carry the infection through to breeding age. However, nearly all unbred heifers cease to react positively to the blood test when they are several months old.

Some cattle in every herd are very resistant to the disease and never contract it. They remain negative to blood tests and
never abort, although in constant contact with the infective material. This group is not large. The largest group of the infected animals will abort once or twice, become "shy breeders" for a while, then get settled with calf after an irregular breeding record. These develop great resistance to the disease and carry calves to full term but serve to spread the infection in their discharges following calving and frequently in their milk also. There are two more small groups. In one of these, cows will abort many times and are very hard to get bred, and in the other the cows will abort once and become sterile.

Bulls are susceptible to the disease. The percentage of them that are infected is much smaller than the percentage of cows. This is especially true of Wyoming range bulls, which have been found by blood tests to be comparatively free from the disease.

It has been reported that young calves from infected cows have the disease in the form of infectious pneumonias and scours. It is doubtful if these pneumonias and scours are directly produced by the abortion organism. Calves from infected cows often are weaker and more susceptible to pneumonias and scours than those from normal mothers.

IMPORTANTANCE

This is the most common cattle disease in the world and is very widespread over the state of Wyoming. Probably ninety-five per cent of all abortions are due to this disease, and both beef herds and dairy herds suffer considerable loss from it. Without doubt it causes more economic loss to the cattle industry in this state than all other cattle diseases combined. These losses consist not only of the actual abortions, still borns, miscarriages, premature births, and "slinkings," but sterility, "shy breeders," retained placentas or failure to clean, and loss of milk supply are very commonly caused by infectious abortion. Diseased cows frequently have disorders of the ovaries and also the uterus, or womb, which make it necessary to breed them five or ten times before they are with calf, and many times they are permanently sterile.
The number of cows per bull is not the only factor in the percentage calf crop. When the percentage calf crop is under seventy, unless one has an enormous number of cows per bull for his particular type of summer range, infectious abortion should be strongly suspected. The disease is not uncommon in range herds with a much higher percentage calf crop.

Many cattlemen of Wyoming report that they have had from twenty to fifty cows abort in one season and that they have had several dozen cows fail to clean following calving. Reports from dairymen also show they are having losses, although theirs, of course, are scattered over the entire year.

PREVALENCE IN WYOMING

It is not known when the disease was first diagnosed in Wyoming by blood tests. It is certain that it has existed here for over twenty years, and probably abortions in cattle in this state caused by this disease had occurred previously, although blood tests were not made.

In order to determine something relative to the prevalence of the disease in Wyoming, figures have been compiled from complete records, most of which have been made since 1928 but a few of which were made during the two previous years. These records consisted of blood tests upon 4501 samples from cattle. These were all original samples and did not include repeat tests on any animal.* Samples from the University of Wyoming herd were not included in this number. Those under consideration were from 274 herds from sixty-five localities in the state, which are shown in the map (Figure 2.) Every county but one was represented in these tests. Besides this county there were only three others in which no reactors were found. Samples from these counties were not a fair representation for determining if the disease existed in them.

In a part of the 274 herds all the breeding animals were tested, but in most of them only a few were tested, and these were in many cases the animals that were suspected of having

*Dr. Cecil Elder, formerly at this station but now at the Missouri Experimental Station, made some of these tests.
Fig. 2. Towns in the vicinity of the herds from which samples have been tested for infectious abortion.

*One or more infected herds.
°No reactor animals tested.

the disease. There were 179 of these herds which had reactors to infectious abortion tests, and 95 herds in which no reactors were found. In only a few of these 95 herds were all the animals tested. To assume that there were no positive animals in these 95 herds would be incorrect. There is need for a true picture of the condition as it exists in Wyoming. The percentage of infected herds and of clean herds can only be determined by testing all the animals in representative herds, those in which the owner has never suspected the disease as well as those in which trouble has been encountered.

There were 1086 reactors in the 4501 cattle tested, which is a percentage of twenty-four. There were 100 cattle which gave a suspicious reaction, which is a percentage of two, and 3315 or about 74 per cent were negative. This is a very low proportion of animals giving a suspicious reaction. Most workers report that from five to nine per cent of all animals tested give a suspici-
The criterion of what constitutes a suspicious reactor is the one recommended by the Official Research Workers in Animal Diseases of North America and is practically identical to the ones recommended by the United States Livestock Sanitary Association and the American Veterinary Medical Association. It is to be expected that in a state where the tests are original and not follow-up tests, that the percentage of suspicious animals will be smaller.

The twenty-four per cent reactors found is not a fair percentage of the total infection in all cattle in this state. There was a preponderance of animals tested which were, from breeding records, suspected of being infected.

**METHODS OF INFECTION**

By far the most important method of infection is by taking the organism in with the feed and water which have been contaminated with the infective discharges of the diseased animal. The most important infective discharges are the membranes, foetuses, and discharges from the genital organs of infected cows following abortion and also following apparently normal calving. The milk is also an infective discharge. Such discharges, membranes, and aborted calves easily contaminate hay, ranges, stanchions, pastures, pens, lots, and barns. Infection also takes place by one cow licking the discharges from an infected cow. It must be borne in mind that it has been estimated that about sixty-five per cent of the cows that abort only abort once. However, these infected cows that apparently have calved normally scatter millions of organisms in their discharges for an average of three weeks and sometimes as long as two months following calving. The milk of cows that are infected often contains many organisms. It has been found that from sixty to eighty per cent of the badly infected cows eliminate the organism in their milk. The number of abortion organisms in each cubic centimeter, or twenty drops, has been found to be from 110 to 4300, and even as high as 50,000 has been reported. The organism may appear in the milk before abortion and remain for from two to four months, and occasionally for life.
The semen of infected bulls may contain the organism. About ten per cent of the infected bulls eliminate the organism in their semen. If such infected semen is carried on the feet to feed or water, it may infect other animals. Also when the organism in large numbers is introduced into the vagina of susceptible cows, infection may result. The bull which is not infected and eliminating the organism in the semen is not much of a factor in the spread of the disease. It has been impossible to infect healthy cows with healthy bulls which had previously served infected cows.

The bull becomes infected by taking the organism in through the digestive tract, from which place it is carried to the genital organs and neighboring lymph glands.

Just what part young calves, from cows with infectious abortion, play in the spread of the disease is not known. Some workers report finding the organism in the manure of calves receiving milk from infected cows.

The disease has been produced by putting the organism in the eye, on the skin, and in the teat canal. These methods of infection are not of any apparent importance.

In the affected adult animal only a few organs contain the organism. The most important of these are the pregnant uterus, the foetus and its membranes, the udder and adjacent lymph glands in the cow, and the testicles and seminal vesicles in the bull.

After the pregnant cow takes the organisms into her digestive tract they are carried to the uterus, where they localize in the cotyledons, or buttons. They set up an inflammation here, which if severe will cause the attachment of the buttons to the foetal membranes to be destroyed. If only a few buttons are so infected, the calf may be carried to full term and the cow apparently calve normally and even clean. If a large number of the buttons are infected, the supply of nourishment to the foetus is destroyed and the calf will act as a foreign body in the womb and will be thrown out or aborted and will usually be found to be a still born. The dead foetus may remain in the womb for some time.
Infectious Abortion

The organism may also be carried from the uterus, digestive tract, and lymph glands to the lactating udder. The length of time the udder may be infected varies: Sometimes only two or three months, but occasionally for the remainder of the animal’s life.

As a rule, the majority of abortions take place from two to four months after infection. Abortion may occur as early as four weeks after infection, and as late as 230 days after infection. The most common time of abortion is when the cow is five to six months along.

RESISTANCE OF THE ORGANISM

The infective discharges reproduce the disease for long periods after being eliminated from the body. The organisms in the membranes, or afterbirths, aborted foetus, and uterine discharges survive for months. In shady, cool places they remain infective for four months. In moist manure they can still reproduce the disease for one hundred days. In urine and dry manure they die in one day. Sunlight destroys them in four and one-half hours, but if they are covered with membranes or damp manure, the sunlight will not affect them. They are killed in two minutes with a mixture of one per cent commercial hydrochloric acid and eight per cent stock salt dissolved in ordinary water. Such a solution applied to membranes and manure containing the organisms will not be effective, because the organisms will be protected here. Creolin in three per cent solution kills them in five to ten hours, provided the organisms are not in membranes, manure, etc.

Taken as a whole, ranges and pastures will remain infective for several months.

SYMPTOMS

There are no infallible symptoms that are always present. Also any symptoms shown by cattle with infectious abortion may be seen from other causes. Symptoms of getting ready to calve prematurely are strongly suggestive of abortion. The act of abortion is also one that should be regarded as a symptom of the disease. Failure to clean and irregular heat periods are com-
monly seen in cases of infectious abortion. No person can recognize the disease by the appearance of the membranes, foetus, or mature animal. However, taking the history of the herd into consideration, one may be reasonably certain the condition is present in the herd when the symptoms named are shown to any great extent.

DIAGNOSIS AND BLOOD TESTS

When many animals abort in a herd, one can be reasonably sure that it is infectious abortion. Just which animals in the herd may have the disease can only be determined by an agglutination test of the blood. There are two methods of conducting such a test. The clear fluid or serum from the blood is used in each test. One test is called the tube or slow method, and the other the rapid or plate method. Both tests are very efficient, and the two tests agree in most cases. The test demonstrates the presence or absence of immune bodies or antibodies called agglutinins in the blood stream. It does not mean that the cow has or ever will abort if the animal is a reactor, or that she will not abort if she is not a reactor. It does mean that the abortion organism is in the animal’s body and that she may be a spreader of the disease or become a spreader at any time. Cows infected and not carrying a calf will react. There is an occasional infected animal which is eliminating the organism in large numbers in her uterine discharges which will not react to the blood test for thirty to ninety days after an abortion. However, most animals will react positively from three to eight weeks after infection. Sometimes an animal will give a positive reaction in less than two weeks after infection takes place.

Forty-four states now require by law that all cows, heifers, and bulls to be used for breeding purposes must pass a negative blood test for infectious abortion before they can be shipped, trucked, or trailed into the state. Wyoming is one of these forty-four states.

In comparisons of the two tests over a two-year period of time, 1961 blood samples from various parts of this state were tested by both methods. There were 1417 or 72.3 per cent neg
ative and 544 or 27.7 per cent positive. The 1417 or 72.3 per cent were negative to both tests. There were 487 or 25 per cent that were positive to both tests. Forty-three or 2 per cent were positive to the tube method only, and 14 or .7 per cent were positive to the rapid method only.

In Wyoming distances are great and transportation of samples to the laboratory is generally poor. A small amount of haemoglobin or coloring matter in the blood will interfere with proper testing of the blood. Unless the clear serum is separated from the blood before the corpuscles break down and liberate the coloring matter, the blood is not suitable for testing. It appeared to the authors that bacterial growth in serum in transit in warm places might cause false reactions. An effort was made to test the effect of age and temperature upon the average sample of blood collected by the owner. One hundred samples were tested when fresh by both methods. They were kept at temperatures from 60° F. to 42° F. and tested at intervals for twenty-four months. There was little effect upon their reaction to either agglutination test. A few positive samples became negative and suspicious.

COLLECTION OF BLOOD SAMPLES

If there is a veterinarian in the community, his services are needed for advice in the proper method of procedure in each particular case. He can advise as to which animals to test and collect the samples. He collects the blood from the jugular vein in the depression running along each side of the neck. It is hard for the average person to collect blood by this means, and it is also hard to give instructions for collecting it from this vein without giving a demonstration. Some owners have seen it done and can collect from the jugular. They frequently find it helps to use a small, soft rope or sash cord and draw it tightly around the animal’s neck before inserting the needle. This produces pressure in the vein, and pressure is necessary in order to get the blood here. It is best to use a large needle about three inches long and fourteen gauge. But any needle used for vaccination for blackleg may be used. It is best to disinfect needles before
using, and blood and disinfectant must be removed from the needle with clean or boiled water before collecting the next sample with the same needle.

Many cattlemen collect blood by cutting the ear. Blood collected by this method is usually suitable for testing. Care should be taken not to squeeze the tissue to make the blood run, as this crushes the corpuscles in the blood and causes the serum to be stained, so that it cannot be satisfactorily and reliably tested.

About one-half ounce of blood is needed for the test. This should preferably be collected in half ounce vials with straight sides and without a rim. Any drug store can order them. They should be boiled and allowed to dry upside down before being used. These vials should be filled and the corks firmly inserted. They should then be marked so as to identify them as to which animal each is from, and then turned upside down until they are firmly clotted. They may be left in this position for an hour or even over night. The cork may then be removed and it will usually carry the clot out with it, leaving the clear fluid part of the blood in the tube. This clot may be thrown away and the cork replaced in the tube. They are then ready to be tested.

By following the above procedure better samples can be obtained. However, any convenient sized vial may be used, and the test can be run from the blood if this procedure is not followed, but more spoiled samples may be found.

Cattle which have no other certain means of individual identification may be marked with paint or lacquer. This will stay on until the results of the test have been reported, and the positive ones may then be identified.

After samples are ready to be tested, they should be turned over to the local veterinarian, or sent to the State Veterinarian in the office of the State Livestock and Sanitary Board at Cheyenne, or sent to the Veterinary Department of the Wyoming Agricultural Experiment Station at the University of Wyoming, Laramie. The University of Wyoming at the present time charges a small fee for each sample tested.
CONTROL, PREVENTION, AND ERADICATION

The best procedure for control, prevention, and eradication will vary considerably with every herd. There is no set of definite rules that can be given. Each herd is a problem in itself, and the best method of procedure in one herd is often not applicable to another. A local veterinarian should always be consulted if possible, and a plan adopted to suit the particular herd and equipment. He will know the important and less important things to be taken into consideration in the management of the individual herd in order to obtain the most practical goal for that specific herd.

Prevention must be considered from the standpoint of the disease-free herds and also from the standpoint of the infected herds. The most efficient method of protecting disease-free herds consists in guarding against the introduction of the disease by means of infected animals. Diseased animals should not be allowed to run with clean animals, and should not be in the same barn. The purchase of pregnant or mature females, if such purchases are absolutely necessary, should be confined to animals coming from herds known to be free from the disease. The individuals selected should be negative to the blood test. Such newly purchased pregnant animals should be kept from the clean cows until the termination of pregnancy. Then they should be blood tested after they have ceased discharging before being placed in the clean herd. Unbred heifers and bulls may enter clean herds without much danger, if they give one negative test. If possible animals should always be purchased subject to a sixty-day retest for infectious abortion and kept away from clean breeding animals until after this retest. In the management of a clean herd, any sudden abortion or suspected abortion should be considered as evidence of the disease, and animals so suspected should be removed and quarantined until it is proved that the abortion is not the result of infectious abortion. Aborted foetuses and the membranes should be burned or buried, and if possible disinfectant should be applied to the area contaminated by these. Breeding animals returning from shows, fairs, etc., should be kept separate from the clean herd for sixty days and have their blood
tested before replacing in the clean herd, if there is any possibility that they have eaten anything which was contaminated with the discharge from infected cows. In clean dairy herds, care must be taken with any milk from infected cows in order to make sure that it does not contaminate the barn. Infected milk should not be fed to calves unless it is pasteurized.

In infected herds control and management will depend upon a number of factors, and the best and most practical method will vary greatly. The most important of these factors are as follows:

1. Type of herd, that is, beef or dairy.
2. Conditions under which animals are kept, such as barn, pasture, range, or farm conditions.
3. Physical equipment on the premises, such as separate pastures, ranges, corrals, box stalls, etc.
4. Whether the animals run with animals of other herds on the range or in the forest reserve.
5. The presence of a neighboring infected herd with pasture or range directly adjoining.
6. Percentage of infection in the herd, as determined by blood tests or abortions.

When the disease appears, care must be given to the animal that aborts, and also to the one about to abort, in order to control the disease. These animals should be isolated at once, the foetus and membranes burned or buried. If abortion takes place in a barn, the stanchion or stall should be cleaned and disinfected.

Under Wyoming range conditions, especially when animals run with cattle from another herd, it is almost impossible to eliminate the disease and maintain an abortion-free herd after the disease has made its appearance. The routine testing of most herds of range cattle is impractical and impossible during a large portion of the year. The disease can be quite well controlled and losses kept low. Some western workers say that, under range conditions, the limiting of the breeding season to two or three
Infectious Abortion

months is of benefit and advisable. This cannot be recommended for Wyoming because rounding up the bulls is impractical in this state. As a rule the number of cows per bull is too high in Wyoming range herds, and such limiting of the breeding season would lower the calf crop too heavily, especially the first year that abortion infection is extensive in the herd. The common procedure of selling dry cows in the fall is of value in controlling abortion disease in range herds. If the breeding period is so limited, there will be, in infected herds particularly, too many dry cows in the fall of the first year. Under this procedure many cattlemen would not have enough calf crop nor cows remaining after selling the dry ones to continue operations the following year.

In this bulletin in referring to control of abortion under range conditions, the authors do not use the terms "range" and "semi-range" cattle as used by some workers. In this state there are mountain valley ranches and prairie ranches, and the cattle raised are called range cattle, even if they are fed hay every winter. There are few if any cattle in this state which are not fed some hay.

There are a few range herds in Wyoming from which infectious abortion has been eliminated by blood tests, and clean herds are now being maintained. If cattle in the range herd do not mingle with cattle from other herds, this is not impractical or impossible. It should not be attempted in heavily infected herds. The first thing necessary in establishing such a herd is to make blood tests, after the fall round-up, on all breeding cattle and bulls which the owner wishes to keep. Any reactors, if not excessive in number, should be shipped to market. Their calves should be kept, and the dry cows should also be shipped. A second test should be made sixty days after the first test, and if very few reactors are found, these also should be disposed of by shipping for slaughter. Two semi-annual tests and then annual tests thereafter will control the disease and usually result in a clean herd, if care is taken concerning suspicious animals, aborters, and membranes during the winter period when animals are in pastures and meadows.
When undertaking the eradication method as has been outlined, if a high percentage of reactors is found, it will usually be found best to maintain two herds, a diseased one and a clean one, or else maintain a diseased herd under control plans to be outlined later. In maintaining two herds, the object is to gradually eliminate the diseased animals and replace them with heifers from both the diseased and the clean herd. The diseased herd may be run in the pastures and meadows with steers and kept, during the winter, spring, and dangerous calving and discharging time, away from the clean herd. The clean herd will then be handled the same as given before for range herds.

In most range herds infection may be kept at a minimum by a few simple procedures. Too much should not be expected of this plan the first year it is put into operation, especially if it is started in the early spring in heavily infected herds. This is the best plan for most Wyoming range herds. Several animals that abort should have their blood tested to determine if the disease is present. This is usually the start of the control. This plan consists of selling dry cows in the fall and maintaining a separate pasture for cows to calve in. If this is impossible, put them in a pasture with steers and dry cows. When they are near time of calving they may be thus separated from the remainder of the breeding herd and kept there during this dangerous time until they have ceased discharging.

In dairy herds and beef herds kept under farm or barn conditions, the disease can be controlled and finally eliminated. In the management of the infection in such herds, the first thing necessary is a test upon every animal of breeding age. If only a few reactors are found, they should be slaughtered, and if replacement is necessary, it should be with animals that have never been bred. A second test in thirty days should be made, and the reactors also disposed of. The next test should be in sixty days or thereabouts. After the tests show that the herd is clean, it is not necessary to test often unless trouble is suspected. Semi-annual or annual tests are usually sufficient. If the first test on a herd of this type has a high percentage of reactors, it is usually best to segregate the reactors and maintain the diseased herd for heifers for replacements. This segregation may even be done in the same
barn under proper supervision. The diseased herd is gradually eliminated with the replacements.

A few simple procedures will keep infection at a minimum in most range herds. The dry cows should be sold in the fall. During the winter and early spring blood test several animals that abort and remove them from the breeding herd until no longer discharging from the genital organs. If infectious abortion is found from these tests upon the blood, a separate pasture for calving should be used. The cows should be put in this pasture near calving time and left there until discharges cease. If such a separate pasture is impossible, one containing steers and cows that will not be used in the breeding herd is satisfactory. The object is to separate infected animals from the remainder of the breeding herd during the time of greatest danger to pregnant animals. This is the best plan for most Wyoming range herds. Results may not appear great the first year of operation, especially when started in heavily infected herds in the spring.

Many workers in all parts of the country have very conclusively proved that abortion-free herds breed more consistently and produce more calves than infected herds, and also that clean herds do not have nearly so high a percentage of cows which fail to clean. In one Wyoming herd with an average of ninety breeding cows, in which ten animals have reacted in the past eleven years, there have only been twenty-eight retained afterbirths during this time.

VACCINATION

Because of recent experimental work done with vaccines which have been encouraging, some papers read by stockmen and dairymen have given the wrong impression about vaccination. The non-virulent vaccine has not yet been proved to be of value. The slightly virulent vaccines apparently decrease the percentage of abortions when used on open heifers in infected herds several months before they are bred. This vaccine needs more experimental work done with it before it should be used except in badly infected herds under close veterinary supervision, as previously mentioned. Then it should only be used upon unbred heifers at least two months before they are bred.
UNDULANT FEVER AND INFECTIOUS ABORTION

Within the last few years a disease of human beings known as undulant fever has received considerable attention by physicians and public health workers. Undulant fever is caused by an organism called *Brucella melitensis* and is characterized by nausea, headache, backache, and drowsiness. Undulant fever or Malta fever was first recognized as being caused by drinking milk from goats that contained *B. melitensis*. Today many claim that undulant fever can also be caused by drinking milk from cattle that have abortion disease and are eliminating *B. abortus* in the milk. The reason for this is that there are many people contracting a disease similar to undulant fever who never use goats’ milk but do use milk from cows with infectious abortion. Other reasons for thinking that abortion organisms in milk produce undulant fever are that *B. melitensis* and *B. abortus* are very similar in appearance and reactions, and that blood serum from affected persons will agglutinate the *B. abortus* in comparatively high dilutions. Many dairy associations and cities are passing rigid laws relative to the sale of milk from cows affected with infectious abortion. Recent researches by other workers seem to indicate that the most common source of human infection is *B. suis* a related organism from swine, and possibly from milk from cattle infected with this swine organism.

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