

BULLETIN 382: BANG'S DISEASE

INFECTIOUS ABORTION

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Eleven years ago the Station published its 32-page bulletin 231 entitled "Concerning Infectious Abortion." In this publication are discussed: the results secured in certain studies made during the preceding 20 years, the outcome of 28 years' experience with the malady in the station herd and the methods used in its control.

In view of the fact that the Federal Department of Agriculture is inaugurating a campaign looking toward the removal of Bang-positive cows from Vermont herds, it would seem to be an opportune time to set forth the results secured in the warfare waged by the writer in the control of this disease since 1927 in the station herd.

Bulletin 231 discusses the nature of the malady, the damage wrought by it, its extent, its cause, the methods of its transmission, its infectiveness, the symptoms, its detection by the so-called blood test, the development of immunity, the use of bacterins and vaccines and remedial measures. This bulletin is still in print in considerable numbers and available without charge to anyone who may apply for it. The statements made therein touching disease control (17 pages) are in the main still applicable² and it does not seem necessary again to use as many pages of printer's ink in general discussion. Consequently, the present publication is confined to a review of the experience of the Station during the past seven years in its combat with this malady and the setting forth of advisable procedures to dairymen who wish to "follow in (its) train" and who realize how fatuous it would be to remove infected cows and to replace them with others which in their turn in a few months would be likely to become infected.

1. CONTROL IN THE STATION HERD

The station herd was established in June, 1888, and has continued in being since that time. The writer undertook its management in 1927 at which time Bang's disease (infectious abortion) was playing havoc. It had been prevalent since 1892 and the need of eradication was clearly indicated. Table 1 and chart 1 from bulletin 231 set forth the essential data from 1895 to 1922, the percentage figures representing

¹ The writer is indebted to Dr. H. B. Ellenberger, Station Animal and Dairy Husbandman, for helpful advice and criticism in connection with his manuscript.

² Of course the world has moved in 11 years and a few of the statements have been proven by further investigation to be of doubtful validity.

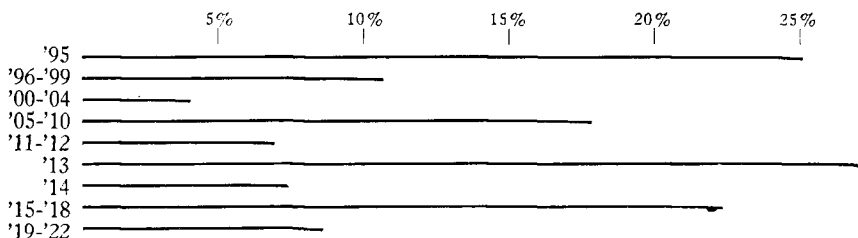
actual abortions. No data are available as to the number of animals infected by and harboring the Bang organism during that time, but its presence in the herd was repeatedly demonstrated. Table and chart clearly show the well established fact that this disease, unless controlled, flares up and dies down, fluctuations due in the main, it is thought, to acquired immunity, that there are cycles through which it passes, and that it may be present in a herd over a long period of years. The records from 1923 to 1927 are very incomplete but it is known that the malady was prevalent during this period and that abortions were somewhat frequent.

Certain so-called treatments (laudanum and carbolic acid injections, the feeding of methylene blue and of creosol and molasses) were attempted at different times. These remedial agents seemed at the time they were used to exert some influence in checking the ravages of the malady, but doubtless this was seeming rather than reality, due in part to expressions of the natural cycle.

TABLE 1.—PROPORTION OF ABORTIONS TO NORMAL CALVINGS IN THE STATION HERD, 1895-1922

| Year | Normal calvings | Abortions | Percentages | Year | Normal calvings | Abortions | Percentages | Year | Normal calvings | Abortions | Percentages | Year | Normal calvings | Abortions | Percentages |
|------|-----------------|-----------|-------------|------|-----------------|-----------|-------------|------|-----------------|-----------|-------------|------|-----------------|-----------|-------------|
| '95 | 18 | 6 | 25 | '02 | 44 | 4 | 8 | '09 | 44 | 8 | 15 | '16 | 35 | 12 | 26 |
| '96 | 29 | 3 | 9 | '03 | 48 | 2 | 4 | '10 | 44 | 10 | 19 | '17 | 31 | 6 | 16 |
| '97 | 31 | 4 | 11 | '04 | 54 | 2 | 4 | '11 | 47 | 2 | 4 | '18 | 36 | 12 | 25 |
| '98 | 25 | 4 | 14 | '05 | 27 | 8 | 23 | '12 | 59 | 6 | 9 | '19 | 36 | 4 | 10 |
| '99 | 35 | 3 | 8 | '06 | 44 | 10 | 19 | '13 | 35 | 13 | 27 | '20 | 39 | 2 | 5 |
| '00 | 32 | 0 | 0 | '07 | 46 | 8 | 15 | '14 | 41 | 3 | 7 | '21 | 47 | 4 | 8 |
| '01 | 33 | 1 | 3 | '08 | 44 | 7 | 14 | '15 | 35 | 10 | 22 | '22 | 45 | 4 | 8 |

CHART 1.—ABORTION PERCENTAGES IN THE STATION HERD, 1895-1922



Feeling that the use of either vaccines or bacterins was inadvisable as compared with the application of the blood test combined with proper isolation and sanitation, recourse was had to the latter system. The

first test (females only) was made September 12, 1927. The males have often been blood-tested and always found to be negative. The first two sets of blood analyses were made at the Connecticut station, those from December, 1927 to July, 1931 at the Vermont State Board of Health laboratory and thereafter at the Vermont Agricultural Extension Service laboratory. The results at these three laboratories check closely.

The September, 1927 test showed more than 40 percent of the animals to be reactors, a discouraging but not an unexpected result. Fortunately, many of them were barren cows, culls or grades and 20 of them were promptly disposed of, only 12 remaining in the herd in January, 1928. Indeed most of these 20 cows were slated for removal in any event, regardless of the result of the test, since they were not of the type desired by the incoming farm management.

The only registered animals in the herd in September, 1927 were Ayrshires and Holsteins, the Jersey and Guernsey units being established later by purchase. The ideal method of buying animals to enter a herd wherein an attempt is being made to control Bang's disease on the basis of the blood test, is to buy only from blood-tested herds. Few if any such then existed in Vermont and it became necessary to buy from untested herds; however, no animal was bought who failed to pass a clean blood test indicating freedom from infection. All pregnant animals purchased should have been isolated until retested after calving, for the reason that the blood test is not 100 percent accurate, especially when used on cows far along in pregnancy. Such a procedure, however desirable, could not be carried out in the present instance owing to the large numbers bought and the newcomers were allowed to mingle with the rest of the herd.

The Bang's disease control method practiced during the first few years after the herd had been culled and new animals added, entailed the removal of each positive animal from the herd several days before calving and its isolation for from 40 to 50 days after calving. Negative cows calved in the main barn. For some 15 months isolation quarters were located at some distance from the main barn and the caretaker did not work with the main herd. Later, when it became necessary to use other isolation quarters also located at some distance from the main barn, the attendant went from the main herd to care for the quarantined animals. However, he was required to wear rubbers in the isolation barn and to use a disinfectant. The calves dropped there were returned to the main barn when three days old, where they received milk from non-reacting (negative) cows. Whenever a cow was returned from quarantine to the

main barn, or, indeed, elsewhere, unless sold for slaughter, her feet, tail and vulva were washed with a disinfectant solution. The original plan was changed in the summer of 1929 when five positive cows, to be discussed later, were retained in quarantine and two were sold. Again, in August, 1930, the remaining positive cows were removed to permanent quarantine quarters or sold from the herd. Since that date positive cows have not been retained in the main herd. At the same time arrangements were made to remove all negative cows to isolated maternity pens for calving. Positive cows have been mated with the regular herd sires, but not until three months after calving.

The herd has been tested at intervals of one to six months, the dates of which are shown in tables 2 and 3. From September, 1927 to July, 1931, the results were reported from the laboratories as positive (+), negative (N) or suspicious (?). Since December, 1931, a reading of N, 1+, 2+, 3+, or 4+ has been reported for each dilution of $\frac{1}{25}$, $\frac{1}{50}$, $\frac{1}{100}$, $\frac{1}{200}$, $\frac{1}{400}$ and $\frac{1}{800}$. The animals have been classified as positive, negative or suspicious according to the standards adopted by the United States Live Stock Sanitary Association and used by the Connecticut station (1). Blood samples have been drawn by the writer except for the tests of December, 1931, February and April, 1932. The samples for these three periods were drawn by an inexperienced attendant. The percentage of suspicious reactions was high for these periods, indicating faulty technic.

All tests, except those for 37 animals culled from the herd within the first few months, are reported in tables 2 and 3. Table 2 includes all cows retained in the negative herd and considered as animals not harboring the Bang organism. One hundred twenty-two of these have been negative at each test during their stay in the herd. Their individual histories are not given but the numbers tested at the different test periods are shown on the upper line of the table. Forty-three other cows listed in table 2 do not have a perfect history. Some have shown a suspicious reaction, while others have been reported as positive at one time or another. No animal has been condemned, except those sold as culls in the beginning, on one positive reaction. Each animal reported as suspicious or positive has been retested and the result follows that of the regular test. Some, as No. 29, have had numerous check tests. Cows showing a positive reaction to two or more successive tests are listed in table 3. These cows were either sold or removed to permanent quarantine as indicated in the table. [No. 99 has recently been returned to the negative herd, but she will be checked again.] They have not been tested at all of the regular herd tests.

It is evident that perfect success was not soon attained, although now nearly if not quite attained. New positive cases have shown up from time to time, the source of infection seeming clear in most instances. The first serious setback dates from January 20, 1928, when four new reactors (Nos. 40, 41, 44, 45, table 3) appeared. No. 41 had long been a herd member and had passed two negative tests, both of which were made while she was open. The source of infection is not known. The other three were pregnant cows bought in December, at which time they were negative. One of them, No. 44, calved normally three days before she gave a positive reaction. She had been in the maternity pen for nearly two weeks, because she seemed out of condition. She could hardly have infected the other two cows since they were stanchioned on the opposite side of the barn from the maternity pen. It would seem more reasonable to assume that one of these, No. 45, was carrying the infection at the time of purchase, notwithstanding her failure to show a reaction. This assumption seems borne out by the fact that she fluctuated from negative to positive on later tests. No. 44's case may be similarly explained for she was heavy in calf when she gave the negative result. The third cow, No. 40, was negative to the blood test taken before purchase and came from a herd which the owner claimed to be abortion free. Positive on January 20, she aborted on February 8 in isolation quarters to which she had been removed two days previous. Just how she could have contracted the disease was a mystery for some time, but only for a time. It was later learned that as a matter of fact abortion had played havoc in the herd from which she came during the winter of 1927-28. Heifers from this herd had been out to summer pasture with aborting animals from another herd and were brought back into the barn in November. They, later, aborted as did most of the cows. No. 40 probably became infected before leaving the herd of her former owner, for it now appears that abortions occurred between the date of the test and the date when the cow was shipped, which fact the party who sold the cow did not reveal. Fortunately no new cases developed directly from these mishaps.

Four more cases (Nos. 21, 48, 60, 61, table 3) developed in May, 1929. The explanation of this recrudescence seems clear. No. 44, the positive cow mentioned above, aborted in the barn during the night of November 25, 1928. Unfortunately she was led from the stanchion the next morning to the exit door without first disinfecting her feet; and, to make a bad matter worse, milking and feeding was continued and finished before the platform behind her stanchion was scrubbed and disinfected. An excellent opportunity to spread the disease was

TABLE 2.—RESULTS OF TESTS ON COWS RETAINED IN THE NEGATIVE HERD. INDIVIDUAL FOLLOWED BY

| | 1927 | | 1928 | | | 1929 | | | | 1930 | | | | | | | |
|----------------|-----------|----------|---------|-------|----------|------|--------|---------|----------|---------|----------|-------|-----|------|--------|---------|----------|
| | September | November | January | April | November | May | August | October | December | January | February | March | May | July | August | October | November |
| †Negative cows | 20 | 21 | 25 | 23 | 25 | 24 | 23 | 24 | 37 | 43 | 42 | 42 | 49 | 49 | 48 | 48 | 45 |
| Herd number | | | | | | | | | | | | | | | | | |
| 3 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 4 | N | N | N | N | N | NN | N | N | ?N | N | N | N | N | N | N | N | N |
| 12 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 14 | ? | ? | N | N | N | Sold | | | | | | | | | | | |
| 18 | | Pn | N | N | ?N | NN | NN | N | N | N | N | N | + | N | N | N | N |
| 20 | | Pn | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 29 | ? | ?? | + | NN | NN | NNN | N | N | N | + | N | NN | N | N | + | N | N |
| 30 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 31 | N | N | N | N | N | NN | N | N | N | N | N | N | N | N | N | N | N |
| 33 | ? | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | Sold |
| 35 | | Pn | N | NN | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 46 | | Pn | NN | N | NN | N | N | N | N | N | NN | NN | N | N | N | N | N |
| 53 | N | N | N | N | N | N | N | N | N | N | N | N | N | ? | N | Sold | |
| 56 | | | | Pn | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 59 | | | | Pn | NN | N | N | N | N | N | N | N | N | N | N | N | N |
| 71 | | | | | | | Pn | N | N | N | N | N | N | N | N | N | N |
| 74 | | | | | Pn | N | N | N | N | N | N | N | N | N | N | N | N |
| 77 | | | | | | | | | N | + | N | N | N | N | N | N | N |
| 81 | | | | | | | | Pn | N | + | N | N | N | N | N | N | N |
| 83 | | | | | | | | | | N | N | N | N | N | N | NN | NN |
| 85 | | | | | | | | | | + | N | N | N | N | N | N | NN |
| 87 | | | | | | | | | | N | N | N | N | + | N | N | N |
| 93 | | | | | | | | | N | N | N | N | N | N | N | N | N |
| 95 | | | | | | | | | | | | | | | | | N |
| 97 | | | | | | | | | | | | | N | N | N | N | N |
| 104 | | | | | | | | | | | | | | | | | |
| 106 | | | | | | | | | | | | | | | | | N |
| 120 | | | | | | | | | | | | | | | | | |
| 132 | | | | | | | | | | | | | | | | | |
| 133 | | | | | | | | | | | | | | | | | |
| 134 | | | | | | | | | | | | | | | | | |
| 135 | | | | | | | | | | | | | | | | | |
| 136 | | | | | | | | | | | | | | | | | |
| 138 | | | | | | | | | | | | | | | | | |
| 139 | | | | | | | | | | | | | | | | | |
| 144 | | | | | | | | | | | | | | | | | |
| 145 | | | | | | | | | | | | | | | | | |
| 148 | | | | | | | | | | | | | | | | | |
| 151 | | | | | | | | | | | | | | | | | |
| 152 | | | | | | | | | | | | | | | | | |
| 154 | | | | | | | | | | | | | | | | | |
| 24d1 | | | | | | | | | | N | + | N | | | | | Died |
| 117d1 | | | | | | | | | | | | | | | | | |

* Samples drawn by inexperienced technician; only part of herd tested.

** Only dry cows and heifers tested.

Pn = Purchased on negative blood test.

+A = Atypical reaction.

† Samples were divided and check tests made at the Connecticut station laboratory, O = Negative, S = Suspicious.

N = Negative, + = Positive, ? = Suspicious.

‡ "Negative cows" refer to the animals in the herd of each test period which were always negative.

TABLE 3.—RESULTS OF BLOOD TE

| Herd number | 1927 | | 1928 | | | 1929 | | | | 1930 | | | | | | |
|-------------|-----------|----------|---------|-------|----------|------|--------|---------|----------|---------|----------|-------|-----|------|--------|---------|
| | September | November | January | April | November | May | August | October | December | January | February | March | May | July | August | October |
| 13 | + | + | + | Sold | | | | | | | | | | | | |
| 16 | + | + | + | + | + | Sold | | | | | | | | | | |
| 21 | N | N | N | N | NN | ++ | Sold | | | | | | | | | |
| 23 | + | + | + | + | + | +Ex | | | ? | + | + | + | + | + | + | |
| 24 | + | + | + | + | + | + | | | | + | + | + | +Q | + | | |
| 25 | | + | + | + | Died | | | | | | | | | | | |
| 27 | ? | + | + | + | Sold | | | | | | | | | | | |
| 40 | | Pn | ++ | ++ | + | + | Q | | + | Sold | | | | | | |
| 41 | N | N | + | Sold | | | | | | | | | | | | |
| 43 | + | + | Ex | | Sold | | | | | | | | | | | |
| 44 | | Pn | ++ | ++ | + | + | Q | | + | Sold | | | | | | |
| 45 | | Pn | +N | ++ | N+ | N+ | Q | | + | Sold | | | | | | |
| 47 | + | + | ++ | + | + | Sold | | | | | | | | | | |
| 48 | N | N | N | N | NN | ++ | Sold | | | | | | | | | |
| 49 | Pn | N | NN | N | NN | N | N | N | N | N | N | N | + | + | + | N |
| 60 | | | | Pn | N | + | Q | | + | Sold | | | | | | |
| 61 | | | | Pn | N | ?+ | Q | | + | Sold | | | | | | |
| 66 | | | | | | | PnN | N | N | + | + | + | + | + | Q | |
| 69 | | | | | | | Pn | N | N | + | + | + | + | + | Q | |
| 70 | | | | | N | N | | + | + | + | + | + | + | + | Sold | |
| 73 | | | | | | | | | | | | PnEx | + | + | + | |
| 99 | | | | | | | | | | | | | | | | |

* Blood samples drawn by unskilled technician, only part of herd tested.

** Only dry cows and heifers tested.

Pn = Purchased on negative blood test.

Q = Quarantine.

Ex = Removed for feeding trials; same as quarantine.

+A = Atypical reaction.

N = Negative, + = Positive, ? = Suspicious.

afforded by this faulty technic. Luckily only four cases developed. Two of the infected cows stood in stanchions directly to the left while one stood just to the right of the original aborter. The other stood at the end of the row and near the door through which the cow was led from the barn.

The fifth positive case to develop during 1929 was disclosed by the October test. A heifer (No. 70, table 3) which had been kept in the University timber pasture with about 25 negative heifers and dry cows, was the only one to pick up infection. Its source is not known. A stream which flows through the hog lots where city garbage was fed or streams flowing from other pastures may have carried it. She did not abort but continued consistently positive.

After the setback in May, 1929, two positive cows were sold while arrangements were made to isolate five of the reacting cows which had also aborted. They were retained for breeding purposes but their

being retained in quarantine quarters. All cows were placed in isolated maternity pens for calving. No females have been bought during the past four years. Since that time the disease has been held well in check. One heifer (No. 99) which had been in the University timber pasture during the summer of 1931, reacted that fall and, later, aborted. As previously explained, neighboring cattle may have been at fault. Thus only three cases have appeared in five years.

As previously stated, the animals listed in table 2 have been retained in the herd as negative cows. Certainly there can be little question that those cows, showing one or two suspicious reactions followed by negative check tests, are true negatives. There may be some question about such cows as Nos. 18, 29, 53, 77, 81, 83, 85, 87, 106, 133 and 136, for some may argue that they are positive or infected animals and should be discarded. If they had been tested under the present Federal program for the eradication of Bang's disease these good cows would have been slaughtered. Everyone of them has shown a negative reaction within 30 days after the positive reaction was obtained. Furthermore, they have not returned to a positive reaction (except No. 29). No. 29 is a peculiar case. The readings in the different dilutions were not reported in the case of the first three reactions, but she was negative on numerous retests. In May, 1934, she was reported as suspicious although the reclassification of results by the "Standard Method" lists her as negative. She was retested because she had recently calved. This result was suspicious so another check was made at which time she was deemed to be strongly suspicious. A few weeks later she was negative in all dilutions and again in August at the regular test a like result was obtained. Particular attention is given to this cow at calving time, but it does not seem that she should be slaughtered.

As is pointed out later (p. 16), the technic of the blood test is not yet worked out in its finality. Errors sometimes occur. Its status may be likened to that of the so-called T. B. test as operated 35 years ago. Time has resulted in improved T. B. test technic and will doubtless operate similarly in connection with the blood test technic. Sample taking procedure and laboratory methods and interpretations are likely to improve. Laboratory technicians do not always agree. The case of one of the station cows may be cited in this connection. No. 85 was positive in January, 1930, but negative on repeated tests until December, 1932, when duplicate samples were drawn and tested at different laboratories, one reporting her negative and the other positive. A retest was made at the latter laboratory and a positive reaction reported. The actual readings at the two laboratories were only slightly different

notwithstanding their divergent classifications. When the standard method of classification was used the results reported as positive by the one laboratory were found to be in the suspicious class. Three succeeding tests with this cow have been negative. Fifty-two other samples were taken in duplicate and tested by these two laboratories at the same time. All but two were in agreement. One laboratory reported one negative and one suspicious while a reciprocal result was obtained from the other laboratory.

Sixteen abortions have occurred among 13 negative cows:

| | | | |
|--------|------------------------------------|---------|-------------------------|
| No. 3. | Oct., 1927 | No. 54. | Sept., 1930; Dec., 1932 |
| 4. | Sept., 1927 | 113. | Aug., 1934 |
| 7. | Mar., 1928 | 120. | Nov., 1933 |
| 11. | Nov., 1927 | 124. | July, 1933 |
| 46. | Feb., 1930 | 133. | Oct., 1933 |
| 50. | Sept., 1931 | 149. | Aug., 1934 |
| 19. | Nov., 1930; Jan., 1932; Dec., 1932 | | |

Nos. 3, 4, 7 and 11 aborted shortly after the testing program was instituted. Most breeders, encountering such an experience, would have lost faith in the test; however, repeated results clearly indicated that Bang's disease was not responsible for these mishaps. Most investigators recognize that abortions are sometimes due to causes other than infection with the Bang organism. Wisnicky, Beach and Larson (2) say that "various authorities have estimated that . . . : 20 percent (of all abortions in cattle) are due to several different causes" (that is to say, causes other than Bang's disease). It seems likely that bulls may become infected with abortion-inducing organisms other than *Brucella abortus*. Williams (3) and McNutt, Walsh and Murray (4) have recently shown that in some instances *Trichomonas* may be at fault. Three of these four cows were mated with one sire, and possibly the fourth may have been also, although there is no record of such a mating. He may have been responsible for these abortions. No reason is known for No. 46's and No. 50's misfortunes. No. 54 was injured in shipment just preceding the first abortion while the second may have been brought about by pregnancy examination, although this hardly seems possible since it occurred 10 days later. No. 124 was seriously injured in pasture preceding miscarriage. A considerable discharge occurred preceding No. 120's abortion. No sample was taken, but a sample of the placenta was sent to the State Board of Health laboratory and was reported negative for Bang's bacillus. Nos. 113 and 149 were negative in May, 1934 and were turned to separate pastures. They had not been together, but their abortions occurred three days apart.

No. 133 (table 3), after two negatives in 1932, was reported early in January as "slightly positive," but four succeeding tests in 1933 were negative. She aborted in October, 1933. Placental samples were re-

ported by two laboratories as negative for Bang's bacillus. Other tests have shown this cow to be negative until May, 1934, when she was reported as positive, but the reaction was atypical. Two later check tests were reported as negative. Just where this cow may finally be classified is not clear.

No. 19 is an anomaly. She was removed from the herd for feeding trials in November, 1928. She has been consistently negative having been tested 23 times. She calved normally in 1929. The next three calvings were abortions while a full term but still-born calf came next. The method of feeding can not be held responsible for she was on a well-balanced ration supplemented with calcium and phosphorus.

SUMMARY

Attempts at control of Bang's disease in the station herd were begun in 1927. Blood tests were made to detect animals infected with *Brucella abortus*. From 1927 to August, 1930, negative and positive cows were housed and pastured together, except that the latter were isolated at calving time. Infection was spread thrice under this system of management. In August, 1930, positive cows were removed from the herd and isolated maternity pens were so equipped that all cows, even though they were negative, could be removed from the herd for calving. Since the inauguration of this procedure the spread of infection has been negligible. One heifer, which had been to pasture during the summer, gave a positive reaction and, later, aborted. Sixteen abortions occurred among animals classified as negative.

The results obtained with the station herd indicate that more progress is made in the control of Bang's disease where it is possible to remove all reacting animals from the herd than under conditions where this can not be done. This may be due in part to the practice followed in isolating all cows at calving time during the past four years. Unquestionably this latter practice should be followed in herd management whether or not complete isolation is practised.

2. ADVISABLE PROCEDURE¹

A résumé of the current knowledge of Bang's disease and the advisable procedure to follow in its eradication are set forth in the following pages:

Cause.—A microorganism, *Brucella abortus*. Abortions are sometimes caused by other organisms, sometimes are due to mechanical causes (injuries) and occasionally to malnutrition or to the eating of certain poisonous plants.

¹The writer is indebted to his associate, Dr. F. A. Rich, Professor of Veterinary Science, for helpful suggestion in connection with this section of his manuscript.

How Acquired.—Usually by way of the mouth, in contaminated feed and drink or by licking affected animals, soiled mangers, etc.; at times through the eyes or through breaks in the skin.

Where Located.—The fetus, afterbirth, and uterine and vaginal discharges, before, at the time of and for some time following abortion, contain vast numbers of the germs. They reek therewith. Furthermore, these ejecta from infected cows which calve normally may also be laden with the Bang organism. The disease in such cows is often present in a chronic form and does not visibly affect their health. The udders of infected cows may contain the germs which pass off in the milk, and this contamination and source of infection may exist throughout life. In some cases it is prevalent in the male generative organs and in the intestines of newly born calves. This latter infection will leave the body of the calf if the source of infection is removed.

How Introduced and Spread.—The disease is usually bought and paid for. Bulls and young heifers rarely are at fault, but purchased cows or pregnant heifers often transmit it. Roughage or grain from farms where Bang's disease exists may become soiled with discharges from infected cows and thus transmit the malady. Pasturing cattle with or in pastures adjoining infected cattle—even though they may not have aborted—is a frequent cause of trouble. Unpasteurized creamery skimmilk may transmit the germs to an uninfected farm. Show cattle may contract it in fair-ground stalls or pens. Stable disinfection may have been inadequate. A visitor may innocently bring infection onto the premises on his shoes, clothing or hands, or a farm hand unwittingly handle an infected animal or enter a contaminated stable. There are many ways in which the organism may be brought into a herd, but usually the infected cow or infected pregnant heifer is the offender.

Its Cost.—The toll is heavy. The calf crop is lost, milk production lessened, the cost of herd maintenance is increased per unit of production and successful management is made more difficult since sterility is apt to ensue and livestock sales become curtailed.

Some dairymen, whose experience with this scourge does not extend through the years and have seen it disappear from their herds, believe that it dies out of its own accord. Their faith is built upon the sand. To such is commended a study of the chart on page 4 covering 28 years of observation at this Station. Furthermore, there is every reason to believe that the disease is widely prevalent throughout Vermont and in all dairy regions the world over. It neither "dies out" or "runs out."

Symptoms.—Other than premature birth, they are apt to be somewhat variable and indefinite. Many infected cows never abort but they

may infect others who do. Among the indications which may be deemed suspicious and justify prompt action are:

(1) Indications of approaching premature parturition: udder enlargement, slight swelling of external genitals, uneasiness, straining.

(2) Discharges from the genital tract prior to and/or subsequent to abortion or normal calving. They are quite apt to be of a stringy mucous character.

(3) Retained afterbirth. This is common when abortion occurs during the latter stages of pregnancy, or when infected cows calve normally. When removed, its appearance is often abnormal.

(4) Sterility.

Sometimes the fetus may be expelled during an early stage of pregnancy and be so small that the act of abortion may occur unobserved.

Treatment.—Drugs seem ineffective. Neither bacterins nor vaccines have thus far proved sufficiently successful to warrant the writer in advising their use. Vaginal and uterine douches with non-irritant, antiseptic fluids or common salt solution, when properly made—especially in cases of retained afterbirth—may hasten recovery and lessen the likelihood of sterility. They will not destroy the germs causing abortion or change a reactor into a non-reactor.

Diagnosis.—The agglutination test (blood test), although neither perfect nor infallible, is the most satisfactory, reliable and practicable means now available. It does not designate cows which will abort but those which are infected. Reactors may or may not abort, some being inherently more resistant to the disease than others. A few reactors, harboring the germ, may recover from the disease and become non-reactors and non-reactors may “catch” it and become reactors. Some infected animals may not react, especially if tested when pregnant or shortly after parturition. Furthermore, three or four months may elapse between infection and response to the test. Obviously a single test affords the herd owner no assurance of freedom from infection.

It must be frankly admitted that a reported reaction may not be truly such. The test is very serviceable as a diagnostic agency, as an aid in freeing herds from infection and in keeping them free, but it is not 100 percent perfect. Its interpretation is often difficult, the results it affords indefinite. The laboratory technician can readily dispose of pronounced reactors; but many are border line, twilight zone cases, and their allocation involves specialized knowledge and much laboratory experience. The “suspects,” the doubtful cases, the animals which occasionally show up positive, are sometimes hard to place. One laboratory technician may designate one of these doubtful reactions as suspicious, and another equally well trained will call it negative. Hence

it is that laboratory reports sometimes differ. It is usually advised to play safe, to isolate the reacting or suspicious animal, but to retest her after two to three weeks.

Much work has been done within the past few years looking toward the standardizing of the blood test and of its interpretation. Progress has been and is being made, just as it has been made from the early days of T. B. testing to the present time. However, blood test reading is a far more delicate matter than is the reading of the tuberculin test. Test fluids vary and, as has been pointed out above, judgments differ in border line cases. Then, too, some cows really infected are slow to react, which makes for confusion. When, as is almost always and inevitably the case, the test operator knows little or nothing of the history of the herd whence the samples originate, whether disease free, recently infected or long diseased, he works at a disadvantage and he becomes more or less mechanical in his handling of the process.

There is this much to be said, however, that "breaks" and the errors in judgment and technic which sometimes occur do not justify wholesale condemnation of tests or of test operatives. The welfare of the dairy industry in all regions where this malady exists depends in no small degree upon the careful and impartial application of the blood test. It has come to stay until it is replaced by a more accurate test. Whether or not the campaign now being waged is expedient at this time is a moot question concerning which differences of opinion exist. That there is still much to be done in perfecting the handling of the test is freely granted and no one is more alive to that need than the laboratory technicians themselves. However, if samples are properly taken and adequately cared for in transit, if tests are properly made and the results properly interpreted, the blood test becomes a helpful and reasonably effective diagnostic agency, at any rate the best we now have.

Control, Eradication.—An ounce of exclusion is worth a pound of eradication. The relative cost of exclusion and eradication are more nearly 1 to 160 than 1 to 16. Eradication is a heart-breaking task when the disease is rife and abortions repetitious, but is more likely to succeed when the disease is in a relatively dormant stage. Unfortunately,

"When the devil was sick, the devil a monk would be
When the devil got well, the devil a monk was he."

Too many dairymen feel when the quiescent stage is reached that the fire has burned out and that recurrence is not to be expected. Let such look at the chart on page 4 and take warning. Some cows do recover of their own accord, but many do not. The "do nothing" method has little to recommend it.

The *test and slaughter* method involves prompt slaughter of reactors and thorough stable disinfection. It also involves repeated tests at monthly or bi-monthly intervals followed, if more reactors are found, by similar slaughter and disinfection. This method may work well in herds with few reactors, or in those of relatively low producing capacity, or when the disease is not very active. It may be costly when the percentage of infection is high or the disease rampant.

The *test and isolation* method—the one used by the Station and discussed on pages 5-6—may appeal to some, especially to those whose cows are registered or are heavy producers and whose premises are so arranged as to enable separation. The reactors are housed apart from the non-reactors, the goats segregated from the sheep. Sometimes—not always—managerial expense is not greatly increased, the disease is eradicated more gradually and valuable blood lines are conserved. Usually two barns are necessary and extreme care must be taken if the same farm hands attend both herds. Calves may be added to the clean herd from both the units. This method is not always—perhaps not often—applicable in small herds.

The Test and Partial Isolation Method.—Many farmers can not completely separate the two herds. Under such circumstances a temporary partition with clean animals on one side and infected cows on the other might serve in a pinch; or one lot may be placed on one side and the other on the other side of the barn. The two lots in any event should be yarded and pastured separately and in no event should the negative herd have access to the manure pile. Each cow must be isolated at calving time. Positive cows should be removed to isolation quarters a week before calving and remain there four to six weeks. Negative animals should be isolated in separate quarters and may be returned to the herd in 48 hours after calving, if they are normal. Of course, under such circumstances the likelihood of successful eradication is lessened, the probability of infecting clean cows increased. The utmost care must be taken to maintain the barriers and to see to it that separate utensils are used and—if possible—different crews of barn hands employed.

Many dairymen will be unable to carry out these procedures. To such, a small fraction of a loaf may be better than no bread. They are advised that isolation at calving time or when abortion seems imminent will serve to eliminate much of the danger. The establishment and careful conduct of a maternity ward is eminently desirable. Since the bulk of the infection is spread at this time, the isolation of the offender serves to minimize the danger.

Sanitation.—This may help somewhat. It is not as costly in terms of direct and indirect outlay as the two control methods above outlined, but it is costly in terms of continued effort. However, it often is quite effective in reducing losses and lessening the likelihood of infection spread.

Since the germ which causes all the trouble is expelled from the cow in the fetus, afterbirth, uterine fluids and vaginal discharges following abortion and sometimes in the milk for prolonged periods and from calves dropped by infected cows in the feces, and since cows usually become infected through the mouth, the following suggestions should tend to lessen the spread of the malady:

1. Isolate all pregnant cows in individual stalls 7 to 10 days before calving and for a month following calving or for as long as uterine discharges occur.

2. Keep close watch of pregnant cows for symptoms (page 15). If a suspect is discovered, one who is manifesting symptoms of abortion, separate her at once from the rest of the stock.

3. If abortion occurs, bury, burn or otherwise destroy fetus and afterbirth and contaminated litter and thoroughly clean and disinfect all contaminated areas, using a properly prepared and reliable disinfectant. So long as vaginal discharge exists, the rump, vulva, thigh and tail should be thoroughly scrubbed each day with warm disinfecting fluid.

4. If abortion occurs in the stall unexpectedly, isolate the cow at once, thoroughly scrub and disinfect the stall and adjacent gutters, including nearby stalls and gutters, and destroy fetus, etc., as indicated under 3. Test nearby cows within three to four months in order to determine whether they have become infected.

5. Clean and disinfect maternity stalls before each occupancy.

6. Avoid transfer of germ-laden material on boots, clothing, hands, etc., from maternity stalls or stall in which unexpected abortions have occurred. Boots should be well scrubbed with a disinfectant solution on leaving an infected stall or else special rubbers should be worn while in and kept in the stall.

7. Leave cows unbred for two or more months.

8. Isolate aborters for six to eight weeks, and keep cows showing uterine discharge away from all stock at all times until it has ceased.

9. Destroy bedding used by infected or suspected animals.

10. Use only infection-free bulls. Bulls are much less apt than cows to be infected; however, if infected they should be used only on infected stock.

Protection.—In order to keep an abortion-free herd as nearly as may be abortion-free, it is suggested:

1. That blood testing be done at least annually, better semi-annually; if infection is found at any time, at monthly intervals until it disappears.

2. That, in so far as possible, only animals from Bang's disease-free herds be added to the herd. If necessary to purchase animals from untested or infected herds they should be quarantined and retested after 30 to 60 days. All pregnant animals should remain in quarantine and be retested at least 30 days after calving.

3. That no use be made of outside or non-tested bulls.

4. That only cows from disease-free herds be bred to negative herd bulls.

5. That cows due to freshen be isolated and returned to the herd only after they are again normal.

6. That stable sanitation be enforced, barns and yard be kept clean and free from trash, the former well lighted, well ventilated.

7. That the aborting cow be isolated, a blood test made promptly and a retest made 30 days later, if the first is found to be negative. Following two negatives, the cow may be returned to the herd; if found positive, removal should ensue and all animals should be promptly blood tested.

8. That following abortion, adjacent stalls and gutters be thoroughly cleaned and disinfected, and fetus, afterbirth and all litter be burned.

9. That so far as practicable the herd be recruited from the calf crop, purchases being made only to maintain blood lines and to increase production.

10. That in the event of the entrance of animals into a negative herd, their feet be cleaned and soaked in disinfectant solution before they enter the premises.

11. That the herd be not deemed to be Bang's disease-free until every animal has passed two consecutive negative blood tests at three- to six-month intervals.

12. That a good ration of roughage and concentrates be fed.

13. That careful record of service dates be kept.

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