BRUCELLOSIS IN BISON, ELK AND MOOSE IN ELK ISLAND NATIONAL PARK, ALBERTA, CANADA[1]

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Periodically, in Elk Island National Park, it becomes necessary to reduce animal numbers to keep the populations of various species within the limits of the available food supply. A depopulation programme was commenced in December, 1956, in the course of which 350 bison, 298 elk and 150 moose were slaughtered. The slaughter provided an opportunity to collect data on animal diseases in the park, and the present paper is an account of observations made on brucellosis in the animals slaughtered in the winter of 1956-57, along with observations made on certain other specimens.

INTRODUCTION

Elk Island National Park is situated some 20 miles east of Edmonton, Alberta. Originally the park was established in 1906 as a sanctuary for elk, moose and mule deer in the area. In 1907 a bison herd was purchased by the Government of Canada and part of the herd was placed in Elk Island National Park. In 1922 the original area of 16 square miles was increased to 52 square miles. In 1947 another 23 square miles were added, bringing the area of the park to its present size of 75 square miles. The park is the largest fenced game preserve in Canada.

The present elk, moose and mule deer herds are the descendants of animals fenced in when the park was originally established. White tailed deer subsequently found residence in the park and now far outnumber the mule deer.

The origin of the bison herd dates back to 1873 when an Indian, Walking Coyote, captured four calves near Milk River, Alberta, not far from the International Boundary. These calves were taken to the Flathead Reservation in Montana and by 1884 the original herd had increased to 13.

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In that year two Montana ranchers, Allard and Pablo, who lived on the reservation, purchased the bison. An addition was made to their small herd in 1893 through the purchase of 36 animals from the Buffalo Jones herd at Omaha, Nebraska. The Buffalo Jones herd, while mainly built up from Texas stock, was bred in part from bison procured from Colonel Bedson of Stony Mountain, Manitoba. The latter had originally been collected in the 1870's.

After Allard's death in 1896, his share of the herd, approximately 300 animals, was divided among his heirs. The Allard share became foundation stock used in establishing most of the bison herds in the United States.

In 1906, the Government of Canada purchased the greater portion of the Pablo holding, and over the years from 1907 to 1912, introduced 716 head of bison into Canada. The earlier introductions were placed in Elk Island National Park, but later shipments were placed in the newly established Buffalo National Park at Wainwright, Alberta.

Later all the bison placed in Elk Island National Park were transferred to Buffalo National Park — all, that is, except 48 animals that successfully avoided capture. The existing herd of bison in Elk Island National Park is the progeny of these 48 animals that were "too wild to capture".

Elk Island National Park is fairly heavily wooded throughout with poplar (mainly aspen), black spruce, tamarack and birch. With an elk herd numbering approximately 1500 animals, in addition to deer and moose, there is not sufficient feed for all the animals the year round and the natural food supply is eked out by bringing additional feed into the park and winter feeding the bison.

For a number of years abortions have been observed in the bison cows on the winter feeding grounds. In addition, a condition manifested by enlarged testicles in a pendulous scrotum has been fairly common among the bulls.

A large number of abortions were noticed on the bison feeding grounds in the winter of 1955-56. A bull with enlarged testicles was also observed. It was not uncommon on the feeding ground to see three or four cows at one time with retained afterbirth hanging from the vulva. During the summer of 1956, seven bison were killed because of lungworm (*Dictiocaulus viviparus*) infestation. Sera from two of the animals, on brucellosis tube agglutination test, were questionable, sera from the remainder being negative.

REVIEW

Mohler (1) in 1917 reported brucellosis from bison in Yellowstone National Park in the United States. Creech (2) isolated *Brucella abortus* from the testicles of a bison bull from the National Bison Range, Moiese,

Montana, in 1930. One hundred and ten bison sera collected by Rush (3) in December, 1931, from the Yellowstone and Moiese herds, on agglutination test reacted as follows: 27 negative, 25 suspicious, 58 positive. Tunnicliffe and Marsh (4) in 1935 reported results of agglutination tests on sera from animals in the Yellowstone and Moiese herds. On the basis of agglutination tests conducted in 1931, 12 of 13 bulls, all of three steers, and 49 of 90 cows were reactors; tests conducted in 1932 showed 25 of 60 steers, 30 of 49 bulls and 52 of 90 cows to be reactors; and tests in 1933, nine of 10 bulls and 42 of 59 cows reacted. These workers recovered *Brucella abortus* from testicular tissues of a bison bull.

In Canada, Moore (5) tested 37 sera collected from bison in Elk Island National Park in the winter of 1946-47, six (16.2%) of which were positive, five (13.5%) questionable, and 26 (70.3%) negative. Eleven sera collected by Dr. George Rankin, Health of Animals Division, Regina, Sask., during a slaughter of bison in Wood Buffalo National Park in the Northwest Territories in 1955-56 were tested by the junior author. Three of the 11 were high titre positives, the remainder negative. Of 20 sera collected by Reeker (6) in the Riding Mountain National Park in 1956-57, 17 were negative, one was suspicious and two were positive.

In moose, brucellosis has been reported on at least two occasions, both in the United States. Fenstermacher and Olsen (7) described a case of brucellosis in a young bull moose in 1942 and Jellison, Fishel and Cheatum (8) reported the disease in a young female in 1953. The latter workers applied the agglutination test to 44 moose sera and found 35 entirely negative, while three gave complete agglutination at the 1:20 dilution and six at 1:40. The present paper is the first report of brucellosis in moose in Canada.

In elk, Rush (3) reported that of 67 sera from animals in the vicinity of the bison range in Yellowstone National Park in 1932, 54 were negative, 10 were suspicious and three were positive. Tunnicliffe and Marsh (4) found the following: in 1931, 11 of 32 sera from Yellowstone National Park reacted to some degree, none at titres over 1:50; in 1932, 52 sera were found negative, one young cow and 10 mature cows reacted at 1:25, one mature cow at 1:50 and two at 1:100. Prior to this paper there have been no reports of brucellosis in Canadian elk. In addition to the data following, one of the authors (Connell) found one of 17 sera from elk in Waterton Lakes National Park collected in early 1957 to be strongly positive.

MATERIALS AND METHODS

Bison — Prior to slaughter, the entire herd, with the exception of a few bulls was enticed into an enclosure by means of scattering small quantities of hay along the various park trails leading to the enclosure. Animals marked for slaughter were shot and bled, blood samples were collected and

each carcass, accompanied by the corresponding blood sample, was immediately transported to the abattoir.

After labelling, the blood samples were permitted to remain at room temperature to clot and the clot to shrink expressing the contained serum. To preclude the danger of haemolysis, the serum from each sample was decanted into a small bottle. The bottles of serum were then shipped to the Veterinary Research Station at Lethbridge for serological testing. The sera were first tested using the standard brucellosis tube agglutination and plate agglutination techniques applied in the testing of cattle under federal brucellosis control policies in Canada. All sera giving reactions were titred out to their end points using the tube technique. All reacting sera were tested twice as a check on technique. After the tests at Lethbridge were completed, the sera were shipped to the Animal Diseases Research Institute, Hull, Quebec, where they were frozen down for a time and eventually thawed and retested by tube and plate techniques and by complement fixation.

Moose and Elk — With existing facilities it was impossible to herd or entice large numbers of moose and elk into enclosures for slaughter, and these animals were hunted by the Warden Service throughout the park. Because of limited staff it was not practical to have men follow the hunters for the express purpose of collecting blood samples and recording data on each animal. Instead the hunters carried a supply of bottles to collect blood samples. When an animal was shot, it was immediately bled and a bottle of blood collected. The bottle of blood was wrapped in paper towels and inserted into either the rectum or vagina of the carcass to protect it from the cold weather. Each carcass was then transported by team and sleigh to trails accessible to trucks and thence by truck to the abattoir. Inserting the blood samples into either the rectum or vagina proved a fairly satisfactory means of protecting the specimens against low temperature and identifying it with the animal from which it was collected. A number of samples were expelled from the rectum or vagina during transportation as a result of peristaltic action and visceral pressure and not being discovered immediately, were destroyed by exposure to low temperature. Others, due to difficulties and delays in transportation, remained in rectum or vagina of carcasses for more than two hours and were haemolyzed by the action of carcass temperature, which due to microbial activity in the viscera, tends to rise after death.

This temperature rise is self limiting, eventually reaching a point that inhibits the organisms. Temperatures high enough to haemolyze blood samples were reached however. The blood samples after reaching the abattoir were submitted to the same techniques and tests as described for the bison samples.

During the course of the slaughter 688 serum samples were collected, 343 from bison, 221 from elk and 124 from moose.

RESULTS

Bison (*Bison bison bison*). — Of the 343 sera collected, on test at Lethbridge, 198 were negative, 34 were suspicious and 111 were positive, giving an overall reactor percentage of 42.27%. In interpreting the tests as negative, suspicious or positive, the criteria used in routine cattle testing were applied, in which a titre of 1:25 or less is considered negative, a titre of 1:50 as suspicious and a titre of 1:100 or higher as positive. While vast experience has shown that these practical criteria apply to cattle, their application to bison tests is highly arbitrary. The 111 samples interpreted as positive comprised of 49 that reacted at 1:100, 38 at 1:200, 12 at 1:400 and 12 at 1:800 or higher. Forty-eight of the 198 samples interpreted as negative reacted at the 1:25 dilution.

Results of the agglutination tests repeated at the Animal Diseases Research Institute and the complement fixation tests carried out there were in quite good agreement with the Lethbridge results. Differences were apparent which involved in part the human element and in part changes that had taken place in some of the sera in the time that elapsed between testing at Lethbridge and testing at Hull.

Pregnancy and lactation did not seem to be a factor in the reactions as can be observed from Table I. The reactions observed in the bison are similar to those found in chronically infected herds of domestic cattle.

TABLE I.

Reactions in 223 female bison.

	No. of Sera	Negative	Suspicious	Positive	Reaction Percentage
Non-lactating and pregnant.....	169	93	16	60	44.97
Non-lactating and barren.....	25	15	1	9	40.00
Lactating and pregnant.....	27	15	2	10	44.44
Lactating and barren.....	3	2		1	33.33

In Table II data is presented which indicates the rate of calving, conception, pregnancy and lactation in recent years. The data in Table II is not as complete as is desirable, because complete data is difficult to obtain. A calf count is taken each fall when the bison are brought into the winter feeding lot but prior to this count the calves are not under close surveillance. Losses occurring at calving time and on summer range could be significantly high, but the incidence and nature of these have not as yet come under close study and here cannot be taken into account. The only calf losses

TABLE II

Calving, conception, pregnancy and lactation in the Elk Island National Park bison herd, 1951 to 1956

	1951	1952	1955	1956
Number of mature females	636	468	598	321
Mature females slaughtered — total	246	—	244	227
Non-lactating, pregnant	40(16.26%)	—	119(48.77%)	172(75.77%)
Non-lactating, barren	16(6.50%)	—	46(18.85%)	25(11.01%)
Lactating, pregnant	169(68.70%)	—	45(18.44%)	27(11.90%)
Lactating, barren	21(8.54%)	—	34(13.94%)	3(1.32%)
Percentage conception	84.96	—	67.21	88.84
Expected calf crop	—	397.6	—	215.7
Calf crop	335	103	323	110
Percentage mature females raising calves	52.67	22.01	54.01	34.27

easily observed are those due to abortion on the winter feeding grounds. Nevertheless, the authors feel that the data presented in Table II possibly indicates effects attributable to brucellosis in the Elk Island bison herd.

Brucellar orchitis in bison. — During the 1956-57 winter season, two bison bulls were destroyed because of orchitis.

Bull No. 1. — The animal was a four year old bull in good physical condition. The scrotum was enlarged, the enlargement being mostly in the left side. An incision in the enlarged left half of the scrotum released a large amount of pus the color and consistency of canned condensed milk. A pale oval caseous mass about three inches long and completely devoid of any blood supply was all that remained of the left testicle. The tunica vaginalis was greatly thickened and there was no evidence that any discharge had occurred or was about to occur. The right testicle was normal. On test, a serological sample from the animal strongly agglutinated Brucella antigen.

Eight guinea pigs were inoculated with suspensions of pus and necrotic testicular material from the orchitis lesions. Seven of the guinea pigs remained perfectly healthy. The eighth guinea pig developed a high serum titre of brucella agglutinins and died of a progressive wasting disease six weeks after inoculation. A *Brucella sp.* apparently *B. abortus* was recovered from the guinea pig. Direct culture of orchitic lesions failed to yield Brucella.

Bull No. 2. — The bull, three years of age, was in good flesh, but due to an extreme pendulous enlargement of the scrotum it moved in a crow-hop fashion. Normally in the bison bull the scrotum is much less

pendulous than in the domestic bull and a scrotal neck is seldom apparent. In the animal in question the scrotum was pendulous to the extent that the rudimentary teats were positioned on the antero-proximal aspect of a scrotal pseudoneck. The scrotum at its greatest width measured 14 inches across and the inner surfaces of both hind legs were chafed free of hair. The bull had been in the condition described for more than six months. Upon opening the scrotal sac, it was found that the testicles had been completely replaced by pus similar to but more viscid than that seen in bull No. 1. No testicular remains were found. Attempts to recover Brucella from the scrotal pus failed, although, serum from the bull was strongly positive on brucellosis agglutination test.

Moose (Alces alces andersoni.)

Sera collected from 124 outwardly healthy moose were strictly negative in the brucellosis agglutination test. Observations were made on two sick moose that yielded indications of brucellosis infection and these are described in detail below.

Moose No. 1. — This male, age one and a half years, was first sighted on October 12, 1956, in a dry slough bottom. It was in an extreme state of emaciation and all movements were executed feebly. The animal was observed for several minutes on this occasion and while it did go to nearby willow and browse, it moved languidly and did not eat with a show of appetite. Two days later the animal was observed again near the dry slough lying down. When approached, it lowered its head as if attempting to hide. Finally, with considerable reluctance it came to its feet with stiff wobbly movements. When closely approached it exhibited the conduct usually shown by a tormented moose, laying its ears back along its neck, raising the hair of its mane, micturating and rubbing its hocks together. The first few steps the animal took gave the impression that it was about to collapse, but in an attempt to escape it travelled better than was anticipated. The moose was shot.

Externally the carcass revealed nothing but extreme emaciation in a young bull. The eyes were sunken, and the antlers, which consisted of very small spikeless palms, were still covered with dry encrusted velvet. This general appearance indicated that the animal had suffered ill health for some time. No ecto-parasites were found.

In the thorax, the pleural membranes were covered with numerous fibrinous tags, although organized pleural adhesions were absent. Both lungs showed consolidation in the lower portions. The consolidated portions were of dark cream color and were dotted with numerous small (diam. 1.0 mm.) lighter colored foci containing pus. Compression of the lung tissue following section caused pus to exude from the bronchioli. Fibrinous pericarditis verging on suppuration completely involved the pericardial sac.

In the abdominal cavity fibrinous tags were attached to the omental surfaces and to the capsule of the liver. An excessive amount of peritoneal fluid, which clotted after a few minutes' exposure to air, was present. The kidney capsules could not be stripped without tearing the cortical tissue. Numerous whitish areas, 5.0 to 6.0 mm. in diameter, could be seen on the cortical surface through the capsule of each kidney. On section of the kidneys, more of these pale areas were observed buried in the kidney tissue. Several of the larger foci contained necrotic centres and pus. The spleen contained numerous small round necrotic foci which were firm to the touch. Several of these caused noticeable elevations in the splenic capsule.

Nearly all the lymph glands, body and visceral, were swollen, œdematous, and exuded large amounts of fluid when incised. Many were necrotic and suppurating.

A large quantity of mucopurulent exudate was found in the pharynx, which perhaps was coughed up by the animal.

Bacteriological and serological examinations were conducted by staff of the Veterinary Laboratory, Alberta Department of Agriculture, Edmonton. *Pasteurella haemolytica* was recovered from lung tissue and pericardium. A species of *Corynebacterium* was removed from kidney tissue. No cultures were made in 10% CO_2, but serum from the animal was positive on brucellosis agglutination test to 1:12,800, the highest dilution tested.

Moose No. 2. — This animal was first observed in the same general locality as moose no. 1. While not in as poor condition as moose no. 1, it nevertheless was thin. It was noticed to stumble in travelling over level ground. The animal was shot on February 4th, 1957.

The carcass was that of a thin, four year old bull moose, and showed no evidence of external injury or parasitism.

The pleural membranes throughout were coated with a thin film of fibrin. Tags of fibrin were attached to the parietal pleurae. The fibrinous coating was heavier and the parietal tags more numerous in the right half of the thoracic cavity. The lungs were congested, but purulent exudate could not be expressed from cut bronchioles. The pericardial sac contained a large quantity of cloudy, straw-colored fluid. Fibrinous pericarditis, with adhesions, was present, and was most severe over the auricles and around the coronary groove, while fibrinous tags formed a loose mat in the pericardial fluid. A small abscess (diam. 2.0 cm.) containing cream-colored pus was found ventral to the great vessels of the neck between the first pair of ribs. All thoracic lymph glands were swollen and oedematous.

There was a generalized fibrinous peritonitis characterized by a thin coating of fibrin on all serous surfaces of the abdominal cavity along with fibrinous tags. Fibrinous tags were attached to the capsule of the liver. The

liver showed many small necrotic foci (diam. 1.0-3.0 mm.) visible through the capsule. On section the liver showed similar foci throughout the parenchyma. The larger of these foci contained caseous cores. The portal lymph node contained many foci or abscesses similar to those observed in the liver but which were generally larger (diam. 8.0 mm.).

There was considerable oedema along the colon and rectum, and in the perirenal tissues and renal pelvis. The kidney capsules could be stripped but only with difficulty, leaving a pitted cortical surface. Small foci resembling those described in the renal cortical tissue of moose no. 1 were observed, but they were less numerous. The medullæ of both kidneys presented an appearance typical of pyæmic nephritis.

The peritonitis extended into the scrotum, coating the serosal surfaces of the testicles with a membrane of fibrin. Both testicles appeared normal in size, except that the epididymis of the left testicle appeared slightly enlarged. The latter presented four small abscesses which contained thick creamy pus.

Bacteriological and serological specimens from this moose were examined at the Veterinary Laboratory, Alberta Department of Agriculture, Edmonton. The serum was strongly positive for brucellosis. Dr. H. Vance succeeded in isolating Brucella from various tissues. A culture of the organism recovered was identified as *Brucella abortus* by Mr. J. L. Byrne, Animal Diseases Research Institute, Hull, Quebec.

Histological examinations revealed that the many focal lesions observed were foci of coagulation necrosis.

Elk (Cervus canadensis manitobensis)

Two hundred and ninety-eight elk were slaughtered in the 1956-57 kill in Elk Island National Park, 221 of which yielded sera that could be tested for brucellosis. Of this number, 192 were negative, four were suspicious and 25 were positive on test at Lethbridge.

As with the bison tests described earlier, the terms negative, suspicious and positive are interpretative and have been used as they are used in the testing of domestic cattle. Of the 192 interpreted as negative at Lethbridge, seven gave agglutination in the 1:25 dilution, the remainder being strictly negative. Three of the positive sera had a titre of 1:100, 12 a titre of 1:200, six 1:400 and four 1:800 or higher.

Check tests carried out at the Animal Diseases Research Institute were in very close agreement.

Summary of brucellosis agglutination tests.

Results obtained on brucellosis agglutination tests are summarized in Table III.

TABLE III.

Summary of brucellosis agglutination tests on bison, moose and elk from Elk Island National Park, December, 1956-January, 1957.

Species	Total samples tested	Negative	Suspicious	Positive	Reactors	% Reactors
Bison.....	343	198	34	111	145	42.27
Moose.....	124	124	0	0	0	0
Elk.....	221	192	4	25	29	13.12

DISCUSSION

Bison. — On the whole the percentage of brucellosis reactors found in the Elk Island National Park bison herd is lower than that found by workers in the United States.

The bison herd in the park is confined to a feed lot during the winter and fed from the ground. It seems highly probable that abortions occurring on the feed lot result in the contamination of feed put out for the animals. This system of management, lending itself as it does to the spread of the infection, perhaps accounts for the higher percentage of reactors among bison as compared to elk. It is interesting that bison in both the United States and Canada, which for the most part have common ancestry, should be generally affected with this disease. Rush (3), however, states that domestic cattle at one time were pastured with bison in Yellowstone National Park. The same practice was followed in the early days of Elk Island National Park.

The danger of bison carrying and transmitting brucellosis to domestic cattle does not appear to be very great. Throughout the settled areas bison are confined to fenced preserves and are not apt to mingle freely with cattle. The unfenced bison herd in Wood Buffalo National Park may provide sporadic exceptions to this general rule, as it is not out of the realm of possibility for bison from Wood Buffalo Park to stray to agricultural settlements in Northern Alberta. Bison are undoubtedly a source of infection to other wild-life species ranging over the same ground.

Moose. — The necropsy findings described from moose with brucellosis are essentially similar to those described by Fenstermacher and Olsen (7) and Jellison, Fishel and Cheatum (8). Neither Fenstermacher and Olsen, nor Jellison *et al,* however, mentioned finding foci of necrosis in the spleen. Fenstermacher and Olsen did not state whether or not they believed brucellosis to be the cause of death in the specimen they examined, while Jellison *et al* reported that they considered brucellosis, in the absence of any other cause, as probably the cause of death. In our cases, as both animals were destroyed

before death, it is not possible to come to a conclusion. In moose no. 1 death would have probably occurred in a short time from the complicating pasteurellosis. On the other hand the absence of brucellosis reactors in grossly healthy moose is difficult to explain. It may be that the browsing habits of moose as compared to grazing animals protect them from contact with the infection. Water contamination might be the source of infection to moose. From the necropsy findings reported by the two groups of American workers cited and those reported here, it would seem possible that brucellosis is a much more severe disease in moose than it is bison, elk and domestic animals. Perhaps brucellosis is always a severe, fatal disease in moose. This assumption would explain the absence of reactors among realtively healthy moose.

Elk. — It has been pointed out above that the bison does not seem to pose an important hazard in the spread and transmission of brucellosis to domestic animals. The elk situation is quite different, however, and elk may present a problem in both domestic and wildlife brucellosis control programmes in various areas.

We have a report from a rancher who maintained an isolated dairy herd that was periodically tested for both brucellosis and tuberculosis. The cattle on his ranch, due to its isolation, had contact with no other domestic livestock. Following the release of elk on the ranch, abortion disease appeared in the cattle. The rancher reported finding an aborted elk foetus on the pasture but unfortunately the foetus was not submitted for laboratory examination. The abortion disease in the cattle was definitely diagnosed as brucellosis, and the rancher's wife contracted brucellosis. The evidence for the introduction of brucellosis by elk in the case just cited is highly circumstantial and might better be ignored were it possible to explain introduction in some other way.

Quite apart from the hazard of disease transmission to domestic animals and man, there would also seem to be involved a pure problem in efficient and desirable wildlife management.

CONCLUSIONS

From the findings described an discussed above, it is apparent that if the conservation of bison in Canada is to be continued efficiently, action should be taken to bring brucellosis under control and to eradicate it from the bison herds in the country.

Brucellosis in elk should be studied thoroughly, because the elk may be a species capable of spreading the disease to other animals including domestic animals. The results of such studies would broaden knowledge and give needed direction to control policies.

The moose with brucellosis is perhaps the victim of a progressive systemic disease terminating inevitably in death. If this is so, the moose is a dead-end

host not capable of being an important spreader according to any common manner of brucellosis dissemination. The susceptibility of moose in general to brucellosis is not known, but if it should be relatively high, it would be well to seek to provide the species with relative freedom from exposure.

Studies of brucellosis should be undertaken in other wildlife species and other parts of Canada.

SUMMARY

Serological specimens from 343 bison, 221 elk and 124 moose slaughtered in Elk Island National Park in the winter of 1956-57 were examined for brucellosis. The moose were all negative, 42.27% of the bison were reactors, and 13.12% of the elk were reactors. The occurrence of reactor bison in Wood Buffalo National Park and Riding Mountain National Park in Manitoba are mentioned and of reactor elk in Waterton Lakes National Park in southwestern Alberta.

Two cases of brucellosis in moose are described. The disease observed in moose was a severe progressive generalized infection quite unlike the disease in bison, elk and domestic animals.

The authors feel that infected elk may play a role in the transmission of brucellosis, including transmission to domestic cattle outside of parks.

Studies of brucellosis in wildlife should be extended to other species and areas.

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FIELD OBSERVATIONS ON THE USE OF TWO TREATMENTS FOR "REPEAT BREEDER" COWS

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One of the most common problems encountered in infertility work is the "repeat breeder". A "repeat breeder" cow may be defined as one which fails to conceive after at least two services, comes in heat fairly regularly, and on examination shows no readily distinguishable genital pathology. "Repeat breeder" cows are responsible for a high percentage of all cases examined.

Most of the various drugs and procedures recommended for the treatment of "repeat breeders" have been used to some extent by the authors and records have been kept in an attempt to evaluate the relative usefulness of these treatments. Only two procedures are discussed in this paper, namely: expression of the corpus luteum 9 to 14 days after heat, commonly known as "changing the heat cycle", and the feeding of an organic iodine compound, Hi-Amine.*

METHODS

The majority of cases included in this report were bred artificially although some were bred naturally. When a request was received to examine a suspected "repeat breeder" the owner was asked to miss one heat and the examination was made usually a week or two later at which time treatment was carried out. If Hi-Amine was dispensed, instructions were left to feed it at the rate of ½ to 1 ounce twice daily mixed with the grain ration beginning 8 to 12 days before the next expected heat. If changing the heat cycle was carried out the corpus luteum was expressed 8 to 14 days after the last heat period. In about one-half of the cases when the corpus luteum was removed 30,000 I. U. of Estrogenic Substance** was administered at

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* Pitman-Moore brand of ethylenediamine dihydriodide.

** Sherman Laboratories.