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Prevention and Eradication  
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in Cattle

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## ACKNOWLEDGMENT

It is not feasible nor appropriate in a bulletin of this kind to include the voluminous bibliography that has grown around this subject nor even to mention all who have done outstanding work on some phase of infectious abortion in animals. It must not, therefore, be regarded as an invidious distinction if the writer mentions only a few who have contributed fundamental facts of practical value in the prevention and eradication of this disease. Among foreign investigators honor should be accorded Franck, Lehnert, and Brauer for their attempts to establish experimentally the infectiousness of this disease, a half century ago, when methods of biological research were comparatively crude. The names of Nocard and Bang whose genius and labors have contributed enduring knowledge of scientific and practical value will always deserve mention. The researches of McFadyean and co-workers, at a later date, in England, and of Zwick and others in Germany, added new and confirmatory data. Grinsted and Holth greatly advanced the means of practical control in adapting the serological tests to abortion diagnosis. In our own country Schroeder and Cotton and colleagues of the U. S. Bureau of Animal Industry have established useful facts which can be turned to practical account in the control of this disease. The same can be said of Giltner and co-workers of the Michigan Agricultural Experiment Station. The work of Williams and collaborators of Cornell University, has also contributed facts of value which will aid greatly in the sanitary control and eradication of infectious abortion, and especially in the prevention of sterility which is so common a sequel of abortion. The significant forward steps that have been made in a practical way by the veterinary sanitarians of Pennsylvania, Barnes and Church, under the encouragement and leadership of Munce, the Chief of the Service in that State, deserve special commendation.

# Prevention and Eradication of Infectious Abortion in Cattle

J. W. CONNAWAY

## INTRODUCTION

The purpose of this bulletin is a purely practical one; namely, to give cattle breeders, herdsmen, and veterinary practitioners the fundamental facts which are now known relating to the nature of infectious abortion in cattle, and to show how these facts may be used to prevent and eradicate this disease.

The facts presented herein are quite generally accepted by investigators the world over, as having been definitely established, or as being supported by such a weight of careful experimental research and clinical observation as to justify their acceptance and practical application for the control of this disease. Many of these facts have been established or verified at this Experiment Station by the writer and his research associates, Durant and Newman; and later in conjunction with Newman and Crouch and Crisler and Uren in working out different phases of the problem. Reports of these researches have been given from time to time in the Annual Reports of the Experiment Station. From this experimental work and from various other sources the facts that the writer believes will be most helpful to the groups mentioned has been prepared for publication in the present bulletin. Undecided and questionable matters have been excluded for future research. Nothing, however, of really essential practical importance has been omitted. The experience of the author and his colleagues has amply demonstrated the practicability of the measures recommended herein for combating the Bang abortion disease in cattle—which, in the opinion of many cattle breeders and livestock sanitarians, does not hold a second place even to tuberculosis in economic loss.

## I. Fundamental Facts Concerning Contagious Abortion

In the management of either a dairy herd or a beef breeding herd there are a few fundamental facts that must be kept in mind in order to maintain herds free from infectious abortion, or to eradicate the disease if the herd is infected. These facts are:

1. It is an established fact that most of the abortions in cattle herds are due to infectious or contagious form of the disease and that this is induced by the microbe known as the "Bang abortion bacillus"; so-called from Professor Bernhard Bang of Denmark, the discoverer, whose early studies established the relationship of this germ to epizootic abortion disease in cattle.

2. Neglect to regard every case of abortion as being an infectious case (until repeated blood tests prove the contrary) results as a rule in the extensive spread of the disease through the herd.

3. The blood tests, "agglutination" and "complement fixation", are reliable tests for the diagnosis of this disease, as shown by critical research work and by large practical experience. (More than 1,800 herds, including a total of more than 25,000 cattle have been tested for abortion disease by the veterinary department of the Missouri Experiment Station.) The test has been shown to be as reliable for diagnosis of the Bang abortion disease as the tuberculin test is for the diagnosis of tuberculosis.

4. The disease is spread mainly from the diseased cow directly to the healthy cow by a more or less close association of the animals; also by the healthy animal eating bits of the after birth, by licking the tail and rump soiled by discharges from the infected uterus, or by eating stable litter or bedding that has been contaminated by the infected uterine discharges. Transmission by the bull, though not to be ignored, is of relatively minor importance.

5. The infected cow is an active source of danger to other cows as long as there is any discharge from the uterus; that is, from a short time before calving, or aborting, until the cow has thoroughly cleaned. The germs of abortion disease have been found in the uterine discharges of infected cows for six to eight weeks after abortion has occurred.

6. The infected cow is practically a harmless cow, after she has passed the cleaning period of six to eight weeks, and has had the tail, rump, and other soiled parts of the body well disinfected. She is not dangerous again, so far as the uterine infection is concerned, until she has been bred again. The "open" or non-pregnant infected cow does not spread the disease.

7. There is no discharge of abortion infection from the uterus at the "heat periods" following the cleaning period of six to eight weeks; hence, there is no danger of infesting the bull by service, if the infected cow is not bred too soon after abortion or calving.

8. After an infected cow is bred she again becomes a possible source of danger, and must be kept under careful surveillance during the entire period of gestation; since she may abort at any stage of pregnancy. The pregnant infected cow, however, is not a source of actual danger unless there is a discharge from the uterus, in which case there is, as a rule, some premonitory sign of an impending abortion or calving.

9. Bulls may become infected in the same way that cows become infected; that is, by eating materials soiled by the infected uterine discharges. The bull that runs free with an infected herd is more likely

to contract the disease than one that is kept in a separate pen during the intervals of breeding. A bull that is infected with the Bang abortion germs may become sterile from disease of the testicles, and may also transmit the infection to cows. Transmission of the disease by a healthy bull, in a mechanical way during breeding, occurs but seldom and can easily be prevented.

10. An important fact to know about the Bang bacillus is that in spite of its temporary disappearance from the uterus after calving, the cow nevertheless continues as a rule to be a carrier of these germs, and continues to react to the abortion tests. The udder of the cow has been shown to be the more constant habitat of these infectious organisms than the uterus; and, that the uterus becomes infected intermittently, and mainly during pregnancy, by the transfer of infection through the blood stream from the udder, or infected lymph glands.

11. The milk of the infected cow is not entirely without danger as a source of spread of the disease in the herd. For instance, if from gross carelessness the stable floors and stable litter should become badly contaminated from the milk of an infected cow healthy cows might contract the disease. This danger, however, seems to be very slight in comparison with the danger from the uterine discharges in which the abortion germs occur in great numbers.

12. The nursing calf is practically insusceptible to *permanent* infection from drinking the infected milk. The instances are very rare in which the disease has been transmitted permanently from the mother to her calf before the calf has reached sexual maturity; namely, before the uterus and the mammary glands of the young animal are capable of assuming functional activity.

13. The abortion germs have been found in the feces of calves fed on milk containing such germs; on the other hand calves that were sucking infected mothers from birth until weaning time failed to contaminate the pastures sufficiently to transmit the disease to non-reacting pregnant heifers that grazed through the summer upon the same pastures. It would seem, therefore, that under natural conditions the milk from abortion reacting cows is not a dangerous source of infection for the spread of the disease through the herd.

14. An abortion-free herd can be reared with comparative ease from abortion-infected dams. The difficulties are far greater in attempting to rear healthy calves from cows affected with tuberculosis.

15. Some cows which contract the disease and abort develop some degree of immunity or resistance to the Bang abortion infection and may not abort again, while on the other hand some cows abort twice or even three or four times in succession or alternating with normal calving. An absolute immunity does not seem to be conferred as in some other diseases, such as smallpox or diphtheria in the human, or cholera in swine. Moreover, attempts to confer immunity against the

Bang abortion disease by inoculating with the germs of the disease have not given satisfactory results from the point of view of the cattle breeders and dairymen. The "bacterins" or killed abortion germs do not stimulate sufficient immunity, and the "live germ vaccine" is dangerous, producing a permanent infection of the greater number of the cows in the herd, and thus greatly retarding the ultimate eradication of the disease from the herd.

16. The retention of the afterbirth is a frequent sequel of abortion in cows, and a cause of sterility from the invasion of the uterus by pus-forming germs which may produce a chronic inflammation of the uterus.

17. Mammitis (or garget) of a destructive character not infrequently results from the soiling of the udder and teats with the purulent discharges from the uterus of an aborting cow, with a retained afterbirth.

18. Swine suffer from a bacterial abortion disease identical or closely related to the Bang abortion disease of cattle. Swine have been artificially infected with the bovine strains, and cattle have been artificially infected with the swine strains of the disease.

19. Human beings have become infected with the Bang abortion germs from both cattle and swine, by ingesting infected cows' milk, and by handling the aborted fetuses and afterbirths of both species. The disease in man, thus contracted, is known as "undulant fever". The fever is of an undulating or wave-like type—mistaken at times for malaria, typhoid, rheumatic fever or "flu". The attack in some patients is mild, while in others it is severe and with remissions may persist for several weeks or months.

The fundamental facts relating to the nature of the Bang abortion disease, as given in Section I, furnish a rational basis on which to build practical measures for keeping healthy herds free from the disease, and eradicating it from infected herds. In Sections II and III, these phases of the problems are considered.

## II. Prevention of Infectious Abortion in Healthy Cattle Herds

There is a popular impression that infectious abortion disease is present to some extent in practically all cattle herds, particularly dairy herds. Our investigations, however, show that there are many herds that are free from this disease even where some genital trouble has led owners to suspect the presence of the Bang abortion disease. The insidious nature of this disease and the losses suffered when a considerable number of animals become infected emphasize the importance of keeping the disease out of the herd, in order to avoid the more dif-

difficult task of preventing its spread through the herd and eradicating it when it has gained strong headway.

### PROCEDURE

**Blood Test.**—First determine the condition of the herd with respect to the Bang abortion disease by having every animal of breeding age in the herd subjected to the blood test. It is not necessary to test suckling calves or young cattle which have not yet reached sexual maturity, since these young animals as a rule do not harbor the infection permanently until the uterus and the udder are capable of assuming functional activity.

The veterinary department of the Missouri College of Agriculture and Experiment Station makes these tests at a nominal small charge to cover in part the cost of materials used in the testing work. Sterile blood sample tubes, and sterile trocar needles are supplied by the College, with directions for drawing the blood samples and preparing them for shipment. The aid of the local veterinary practitioner is advisable in drawing these blood samples, since on account of their larger experience in surgical technic the blood samples are more likely to reach the laboratory in good condition for the tests.

In interpreting the results of the test in cases that are negative to the test, it is important for the laboratory technicians to know the stage of gestation of the pregnant animals, and whether an abortion has recently occurred or a normal parturition, since a "negative reaction phase" occurs in some animals near the date of parturition and for a short period thereafter. Blank data sheets are sent to every dairyman or cattle breeder who wishes the test made. The data asked for is as follows: First, the identification of the animal and the blood samples, the age of the animal, the date last bred, the date of last normal calving, the date of last abortion or premature calving, the number of full-term calves (number living, number dead), the number of premature calves or abortions (number living, number dead). These data, supplied as fully as possible, give a basis for a more accurate interpretation as to whether an animal is in the doubtful class and should be separated from the herd and retested to avoid spread of the disease in the herd. Moreover, the data often suggest immediate or more remote procedures upon which the laboratory experts can give advice. The clinical information has no bearing upon the results of the test. These tests are reported as they occur, irrespective of what the clinical history of the animal shows. But the determination of the advice to be given the herd owner and the veterinarian depends upon the full study of the results of the test in conjunction with the clinical data. To cite an example; an individual blood sample may be sent to the laboratory with a request for the abortion test but without information concerning the cow. The test is made, found to be negative and the report sent to the owner.

The sample may have been drawn from a cow that has just aborted; and the owner naturally concludes that the cow has aborted from some other cause than the Bang abortion disease. If, however, he had reported that the cow had recently aborted the advice would be given to put the cow on the suspicious list, isolate her from the herd for a period of six to eight weeks and make a retest. In cases of this kind a quicker positive test can, as a rule, be obtained by sending a sample of the colostrum milk, since this contains the reacting abortion antibodies in abundance.

Let us assume, however, that the herd which has been tested shows a negative reaction for every animal tested, and that the history of each animal, as shown by the clinical data indicates no suspicion of abortion infection in the herd; the only problem before the owner, then, is to take proper precaution to avoid introducing the disease into the herd. Infectious diseases are not of spontaneous origin. They are always introduced from outside sources. And in the case of Bang abortion disease, the bringing of an infected animal to the farm is the usual way in which the disease is introduced. The proper precautions are evident; namely, do not allow newly purchased cattle to come in contact with the home herd until fully assured that such animals are free from abortion disease as shown by the blood-tests and the breeding history. Do not send cows away to neighbors' farms to be bred, unless absolutely certain that the neighbors' cattle are free from Bang abortion disease, as shown by official tests of the herd. Moreover, do not endanger the neighbors' herds by sending cows which are not known to be free from the disease. When purchases of breeding animals are made at public sales, even though the cow may have a living calf at her side, keep such cow and calf in quarantine until a blood test has been made under proper conditions. In the purchase of breeding cattle from other breeders, either within the state or from other states, make the purchase, if possible, subject to the results of the serological tests for the Bang abortion disease. Remember that it is safer to purchase unbred heifers which have not reached sexual maturity than to buy mature cows which have had one or more calves. In the purchase of a herd bull, apply the abortion test and reject the positive reactor. If a member of a bull club, do not breed to a bull which is permitted to serve infected cows in the herds of other members of the club. Insist on all members of the club maintaining abortion-free herds. The success of the cooperation in the building up of profitable herds depends as much upon freedom from disease as on the merit of the breeding sire.



### III. How to Handle Abortion Infected Herds of Cattle For Control and Eradication of the Disease

In the preceding section the importance of keeping abortion infection out of clean herds was emphasized, and practical ways of doing this were given. Too often, however, an owner or herdsman, and especially one who has not had previous experience in handling an infected herd, takes but little interest in a disease that has given his herd no trouble, consequently, he may neglect the essential precautions emphasized in the foregoing sections and may take bad risks in the purchase of breeding cows. He may even expose and infect his herd by permitting infected cows from neighbors' herds to be brought to the farm for breeding. In this and other ways already indicated, clean herds become infected, and the question most often uppermost in the mind of the breeder is how to get rid of the trouble *now* causing serious damage to his herd. This phase of the subject is here considered:

#### PROCEDURES

1. If abortion occurs in a herd, isolate the animal promptly. Do not take the risk that the abortion was due to an accidental injury or shock, or to some non-specific infection.
2. Destroy the aborted fetus and afterbirth; burn or bury them deeply, adding quick-lime before covering with earth.
3. Disinfect the stall and stable litter where the abortion occurred. Use Compound Cresol (U. S. P.) or other good disinfectant. If the abortion occurred in the open field, or in the cattle-yard, cover the spot with freshly slaked lime, or sprinkle thoroughly with a disinfectant which has a disagreeable odor to prevent healthy cattle from licking up the infected material.
4. Give attention to the quarantined cows as follows:
  - (a) If the afterbirth has been retained, consult the local veterinarian who will give appropriate treatment to prevent complications leading to chronic inflammation of the uterus, or to other conditions that may result in temporary or permanent sterility.
  - (b) For several days after the abortion has taken place, sponge or spray the rump, tail, vulva, escutcheon, or other contaminated portions of the body with an antiseptic solution, such as a three to four per cent Compound Cresol solution or other standard disinfectant in proper strength. At the same time spray the stall and contaminated bedding with the same disinfecting solution. This will prevent carrying infection on the stableman's feet to the stalls occupied by healthy cattle. Place the stable litter where healthy cattle cannot come in contact with it, and later

spread it upon cultivated fields where it will be plowed under, and not upon the grazing pastures. In the summer time an isolated half-acre paddock will serve the purpose of quarantine quarters, and will lessen the labor.

(c) Keep the abortion cow in quarantine until uterine discharges have ceased. The period of quarantine should not be less than three weeks and preferably six to eight weeks. Before releasing from quarantine, sponge or spray the rump and tail, and other parts of the coat of the animal liable to contamination, with a disinfectant which has a sufficiently disagreeable odor to prevent healthy cows from licking the soiled parts.

5. While the cow is in quarantine have a blood test made in the following manner:

(a) Draw a blood sample from the jugular vein into a small, clean vial by means of a hypodermic needle, and after the blood sample has clotted firmly send it by parcel post to the Veterinary Department, Missouri Experiment Station, Columbia, Missouri, where the diagnostic tests for abortion disease will be made. Tubes, needles, and directions for drawing the blood samples are sent on request. The local veterinary practitioner will give assistance in drawing these blood samples and in preparing them for shipment to the laboratory, when such assistance is desired.

(b) If the first sample of blood, drawn soon after the cow aborted, proves to be negative to the test, draw another sample in ten or fifteen days and have a retest made. (It occasionally happens that the blood serum of a cow that has recently aborted does not contain sufficient reacting "antibodies"—in a free state—to give the specific reaction). If convenient, also send a sample of the "colostrum" or first milk. This fluid contains the reacting "antibodies" even when they are apparently absent from the blood of an infected cow. As a rule, however, the blood reacts strongly both at the time of parturition and at later periods. If, therefore, a negative reaction is reported on the colostrum sample drawn soon after the cow aborted, and on the blood samples drawn at the end of the quarantine period of six to eight weeks, the probabilities are that the cow aborted from some other cause than the Bang abortion disease.

6. Proceed as promptly as possible, after an abortion has occurred, to determine the full extent of the infection in the herd by testing *all* the sexually mature breeding cows in the herd, and the mature bulls as well. There may be other infected animals in the herd that are not suspected, that are "carriers" and dangerous distributors of the Bang abortion bacteria. For instance, cows that have previously aborted but have become somewhat resistant to the infection. Such a cow may

have been purchased at a sale, and the fact that she is an infected cow and likely to spread infection at every calving period may not be known until the blood tests reveal that she is a reactor.

It is not necessary to test suckling calves, or young heifers and young bulls, that have not reached sexual maturity; since the heifers, as a rule, do not become permanent carriers and potential distributors of abortion infection until the uterus and mammary glands are sufficiently developed to be capable of functional activity; and thus provide more favorable conditions for the permanent infection of the animal. Every young cow, however, that has reached breeding age should be tested, even though she has not been bred, since the non-pregnant heifer at this age can contract the disease by eating infected materials, and may become a source of danger after breeding.

7. After the test of the herd has been made the following steps are important:

(a) Mark or identify in some plain manner all the reacting individuals.

(b) If convenient, separate all the reactors from the non-reactors in different pastures and barns, to facilitate proper handling and observation as well as to lessen the risk of spreading infection to the healthy animals.

(c) Make a careful appraisalment of the worth of the reactors as breeding animals or as milk and butter producers; keeping in mind, with respect to the latter, the possible dangers to human health from an infected milk product.

(d) Sell to the butcher all reactors that are not of special merit; such as old cows that have about reached the end of their usefulness; animals of defective conformation, poor milkers, unthrifty hard-keepers, uncertain breeders, cows with bad udders, cows affected with persistent leucorrhoea, metritis, or other genital ailment that has not yielded to expert treatment. The greater the number of reactors of the classes mentioned that are sent promptly to the butcher, the better it will be for the owner of the herd, and for the industry. It will lessen the number of potential distributors of abortion infection to be kept under surveillance, and will hasten the day when the herd will be free from the disease. *The ultimate elimination of all reactors is the end to be striven for.*

*Do not sacrifice animals of special merit.* Although it is desirable to cull out every unfit animal that is an abortion reactor, it would be highly imprudent to sacrifice any breeding animal of exceptional merit. The questions of the conservation of blood-lines, and the perpetuation of a highly developed milking capacity in the progeny of outstanding cows or bulls must be given careful consideration; otherwise the future productive capacity of the herd will be lowered, and the breed itself will

suffer. Fortunately, such animals as are worth saving, for the purposes mentioned, can be kept on a farm without great danger of spreading the disease, if proper facilities for handling the infected animals are provided, and a right program of herd management is followed. Some of these infected cows will abort again, and a few may abort three or four times in succession, or in widely separated pregnancies; and practically all will remain reactors and potential distributors of the infection throughout life; yet many valuable animals will become quite regular breeders, and their progeny with but few exceptions can be reared free from the abortion disease.

In our experimental work, and in many practical demonstration tests, this has had ample verification. For instance, several years ago the University dairy herd was badly infected with this disease; about sixty per cent of the animals were reactors. The disease, however, was eradicated without loss of desirable blood lines or productive capacity, and for a period of seven years no reactions nor losses from the Bang abortion disease occurred. Every Jersey in the herd traces to an abortion infected dam, granddam, or great granddam. Moreover, twenty-five per cent of the Holsteins in the herd also trace to abortion infected ancestors formerly in the herd. The herd at present numbers more than a hundred animals all abortion free; besides, during the past several years a large number of non-reacting animals—bulls and heifers—have been sold from the herd. The maintenance of the herd free from the Bang abortion disease during these several years has been due to the use of blood tests and careful herd management.

In a smaller group of beef bred cattle—grade Herefords—that has been on experiment for several years, in the study of the nature of the disease and modes of infection, healthy progeny have been reared; although the abortion infected dams remained reactors and carriers of the infection.

**Care of the Reactors.**—To prevent the spread of the disease in herds containing one or more infected animals a careful watch must be kept upon all the infected pregnant cows, as long as they are in the herd, and in contact with mature non-reacting cows; and, whenever an infected cow shows signs of premature calving, she must be removed promptly from the herd into quarantine quarters, and handled as described in a preceding section during the several weeks of isolation. Moreover, it must be kept in mind that an abortion reactor may discharge dangerous infection in the afterbirth, even though she carries her calf full time and drops an apparently healthy vigorous calf. The owner of abortion infected cows should, therefore, make it a routine practice to separate every abortion reactor from the herd ten or fifteen days before the calving date, since it is not uncommon for a slight oozing from the uterus to occur several days before calving. Keep the

cow and calf isolated for at least three weeks, and preferably six or eight weeks. Disinfect the afterbirth, discharges and contaminated stable litter in the same manner as described for handling an aborting cow. In the case of infected cows which have become quite regular breeders, a small isolated paddock may be used for calving instead of the calving stable—due care being exercised to destroy the afterbirth, and to sponge or spray the rump of the cow daily until the uterine discharges have ceased. The infected cow, after this period of isolation and cleaning can be returned to the herd without danger of transmitting the disease until the next calving at full term or prematurely.

The management of the abortion reactors following the brief period of isolation and cleaning, and disinfection, requires no special care, so long as the cow is not bred. During this non-pregnant stage the infected cow may be kept indefinitely in close association with healthy susceptible cows without danger of transmitting the disease; since under the conditions named there is no discharge of the abortion infection from the uterus, even during the "heat-periods". After breeding, however the cow again becomes a potential source of danger, though not an *actual* source of danger, until a discharge from the uterus occurs, either at a normal or abnormal parturition. Success, therefore, in handling a herd containing abortion reactors, under conditions where it is not possible or feasible to separate the reactors permanently, depends upon keeping an accurate record of the breeding dates of the reactors so the stage of gestation may be known, in isolating promptly every pregnant reactor whenever any signs of calving occur, whether prematurely or near the normal calving date, and in keeping these reactors away from the herd until the infectious discharge from the uterus has ceased and proper disinfection has been carried out.

**Control by Complete Segregation of Abortion Reactors.**—While the foregoing method of temporary segregation of abortion reactors has given satisfactory results in the hands of careful herdsmen, failure comes to those who neglect to carry out faithfully the simple essentials of the plan. Complete and permanent segregation of the abortion reactors into a separate group is the safer and more satisfactory plan, where conditions will permit of such segregation. The greater degree of watchfulness required when the reactors are associated with nonreactors is not necessary under this plan. Moreover, the complete eradication of the disease from the group which is being cleaned is more rapidly accomplished, as well as the complete eradication of the disease from the farm.

This plan is especially applicable in the management of herds of registered beef-bred cattle; since as a rule the owner has ample pasturage, and by proper fencing can isolate the infected cattle effectually and without great expense. The plan has proved successful and satis-

factory in the management of large herds of dairy cattle as well as beef-bred cattle. Our laboratory records show that by systematic monthly testing of the entire herd, and permanent segregation of the reactors, a clean abortion-free herd can be established within a few months. The blood tests, however, should be continued for several months as a precaution against dormant infection. Moreover, it should be made a part of the routine management of the herd to retest the non-reactors at least twice a year. Some breeders test every three to four months, and especially if new animals are added to the herd by purchase. There is no need to test the isolated reactors, since as a rule, these remain permanent infection carriers, and should not be returned to the clean herd.

*Cleanliness and Disinfection Essential.*—Good dairy practice requires that the barns and adjacent yards shall be kept clean, and shall be properly disinfected from time to time. This is all the more important in the work of eradicating abortion disease. No sanitary equipment, therefore, is more important than a good spray-pump and tank mounted on wheels so as to facilitate the work of disinfecting the barns. The Compound Cresol (U. S. P.) already mentioned or other standard disinfectants, will prove satisfactory if properly applied. The liberal use of quick-lime freshly slaked, on the barn yards at regular cleaning periods, and on the floors of the barns, is especially recommended. The admixture of the lime with the barn-yard litter will pay the cost in healthier animals, and in more fertile fields where the cleanings from the cow-lots are spread.

*Handling the Segregated Reactors.*—There is a mistaken notion concerning the difficulties of safe segregation of abortion reactors on the safe farm with healthy cows. The facts developed by observation and experiments that the disease is contracted mainly by way of the mouth, by swallowing infected materials, and that at the beginning of an outbreak the disease spreads rather slowly, show that quite intimate contact of the healthy cow with the cow that is discharging infection, is necessary to transmit the disease. Proper fencing, therefore, that will prevent the healthy cow from nosing and licking the soiled tail and rump of the infected cow will in most cases be an adequate quarantine barrier for protection against the disease. Such a partition should be of heavy woven wire (No. 9 gauge) 47 inches high, or better 52 inches, with stays 6 inches apart. The lower portion of the fence should be pig-tight. This wire fencing should be firmly stapled to strong posts set 10 feet apart. One or two well stretched galvanized barb wires, with close-set well pointed barbs, should be attached to the posts above the woven wire. And, as an extra guard against swine breaking through the lower portion, another well stretched string of barbed wire should be tightly stapled to the posts just below the woven wire, and near the ground.

For additional protection to the healthy herd the pasture occupied by the infected cows should be on lower ground than the pasture occupied by the healthy cows, so as to avoid any possible danger of infecting the latter by drainage. The danger would be in washing an afterbirth or soiled bedding from the quarantine-pasture into the clean pasture.

In the handling of badly infected milking herds of large size, the difficulties in the way of complete segregation of the reactors, and at the same time carry on the milking operations, are greater than in handling beef herds. These difficulties, however, are not as great as some would believe since it is not necessary to have two sets of milkers and caretakers to handle the two groups of cattle. The same milking barn can be used by erecting a partition that will keep the reacting cattle apart from the non-reactors, and not impede the operations of the milk man and caretakers.

In the routine milking operations the non-reacting herd should be milked first. This would avoid the possibility of carrying infection on the hands of the milker from the infected cows to the healthy animals. The milk from the two divisions should be kept separate, and the supply from the abortion reactors should be pasteurized, in view of the fact that recent observations and researches have shown that *some* strains of the bovine abortion germ (Bang) are capable of producing serious illness in human beings; an illness known as "undulant fever"—a fever similar to the Malta fever produced by drinking goats' milk infected with a germ similar to the abortion germ of cattle and swine. The symptoms, as previously mentioned, have been mistaken for those of typhoid fever, malaria, rheumatic fever, or prolonged illness from "flu".

**Milk as an Abortion Infection Spreader Among Cattle.**—The udder, as already mentioned, is the principal and permanent habitat of the Bang abortion germs in reacting cows. Laboratory cultures have been obtained from the milk at all stages of lactation. These germs have proved virulent for laboratory experiment animals. The milk, therefore, is shown to be a possible source of danger to the herd. The actual danger, however, of spreading the disease to healthy cattle by means of infected milk is not very great. The suckling calves, though they remain with their infected mothers until weaned voluntarily, are practically resistant to permanent infection. And transmission of the disease through the milk to sexually mature susceptible cattle would be of rare occurrence, since milk is not fed to such animals; and they could become infected from this source only through gross carelessness of the dairymen in contaminating feed-stuffs with milk from an infected cow. There is apparently no need to take any precautions against infecting pastures, to a dangerous degree, by the feces of calves which are sucking the infected milk of abortion reactors; for, although the

abortion germs are ingested with the milk and pass out with the feces in sufficient number to be detected by laboratory methods, the practical exposure during several seasons of susceptible pregnant cows to the same pastures occupied by calves sucking abortion infected mothers has not resulted in conveying the disease through fecal contamination of the grasses. The quantitative contamination of the pastures with the Bang abortion organism, under these conditions is evidently insufficient to transmit the disease.

**Care of the Bull in an Abortion-Infected Herd.**—While the bull has been shown not to be the most important factor in the spread of the Bang abortion disease, proper precautions should be taken to prevent the herd bull from becoming infected; since active infection is liable to attack the genital organs and render the bull sterile. Moreover, clinical evidence in our investigational work indicates, in certain instances, that the infected bull which runs free with the herd may be a source of infection to the cows. The rule and practice, therefore, should be to keep the bull in separate quarters from the herd, and allow contact with the cows only at time of breeding. A special breeding pen to be used for this purpose only, should be provided.

An abortion infected cow should not be served by a clean bull *too soon after calving or aborting*; otherwise the bull may become infected by licking the soiled vulva, tail, and rump or by copulation. The infected cow should not be bred until after the prescribed isolation and cleansing period of six to eight weeks. Moreover, a vaginal douche should be given before admitting the bull. A non-irritant salt solution serves the purpose best for cleansing the vagina. This solution is made by adding two tablespoonfuls of refined table salt to each gallon of warm water used. This saline solution can be injected by means of a rubber tube and funnel, the latter held high enough to produce a strong flow of the solution into the vagina. Disinfect the tubing before and after using. A like cleansing of the sheath of the bull after serving reacting cows is good practice. Such precautions will lessen the dangers of the healthy bull becoming infected and becoming sterile.

**Use of Abortion Infected Bull.**—The use of an infected reacting bull on non-reacting cows is a practice which should be avoided. If, however, from necessity or other valid reasons a reacting bull is used on clean cows, a special breeding pen should be provided. The sheath of the bull should be washed out shortly before the service, and the cows should not be allowed to nose and lick the bull's prepuce. After the service the cow should not be turned with the other cows for a few days, and should be sponged over the tail, vulva, and rump with a coal tar disinfectant to prevent other cows from licking infected semen that may have escaped from the vagina after the service. Cir-



cumstances have been recorded which indicate the transmission of the Bang abortion disease in this manner.

Bull clubs should be particularly careful in the matter of preventing the spread of the disease by an infected bull.

Reacting bulls have been used on healthy cows without transmitting the disease, and in such instances the escape of infection might have been due to the fact that the focus of the disease in the bull was not in the genital tract but in some other organ of the body. In our experimental work an old focus of abortion infection was found in the liver. The disease, however, is found in the testicles of reacting bulls with sufficient frequency to regard the genital organs as the most probable seat of infection in a reacting bull and such bulls should not be used on healthy cows if it is at all possible to avoid it.

**Vaccination and Immunization.**—A word should be said concerning the artificial immunization of cattle against the Bang abortion disease. The practical results of attempts to solve the abortion problem by vaccination have not given much encouragement to the cattle breeders and dairymen who have tried these methods; and the present tendency is toward eradication of this disease, as advocated in the foregoing pages. The methods which have been tried are the hypodermic injection of the "killed cultures" of the Bang abortion germs, called "abortion bacterin". The concensus of opinion is that these dead cultures do not stimulate sufficient immunity to be of practical value, at a reasonable cost. Repeated injections would stimulate an increased production of the reacting antibodies which are doubtless immunizing bodies. The expense, however, of this procedure would be prohibitive. Moreover, there can be no assurance that this artificial immunization would prove effective against exposure to a virulent natural outbreak of abortion in the herd, since the natural disease itself in many cases does not establish a reliable immunity in the infected animal against the disease, as shown by repeated abortions in the same animal.

Another method that has been exploited for the prevention of abortion disease is that of infecting non-pregnant cows with the "live culture" of the abortion germs. This method stimulates a more active and more persistent reaction as shown by blood tests; and, as claimed by some investigators, a lowered abortion rate in certain official tests. In other official tests, however, the results were quite disappointing. Moreover, in all cases the active disease is produced in as definite manner as natural infection, and the infected animals become in most cases life-long carriers of the infection and potential spreaders of the disease. It is evident that where this method is used but little progress can be made toward eradicating the disease from the herd. The objections to this method are the more manifest when we consider the possibilities of infecting the human consumers of the milk of the abortion infected

cows. A modification of the foregoing method has been advocated and tried; namely, the use of cultures of living "virulent" abortion germs; the object being the establishment of the disease in the animal, in a mild form that will stimulate immunity and not result in abortion. But as stated above, if the stronger stimulation of the production of immune bodies by avirulent cultures does not establish a reliable immunity, but little practical value can be expected from the use of these so-called "avirulent culture" vaccines. Moreover, later critical studies of the alleged "avirulent" vaccines demonstrated that of the several that were on the market all were either actually virulent or dead, and could not therefore meet the advertised requirements.

More recently other alleged "abortion cures" have been put on the market by enterprising veterinary biological companies. It is well to mention that one or more presents a strong appeal to the cattle breeders, and to their local veterinary advisers. The claims being that by a new method (presumably the secret of the producer) a much superior product can be supplied than can be furnished by competing firms. Moreover, that this new process "bacterin" can actually cure the disease; that is, they claim to have demonstrated that infected, positive-reacting cows have become negative to the reaction "within a year following the treatment"; thus "offering a practical means of handling reactor animals in valuable herds. Such claims and advertising have the earmarks of crass commercial propaganda. And no breeder who has a valuable herd should catch at such alluring bait; the careful studies which have been made with bacterins and vaccines and serological tests should justify the prediction that disappointment will be the lot of the cattle breeders who expect to have a non-reacting herd out of an actively infected herd of reactors, at the end of a year following the treatment. Moreover, by the use of any or all of these bacterins and vaccines for abortion control, genuine progress toward the eradication of the disease is retarded; besides, the sale of many a valuable cow is lost because she has been made a reactor by vaccination, or "bacterinization", since but few cattle breeders now want "abortion reactors;" and the live-stock health officials of many states prohibit the entrance of these "reactors".

### Use of Germicidal Drugs in the Treatment of Abortion

*Carbolic Acid.*—The oldest attempt at preventing abortion was by the administration of drugs. Carbolic acid given by mouth and by subcutaneous injections, was a favorite treatment for many years; the purpose of the treatment being to kill the abortion bacteria in the system of the animal. Such direct efforts at cure were, however, never accomplished.

*Methylene Blue.*—Methylene Blue had quite a run as an abortio-

treatment; this was tried out very thoroughly at this Experiment Station. The results, however, were disappointing.

*Intra-venous Germicides.*—Mercurochrome and Acriflavine, comparatively new germicides which have been used intravenously in human practice to combat acute septicemic conditions, have been used experimentally in the treatment of the Bang abortion disease—a chronic infection of cattle. The treatment failed to overcome the infection; the treated animals continued to react to the blood tests, and some of the treated cows aborted subsequent to the treatment but not on account of the treatment.

So far as critical experiments have been carried out in the use of drugs as a treatment for the Bang abortion disease, nothing of value has been established. Reliance therefore for success in the control and eradication of this disease seems at present to depend upon the application of sound sanitary measures in the management of the herds and stock farms, as presented in foregoing sections of this bulletin.

### OFFICIAL PREVENTIVE MEASURES

There are at present no official Federal regulations in this state for the control and eradication of this very disastrous infectious disease of cattle and swine; a disease which has proven to be infectious also to the human species. The economical losses are estimated by many cattle breeders, and live stock sanitary officials to greatly exceed the losses from bovine tuberculosis. Interstate and state regulations are in force throughout the country for the control of this latter disease. No breeding cow nor bull can enter any state from another state without a "CERTIFICATE OF HEALTH" showing that the animal has been officially tested for tuberculosis and found to be a non-reactor to the test. The test for the Bang abortion disease has been in almost daily use for a number of years in the laboratories of several states; and its value as a diagnostic agent for the Bang abortion disease has been shown to be as reliable for the detection of that disease as tuberculin is for the diagnosis of tuberculosis. Every argument, therefore, that exists for the official use of the tuberculin test for the control of tuberculosis applies with equal force for the official use of the "abortion tests" for the control of the Bang abortion disease; and for the official promulgation by the U. S. Department of Agriculture of interstate regulations to prevent the shipment of abortion infected breeding animals from one state to another. Such a regulation would be very helpful to the cattle breeders and dairymen in the protection of their herds from infection brought in from another state in the purchase of breeding animals.

### STATES HAVING REGULATIONS ON ABORTION IN CATTLE

Independent of Federal action, several states have taken steps for the protection of their dairy and cattle breeding interests, against the Bang abortion disease. The states which have established regulations requiring a "health certificate" against the Bang abortion disease, based on the recognized serological tests, are as follows: Arkansas, Illinois, Iowa, Minnesota, Alabama, Georgia, Indiana, Mississippi, North Carolina, Ohio, South Carolina, West Virginia, Idaho, New Jersey, North Dakota, Wisconsin, and South Dakota.\* Georgia, South Carolina, and Arkansas have but little abortion disease in their herds, and the regulatory measures have been put in force to guard against a greater increase of the dis-

\*NOTE.—Since this statement was made in the first edition of this bulletin (August, 1930) similar regulations have been established by the following additional states: Arizona, Connecticut, Delaware, Florida, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Missouri, Montana, New Hampshire, New Mexico, New York, Oklahoma, Oregon, Pennsylvania, Texas, Utah, Vermont, Virginia, and Wyoming.

ease that would likely occur within the next few years as the result of the increased interest in dairying in the South, and the increased demands for high producing dairy cattle. (This demand stimulates trade in breeding cattle with sections of the North where dairy production has been highly developed and where also, unfortunately, the Bang abortion disease is more prevalent and has taken heavy toll for many years.) These dairymen of the South want better bred dairy cattle, but they do not want abortion infected cattle that are likely, not only to spread disease in their herds, but also to prove unprofitable breeding animals and milk producers, as the result of the disease they carry. These regulations will work no injustice or hardship on the cattle breeders of the North, since these breeders, by proper herd management, can rear healthy animals for sale and need not sacrifice an infected cow that is worth keeping for breeding purposes. Such cows should be retained on the farm where they contracted the disease, and when leaving the farm should go to the butcher. Their sale for interstate shipment for breeding purposes should be prohibited. Moreover, their purchase by speculators at the stock yards and re-sale to dairymen should be prevented as a public health measure.

The letter files and laboratory records of the veterinary department of the University of Missouri give ample proof that the purchase of untested dairy cattle from the dairy districts of other states has many times brought sorrow to innocent and ignorant purchasers. And, since education is a slow process, based on the still slower process of scientific research, and of practical experience, some of which has been very expensive to the dairyman and cattle breeder, a wise quarantine regulation would prove to be an excellent educational measure, as well as a valuable protective measure. The three southern states mentioned have done a good public service in leading the way in the official manner mentioned.

In Missouri, although no official regulations are enforced, the University, through its veterinary laboratories, is now and has been for several years furnishing considerable protection in a voluntary way to the cattle breeders and dairymen of other states who purchase breeding cattle in this state, by the testing of Missouri cattle herds. This important work will be continued for the purpose of ultimately eradicating the disease and establishing accredited abortion-free cattle herds. This educational and public service work of the Veterinary Department has the hearty support of the Departments of dairy husbandry and animal husbandry, as well as the encouragement and good will of the State Veterinary Service.

Every state in which dairying has been highly developed is at present time giving considerable individual aid to the dairymen by laboratory tests for diagnosis of abortion disease in the herds, and all such states could now give the *official service* for interstate protection against abortion disease, by proper coordination and cooperation of its official agencies, and thus prevent the spread of the Bang abortion disease from state to state through traffic in breeding cattle and swine.