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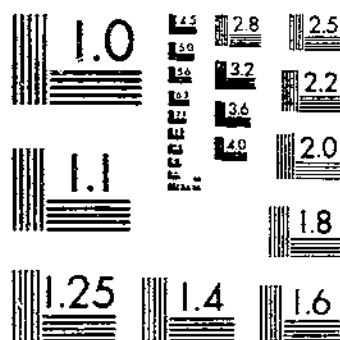
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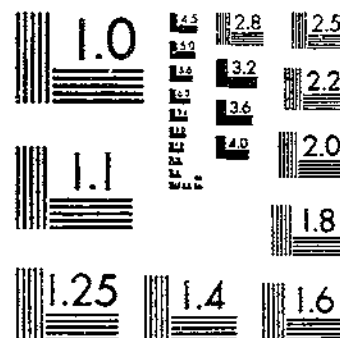
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REPRODUCTION AND HEALTH RECORDS OF THE BELTSVILLE HERD OF THE BUREAU  
MILLER, F. W.; GRAVES, R. R. 1 OF 1

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UNITED STATES DEPARTMENT OF AGRICULTURE  
WASHINGTON, D. C.

# REPRODUCTION AND HEALTH RECORDS OF THE BELTSVILLE HERD OF THE BUREAU OF DAIRY INDUSTRY

By FRED W. MILLER, *Senior Veterinarian and Physiologist*, and R. R. GRAVES,  
*Chief, Division of Breeding, Feeding, and Management, Bureau of Dairy Industry*

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## INTRODUCTION

Dairymen and others interested in dairy cattle have access to reproduction and disease records of certain individual animals, but such information on entire herds over considerable periods of time is rare.

The facts reported in this bulletin are from the records of a herd of dairy cattle made up of registered Holsteins, registered Jerseys, and grades of these two breeds. This herd is maintained by the Bureau of Dairy Industry at the United States Dairy Experiment Station at Beltsville, Md., for the purpose of conducting investigations in breeding, feeding, and management of dairy cattle. The information concerning breeding efficiency and calving efficiency during the 4-year period from May, 1922, to May, 1926, is taken from available records in the Bureau of Dairy Industry. All other information reported has been gathered and recorded by the writers during the 4-year period from May, 1926, to May, 1930.

Experiments in animal pathology are not carried on at the Beltsville dairy station, but are conducted elsewhere by the Bureau of Animal Industry of the United States Department of Agriculture.<sup>1</sup>

The treatments and control measures for disease and sterility practiced with this experimental herd are those thought to be best suited to the conditions at the Beltsville station, and may or may not be best suited to conditions in other dairy herds. These treatments will not be discussed in detail.

From 1922 to 1926 all animals were handled together as one herd. For the purpose of this study the cows that were positive to the agglutination test for abortion disease will be referred to as the abortion-positive group and those that were negative to the test will be referred to as the abortion-negative group. In the spring of 1926, the herd was actually divided, and the two groups were separated by moving most of the abortion-positive animals to a new location about one-half mile away from the negative group. The records over this 8-year period (May, 1922, to May, 1930) afford an opportunity to compare some of the activities of the abortion-positive animals with those of the abortion-negative animals while they were in a herd together and while they were in separate herds.

### FERTILITY OF COWS AND HEIFERS

In this publication, the term fertile, as applied to cows and heifers, is used to designate females that have conceived, regardless of whether they reproduce normal live calves.

The breeding efficiency of cows may be determined by either of the following methods: (1) By finding the percentage of females of breeding age that conceived; and (2) by finding the percentage of females actually bred that conceived.

In the Beltsville herd, the second method of determining breeding efficiency is more desirable to use than the first method, because of the fact that for experimental purposes animals are sometimes intentionally held open five to eight months after freshening. The first method of determining breeding efficiency may be used to obtain the economic status of a herd. The second method is used in this report.

The records show that in the period before the groups were separated, 268 abortion-negative cows and heifers were bred, and 232 conceived, representing an average breeding efficiency of 86.56 per cent; and 165 abortion-positive animals were bred, with 142 conceptions, an average efficiency of 86.06 per cent. After the groups were separated, the breeding of 368 abortion-negative animals resulted in 317 conceptions, an average of 86.14 per cent, and the breeding of 283 abortion-positive animals resulted in 245 conceptions, or 86.57 per cent.

Yearly fluctuations in breeding efficiency were similar in the two groups of animals. With the exception of the fiscal year 1922-23, the average breeding efficiency of the abortion-positive animals was

<sup>1</sup> All testing for tuberculosis in the Beltsville dairy herd has been done by the Tuberculosis Eradication Division of the Bureau of Animal Industry. Laboratory diagnoses, including all bacteriological, serological, and pathological work and the preparation of vaccines, have been done by the Pathological Division and the Bethesda Experiment Station, both of the Bureau of Animal Industry. The Zoological Division of the Bureau of Animal Industry has made numerous examinations of material from the herd for parasites. Members of these divisions of the Bureau of Animal Industry have given freely of their time and energy in studying individual cases, making physical examinations of animals, and advising in their care.

lower than that of the abortion-negative animals while both groups of animals were in the same herd. The average breeding efficiency of the abortion-positive animals remained lower in the first year after separation, but in each year since then it has been greater than that of the abortion-negative animals. When four years are taken as the unit of time, very little difference is found between the two groups of animals, either in the four years before or the four years after separation.

In this bulletin all animals being bred for the first conception are called heifers. All females being bred for the second or later conceptions are called cows. The 88 abortion-negative heifers in the herd before the groups were separated had a lower breeding efficiency than the cows, but the 146 heifers in the negative group after separation had a higher average breeding efficiency than the cows. It has been suggested that there seems to be more breeding troubles with heifers than with cows and that it would be natural to expect the heifers in the negative group to decrease its breeding efficiency. However, since a greater percentage of heifers than of cows conceived, it seems advisable to study the factors that affect conception in young and mature animals to determine whether or not heifers do have more breeding troubles than cows.

#### SERVICES REQUIRED FOR CONCEPTION

Table 1 shows that the average number of matings required for a conception in fertile abortion-negative cows was the same in the four years before as in the four years after separation of the groups. It was a trifle higher in fertile abortion-positive cows after the separation. In fertile abortion-negative heifers it was a little lower after separation. The increased number of matings required for a conception in abortion-positive heifers is of small significance, because of the few animals involved. The average number of services required for conception in all fertile animals in the herd was 2.88 before separation and 2.92 after separation. If services to sterile animals are included, the number of services for conception before and after separation was 3.94 and 3.48, respectively. The separation of the abortion-negative group from the abortion-positive group has had little or no effect on the number of matings required for conception.

TABLE 1.—Data on services required for conception in fertile females, before and after separating the herd into two groups

Class of females	Services to—		Conceptions in—		Services for conception in—	
	Cows	Heifers	Cows	Heifers	Cows	Heifers
Before separation:						
Abortion-negative	417	221	166	36	2.51	3.34
Abortion-positive	350	92	118	24	2.96	3.83
After separation:						
Abortion-negative	514	372	204	113	2.51	3.29
Abortion-positive	744	14	242	3	3.07	4.66

Heifers conceived less readily than cows. This is shown by the fact that heifers required an average of 0.62 more services for conception than cows. Fertile abortion-positive animals required an average of

0.33 more services for conception than fertile abortion-negative animals. The higher average in abortion-positive animals is accounted for by the fact that more services were required to produce conception after an abortion than after the birth of a normal calf. A comparison of Tables 1, 4, and 9 brings this fact out clearly.

#### DISTRIBUTION OF SERVICES

Approximately 42 per cent of the pregnancies in cows resulted from the first service, and in heifers the percentage was approximately 37 as shown in Table 2, which gives the distribution of services required by fertile females for conception. The percentage of conceptions resulting from the first service was greater in abortion-negative than in abortion-positive cows. About one-half as many conceptions in cows occurred in second matings as in first matings, and about one-half as many in third matings as in second matings. As compared with the cows, there were fewer conceptions in heifers on the first and second services, but more on the third to the eighth services. More than 72 per cent of the conceptions in all females occurred on or before the third service.

TABLE 2.—*Distribution of services required by fertile females in the abortion-positive, the abortion-negative, and heifer groups, for conception*

Number of service	Conceptions									
	Abortion-negative cows		Abortion-positive cows		All cows		All heifers		Total	
	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent
First.....	156	44.06	147	40.83	303	42.43	78	36.79	381	41.14
Second.....	73	20.62	72	20.00	145	20.30	29	13.67	174	18.79
Third.....	37	10.45	43	11.94	80	11.20	36	16.98	116	12.62
Fourth.....	28	7.90	19	5.27	47	6.58	27	12.73	74	7.99
Fifth.....	18	5.08	22	6.11	40	5.60	13	6.13	53	5.72
Sixth.....	16	4.52	15	4.18	31	4.34	10	4.71	41	4.42
Seventh.....	6	1.69	11	3.05	17	2.38	6	2.83	23	2.48
Eighth.....	7	1.97	7	1.94	14	1.96	5	2.35	19	2.05
Ninth.....	2	.57	6	1.66	8	1.12	2	.94	10	1.07
Tenth to thirteenth.....	11	3.10	18	5.00	29	4.06	6	2.83	35	3.77

Table 3 shows that at the Beltsville station, where the breeding practice is somewhat less favorable for conception than in many commercial herds because of various kinds of experimental work, the chances are 94.2 in 100 that any female bred will eventually conceive, and that 38.79 per cent of females bred will conceive at the first service. After failure to conceive on the first service, the chances are 90.9 in 100 for eventual conception, and that 29 per cent will conceive at the second service. Table 3 also shows the chances of conception after the second and each successive mating to the tenth. The animals bred between 11 and 20 times are grouped in one class, and those bred between 21 and 30 times are grouped in another class. The chances for conception and for failure to conceive are about equal after the tenth service. The percentage of animals conceiving at each successive mating after the first service gradually decreased until the tenth service, after which there was much fluctuation.

TABLE 3.—Distribution of matings for conception, and the probability of conception for each service and additional services

Number of service	Females bred	Females conceiving		Females discarded as sterile		Chances in 100, immediately before service indicated, of females ever conceiving
	Number	Number	Per cent	Number	Per cent	Number
First.....	982	381	38.79	1	0.10	84.2
Second.....	600	174	29.00	2	.33	90.9
Third.....	424	116	27.35	2	.47	87.5
Fourth.....	306	74	24.18	4	1.30	83.3
Fifth.....	228	53	23.24	3	1.31	79.4
Sixth.....	172	41	23.83	2	1.16	74.5
Seventh.....	129	23	17.82	5	3.87	67.6
Eighth.....	101	19	18.81	2	1.98	63.4
Ninth.....	89	10	12.50	3	3.75	56.3
Tenth.....	67	0	8.95	3	4.47	52.3
Eleventh to twentieth.....	58	27	46.55	21	36.20	50.0
Twenty-first to thirtieth.....	10	2	20.00	8	80.00	20.0

Diagnosis of permanent sterility was made only when the animals were slaughtered and the genital organs carefully examined. Decisions were not made because of the number of services. An example is that of a cow that did not show œstrum and was not bred over a period of two years. When she was slaughtered the genital organs were found to be so diseased that conception was impossible. The cows bred from 2 to 30 times without conception perhaps were just as sterile on the first as on the last service, but a definite decision concerning their condition was reached only when the animal was slaughtered.

Data on the entire herd, as presented in Table 4, indicate that more services were required on an average for conception after abortion than after the birth of a normal calf. Data from abortion-positive animals show similar results. In abortion-negative cows, however, fewer services were required for conception after abortion than after normal calving. This seems to indicate that abortions caused by the micro-organism, *Brucella abortus*, are more harmful to the genital organs than normal calvings.

TABLE 4.—Number of services for conceptions after normal calvings and after abortions

Class of females	Conceptions	Services	Services for a conception
Abortion-negative group:			
Cows bred after normal calving.....	179	517	2.88
Cows bred after aborting.....	16	39	2.43
Abortion-positive group:			
Cows bred after normal calving.....	276	772	2.79
Cows bred after aborting.....	99	360	3.63
Entire herd:			
Cows bred after normal calving.....	455	1,289	2.83
Cows bred after aborting.....	115	399	3.46

## COMPARISON OF COWS AND HEIFERS

The average number of services required for conception in abortion-negative heifers was greater than the number required in abortion-negative cows throughout the 8-year period, except during the fiscal years 1925-26 and 1927-28. Only 67 per cent of the conceptions in heifers occurred on or before the third service, as compared with 73 per cent in cows. The average number of services for heifers was greater than for cows. A larger percentage of heifers than of cows eventually became pregnant.

## PREVALENCE OF STERILITY

An attempt is made in this work to ascertain the influence of abortion infection on permanent sterility. Other phases of the subject are discussed in detail on page 12. The records show that 5 abortion-negative and 18 abortion-positive animals became permanently sterile before the groups were separated, and that 10 abortion-negative and 27 abortion-positive animals became permanently sterile after separation. The number of females of breeding age that were in the two herds when the separation was completed in October, 1926, and the occurrence of permanent sterility, by 2-year periods, is shown in Table 5. The data show that 19 of the abortion-positive animals became sterile in the two years following separation, and only 4 abortion-negative animals became sterile in this period. Of the original animals left in these two herds in the third and fourth years after separation, 6 animals, or 13.63 per cent, in the abortion-negative group, and 8 animals, or 12.12 per cent, in the abortion-positive group became sterile.

TABLE 5.—*Permanent sterility in the original abortion-negative and abortion-positive females since the separation of the two groups*

Group	Total females	Females sterile first 2 years		Total females remaining at end of 2 years	Females sterile second 2 years		Total females remaining at end of 4 years
	Number	Number	Per cent	Number	Number	Per cent	Number
Abortion-negative females of breeding age in October, 1926 <sup>1</sup>	52	4	7.69	44	6	13.63	33
Abortion-positive females of breeding age in October, 1926 <sup>2</sup>	101	19	18.81	66	8	12.12	45

<sup>1</sup> Only those animals that have remained negative to the agglutination test are included here.

<sup>2</sup> Only those animals that were in the abortion-positive herd in October, 1926, are included here.

The fact that the percentage of permanent sterility was greater in abortion-positive animals before the separation of the groups and for two years following separation than during the third and fourth years after separation, indicates that the bacteria causing abortion disease are more virulent when both susceptible and infected animals are kept together, and that the disease when virulent causes sufficient damage to the genital organs to produce sterility. The fact that the percentage of permanent sterility in the abortion-positive animals had decreased during the third and fourth years after separation indicates that abortion disease, when not in so virulent a form has less influence in causing sterility. Factors other than those causing abortion, however, operate both in abortion-negative and abortion-positive animals to produce sterility.

## AGES AT WHICH STERILITY OCCURS

The frequency with which sterility occurred at various ages is shown in Table 6. There was very little sterility in heifers and young cows. A marked increase was noticed when cows became mature, and from six years on there was a steady increase in sterility. Of the 242 heifers bred, 5.27 per cent became permanently sterile before reaching 5 years of age, 11.98 per cent before reaching 8 years of age, and 16.94 per cent before reaching 10 years of age. The two cows bred when 13 years of age were sterile.

TABLE 6.—Age distribution at which permanent sterility occurred in the Beltsville herd

Age (years)	Females		Sterile females		Age (years)	Females		Sterile females	
	Number	Number	Per cent			Number	Number	Per cent	
2 <sup>1</sup> .....	242	6	2.47		9.....	51	6	11.76	
3 <sup>2</sup> .....	164	3	1.83		10.....	20	8	40.00	
4.....	173	4	2.31		11.....	16	6	37.50	
5.....	146	5	3.42		12.....	4	3	75.00	
6.....	104	6	5.77		13.....	2	2	100.00	
7.....	81	5	6.17		14.....	1	0	0.00	
8.....	70	0	7.69						

<sup>1</sup> Two-year olds as given here include those animals bred at 15 to 24 months of age.

<sup>2</sup> Only animals bred are included in this table. All animals were on official test during their first lactation, and some of them were not bred at 3 years of age. This makes a large decrease in the number of animals between the 2-year and the 3-year class.

## FERTILITY OF BULLS

In the breeding experiments at Beltsville, sires 6 years old or older are used more than young bulls. These old sires are handled, as

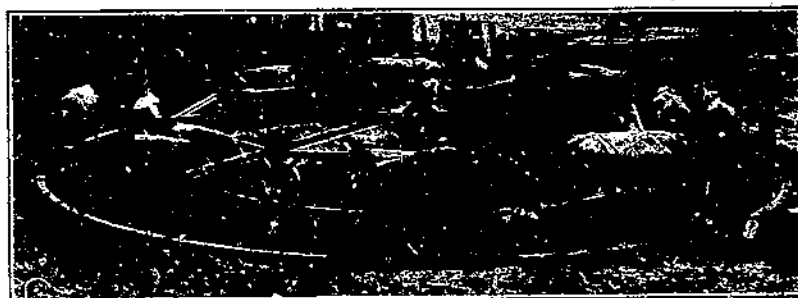


FIGURE 1.—Bull exerciser at Beltsville, Md.

nearly as possible, in a manner to keep them constantly at their optimum efficiency. Regular exercise and the addition of sprouted oats to the ration have been helpful in maintaining this efficiency.

In addition to increased activity and normality of the spermatozoa of bulls fed sprouted oats, the organs of elimination seem to be healthier than in animals not eating sprouted oats. The equivalent of 5 pounds of dry oats were fed when sprouted, each day. The oats were fed when the sprouts were one-fourth to one-half inch long, and a mass of white roots was present.

Regular exercise seems to have a more beneficial effect on the genital functions of bulls than any other treatment, probably because exercise keeps the body muscles in normal tone and the animal is more vigorous and active as a result. Bulls are also more docile when exercised.

The animals are hitched to a circular exerciser and forced to walk for approximately  $1\frac{1}{2}$  hours each day. It is thought there is less danger of injury with this method of exercising than with treadmills.

Microscopical examinations of the semen of herd sires were made from time to time as a check on their breeding efficiency. Aged sires were no longer fruitful after the activity of their spermatozoa fell below 50 per cent. Attempts to rejuvenate these animals did not restore the normal functions of their genital organs.

The details of the morphological and physiological studies of spermatozoa from bulls exercised, from those on various nutritional rations, from aged sires, and from those in which rejuvenation was tried, are not included in this bulletin.

#### EFFECT OF SEASON UPON FERTILITY

A summary of the records of 22 fertile bulls mated with fertile cows from January 1, 1926, to December 31, 1929, inclusive, are presented in Table 7. On an average more services were required for a conception during July, August, and September than during other months of the year. The average number of services required for a conception during these three months was 4.05; for October, November, and December, the average was 2.80; the average during January, February, and March was also 2.80, while the average for April, May, and June was practically the same—2.81. This is contrary to what might be expected. The period of lowest fertility as shown here would be the normal breeding season for the American bison, as reported by Marshall.<sup>2</sup> It is suggested that the hot weather influences the functioning of the genital organs adversely. Increased genital efficiency seems to have been associated with the advent of autumn.

TABLE 7.—Summary of records of the relation of season to fertility of 22 fertile bulls for four years

Month	Services	Conceptions	Average services for a conception	Month	Services	Conceptions	Average services for a conception
January.....	150	57	2.63	July.....	124	29	4.28
February.....	109	32	3.41	August.....	123	34	3.62
March.....	132	53	2.62	September.....	122	28	4.36
April.....	123	36	3.42	October.....	128	44	2.91
May.....	130	53	2.46	November.....	118	36	3.28
June.....	124	45	2.75	December.....	149	61	2.44

#### COMPARISON OF YOUNG AND AGED BULLS

From January 1, 1926, to April 10, 1930, 26 different bulls were used as herd sires in various breeding experiments at the Beltsville station, 10 of them in 1926, 12 in 1927, 20 in 1928, and 1929, and 17 in the first three months of 1930. For comparison the records of the breeding efficiency of these 26 bulls are shown in Table 8. All animals more than 6 years of age are classed as mature bulls, and those less than 6 years of age are classed as young bulls. Eight of the bulls were mature before being used in this herd. Of the 18 young bulls used, 2 became mature within the time these records were made. The records of these 2 bulls made before they were 6 years old appear in the young-bull class, and their records after 6 years of age appear in the mature-bull class. They are Nos. 9 and 10 in the mature class and Nos. 11 and 12 in the young-bull class.

<sup>2</sup> MARSHALL, F. H. A. THE PHYSIOLOGY OF REPRODUCTION \* \* \* 2d and rev. ed. 770 pp., illus. London, New York, [etc.] 1922.

TABLE 8.—Comparison of the breeding efficiency of mature and young bulls  
MATURE BULLS

Bull No.	All services			Services to fertile females only		
	Services	Concep- tions	Services for a con- ception	Services	Concep- tions	Services for a con- ception
1.....	32	11	7.45	38	11	3.45
2.....	121	19	6.38	94	19	4.94
3.....	196	27	7.25	158	27	5.85
4.....	235	40	5.87	224	40	5.60
5.....	81	26	3.39	80	26	3.30
6.....	268	77	3.48	226	77	2.93
7.....	108	39	2.76	98	39	2.61
8.....	44	12	3.66	41	12	3.41
9.....	131	27	4.85	112	27	4.14
10.....	32	11	2.91	32	11	2.91
Total or average.....	1,303	289	4.50	1,109	289	3.83

## YOUNG BULLS

11.....	74	20	2.55	66	29	2.27
12.....	108	31	3.48	58	31	1.87
13.....	70	28	2.71	72	28	2.57
14.....	85	29	2.93	61	29	2.10
15.....	89	34	2.61	73	34	2.14
16.....	62	19	3.26	53	19	2.78
17.....	85	25	3.40	86	25	3.40
18.....	49	27	1.81	40	27	1.70
19.....	48	21	2.28	43	21	2.04
20.....	12	3	4.00	12	3	4.00
21.....	7	5	1.40	7	5	1.40
22.....	21	9	2.33	14	9	1.55
23.....	47	14	3.35	46	14	3.28
24.....	8	6	1.33	8	6	1.33
25.....	12	5	2.40	9	5	1.80
26.....	1	0	0	1	0	0
27.....	1	1	1.00	1	1	1.00
28.....	1	1	1.00	1	1	1.00
Total or average.....	786	287	2.73	656	287	2.28
Total or average, all bulls.....	2,089	576	3.62	1,765	576	3.06

A total of 576 conceptions resulted from 2,089 matings, an average of 3.62 services for each conception. If services to cows that remained sterile are omitted, there were 1,765 matings with fertile cows, which resulted in 576 conceptions, or 3.06 services for each conception. More services were required for conception when mature bulls were used than when young bulls were used. There was also a considerable variation between bulls of the same age, as can be readily seen in Table 8.

## RESULTS OF PREGNANCIES TERMINATED

Only those pregnancies which terminated within the period of this study are considered here. The pregnancies terminated in living calves, abortions, and dead calves. When a fetus was born alive, normally developed, able to stand and nurse its dam, it was designated as a living calf. After the separation of the abortion-negative and abortion-positive groups all fetuses delivered which were apparently lacking in intrauterine development were termed abortions. The mummified fetuses in both the abortion-negative and abortion-positive herds were classified as calves born dead. Other calves were born dead after a normal period of gestation and were fully developed. The majority of these died during delivery, some were unavoidably killed by the attendants during birth, and some seem to have been dead before labor began.

## LIVING CALVES, ABORTIONS, AND CALVES BORN DEAD

Table 9 shows the results of pregnancies terminated. Throughout the 8-year period, the abortion-negative animals produced more living calves, fewer abortions, and more dead calves than the abortion-positive animals. The percentage of living calves in the abortion-negative group decreased and the percentages of abortions and dead calves increased after the separation, and in the abortion-positive herd the percentages of living calves increased, abortions decreased, and dead calves increased. The increase in percentage of calves born dead can be partly explained by the fact that a number of heifers in the abortion-negative group had genital tracts which were too small to deliver live calves, and some of the older cows in the abortion-positive group became sluggish, relaxed, and listless near calving time and delivered dead calves.

TABLE 9.—Results of pregnancies terminated

Item	Before the separation					After the separation				
	1923 <sup>1</sup>	1924 <sup>1</sup>	1925 <sup>1</sup>	1926 <sup>1</sup>	Total	1927 <sup>1</sup>	1928 <sup>1</sup>	1929 <sup>1</sup>	1930 <sup>1</sup>	Total
<b>Abortion-negative animals:</b>										
Females of calving age in herd										
Number	72	70	95	57		74	80	93	116	
Pregnancies terminated	48	58	54	34	194	48	52	69	87	256
do.	39	54	50	32	175	39	42	59	74	214
Living calves	Per cent. 31.25	33.10	32.59	94.11	90.20	31.25	30.76	35.50	35.05	33.59
Number	8	3	1	1	13	2	3	6	8	19
Abortions	Per cent. 16.66	5.17	1.85	2.94	6.70	4.16	5.78	7.39	9.19	7.42
Number	1	1	3	1	6	7	7	4	5	23
Dead calves	Per cent. 2.08	1.72	5.55	2.94	3.09	14.58	13.46	5.79	5.74	8.08
<b>Abortion-positive animals:</b>										
Females of calving age in herd										
Number	38	47	37	94		99	86	83	79	
Pregnancies terminated	29	25	30	67	151	61	61	63	61	246
do.	19	18	20	35	90	32	47	46	47	172
Living calves	Per cent. 35.51	64.00	56.66	52.23	59.60	52.45	77.04	73.01	77.04	69.91
Number	10	8	9	31	58	26	9	12	13	60
Abortions	Per cent. 34.48	32.00	30.00	48.26	38.41	42.62	14.76	19.04	24.31	24.39
Number	0	1	1	1	3	3	5	5	1	14
Dead calves	Per cent. 0.00	4.00	3.33	1.49	1.98	4.91	8.19	7.93	1.63	5.69

<sup>1</sup> Year ended May 31.

Before the groups were separated all abortions in the abortion-negative animals were single births, and one of the abortions in the abortion-positive animals was twins. Of the 19 abortions in the abortion-negative group after separation, 6 were twins and 13 were single births. One of the 60 abortions in the abortion-positive group was twins.

A complete record of bacteriological and pathological studies of aborted fetuses produced by abortion-negative animals in the period before separation is not available. In the period after the groups were separated such studies revealed the presence of *Bacillus pyogenes* in one case, *B. coli* in one case, streptococci in one case, and no *Brucella abortus* or other bacteria in the other 16 cases of abortion in the abortion-negative group. The cause of the abortions in these 16 cows is unknown. One cow in the abortion-negative group has aborted three times, and it was in her last abortion that streptococci were found. The *B. coli* were found in an abortion of twins and the *B. pyogenes* in an abortion from an old cow.

The abortions that occurred in the abortion-positive group have been recorded by 6-month periods to permit of a comparison of the abortions in cows that were in the positive group at the time of the

separation with those of cows that were added later, from the negative group, as they became positive. From May 11 to December 31, 1926, inclusive, there were 18 abortions. Of these 18 cases, 11, or 61.11 per cent, were from cows that were in the positive groups at the time of the separation, and 7, or 38.89 per cent, were from animals that were added to the group later. From January 1 to June 30, 1927, inclusive, 13 abortions occurred. Nine of these, or 69.23 per cent, were from cows of the original positive group, and 4, or 30.77 per cent, were from animals added later. From July 1 to December 31, 1927, inclusive, there were only 3 abortions. One of these was from a cow of the original positive group and 2 were from animals added later. Only 2 abortions occurred during the next six months, 1 from a cow belonging to the original abortion-positive group and 1 from an animal added later. In the period from July 1 to December 31, 1928, there were 4 abortions from cows of the original group and 3 from animals added to the group later. From January 1 to June 30, 1929, there were 9 abortions. Two of these, or 22.22 per cent, were from cows of the original group, and 7, or 77.78 per cent, were from animals added later. From July 1 to December 31, 1929, 6 abortions occurred. One abortion, or 16.67 per cent, was from a cow belonging to the original group, and 5, or 83.33 per cent, were from animals added to the group later. In the first six months in 1930, there were 4 abortions in animals that had been added, and none in animals of the original group. In this 4-year period 59 abortions occurred, and of these, 26 were in animals in the abortion-positive group at the time of the separation and 33 were in animals that became positive later. Of the 26 abortions in the original positive group, 20 occurred in the first year after the separation. These data may indicate that the abortion infection loses its virulence when abortion-positive cows are kept by themselves, or, as appears more likely, the abortion-positive cows develop a certain resistance or tolerance to the infection that is sufficient to enable them to retain the fetus to full term.

## EFFECT OF AGE ON CALVING EFFICIENCY

The distribution of calving efficiency by age of dam and number of pregnancy is shown in Table 10.

TABLE 10.—Distribution of pregnancies terminated before and after the separation of the abortion-positive from the abortion-negative cows

Class of cows and number of pregnancy	Before separation						After separation					
	Living calves		Abortions		Dead calves		Living calves		Abortions		Dead calves	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Abortion-negative:												
First.....	41	83.67	4	8.16	4	8.16	73	78.49	6	6.45	14	15.05
Second.....	42	93.33	3	6.67	0	0.00	41	87.23	4	8.51	2	4.26
Third.....	34	89.47	3	7.89	1	2.63	29	60.62	1	3.12	2	6.25
Fourth.....	24	100.00	0	0.00	0	0.00	23	95.83	1	4.17	0	0.00
Fifth.....	9	75.00	2	16.67	1	8.33	10	82.00	2	8.70	2	8.70
Later.....	25	96.15	1	3.85	0	0.00	29	78.38	5	13.51	3	8.11
Total.....	175	90.21	13	6.70	6	3.09	214	83.50	19	7.42	23	2.98
Abortion-positive:												
First.....	11	39.29	17	60.71	0	0.00	8	28.57	19	67.86	1	3.57
Second.....	14	56.00	9	36.00	2	8.00	27	54.00	20	40.00	3	6.00
Third.....	15	60.00	10	40.00	0	0.00	42	70.24	10	18.87	1	1.89
Fourth.....	14	60.87	9	39.13	0	0.00	35	85.36	4	9.76	2	4.88
Fifth.....	11	68.75	4	25.00	1	6.25	24	77.42	4	12.90	3	9.68
Later.....	25	73.53	9	26.47	0	0.00	35	83.72	3	6.98	4	9.30
Total.....	90	59.60	58	38.41	3	1.99	172	69.92	60	24.39	14	5.69

In the abortion-negative animals the greatest percentage of living calves were born of the fourth pregnancies. The same is true of abortion-positive animals after the separation of the groups, although older animals produced more living calves before separation. The smaller percentages of live calves in earlier pregnancies of the abortion-negative animals are accounted for by the larger number of calves born dead (the reason for the number of calves born dead in first pregnancies has been given) and the smaller percentages of live calves in the latter pregnancies were a result of the larger number of abortions.

The greatest percentages of abortions in the abortion-negative animals, after the separation of the groups, were after the fifth pregnancies. In the abortion-positive animals the greatest percentage of abortions was during the first pregnancies. A sharp decrease in the percentage of abortions occurred during the second pregnancies, followed by a gradual decrease in succeeding gestations.

A slight error may have entered Table 10, because a few grade cows, whose ages were unknown, had been purchased early in the history of the herd. The results of their gestations before the separation of the groups were counted with the later pregnancies only. The age and number of pregnancies of all animals in the groups after the separation were known.

#### CAUSES AND TREATMENTS OF STERILITY

Sterility refers to the loss of reproductive power, and may be temporary or permanent. Aside from being caused by obesity, starvation, malformations, and systemic diseases, sterility may be caused by morbid conditions of the genital organs, and it occurs also in some animals where no signs of pathological changes can be found.

Temporary sterility is the term used in this publication to describe the condition of an animal that conceives after four or more matings. The term "permanent sterility" is applied, after exhausting present knowledge of diagnosis and treatment, to those animals that do not conceive. Sometimes as many as 20 services over periods of more than two years have failed.

Pathological conditions of the genital organs readily recognized in the living animal were persistent corpora lutea, ovarian cysts, atresic follicles, and some inflammatory changes in various parts of the genital organs.

#### REMOVAL OF PERSISTENT CORPORA LUTEA

Persistent corpus luteum prevents œstrum in the cow. When a barren cow does not show œstrum for a long period the condition of the animal may be interpreted as being similar to pseudopregnancy. The retained corpus luteum interferes with normal conception. Usually when the corpus luteum is removed from the ovary the genital organs begin to function, œstrum showing in from 3 to 10 days. Sometimes the signs of œstrum are not prominent enough to be noticed, and the results of removal of the corpus luteum may be misinterpreted.

Results of the removal of persistent corpora lutea on conception are shown in Table 11.

TABLE 11.—Results of removing persistent corpora lutea

Class of cows	Cows	Days without oestrus	Conceived on first service	Conceived later	Not yet pregnant	Died, not conceiving
Abortion-negative.....	38	80	21	11	3	3
Abortion-positive.....	26	78	11	11	2	2
Total.....	64	170	32	22	5	5

<sup>1</sup> Average.

It has been the practice at Beltsville to breed cows during the first oestrus observed following the removal of corpora lutea. Fifty per cent of those bred at the first oestrus following the removal became pregnant, and 34 per cent conceived when bred during later oestri. The data in Table 11 show that when persistent corpora lutea are removed the genital organs start to function normally and that it is advisable to mate the cow during the first oestrus.

## REDUCING OVARIAN CYSTS

Ovarian cysts seem to manifest themselves in two ways: (1) By causing irregular oestri, and (2) by causing irregular oestri accompanied by nymphomaniac symptoms. The first type of cysts yield readily to treatment by rupturing, while the second type does not respond so readily to this treatment.

Six abortion-negative and 13 abortion-positive cows have been affected with ovarian cysts since the groups were separated. One abortion-negative and two abortion-positive cows were affected more than one sexual season; therefore, 22 cases of ovarian cysts were observed in 19 cows.

Of the 22 cases, 4 appeared in the second sexual season, 5 in the third, 2 in the fourth, 6 in the fifth, 3 in the sixth, 1 in the seventh, and 1 in the ninth sexual season.

Seventeen cases of ovarian cysts appeared while the cows were on official test and five cases while the cows were not on official test. All of the cows seemed normal and in good flesh before the ovarian cysts appeared. The cysts were noted during 8 of the first 10 months of the lactation period.

There were eight cases of irregular oestri with very little or no excitement, all in the second and third sexual seasons, and all responded to treatment by rupture of the cysts.

Nymphomaniac symptoms were present in 14 cases, all occurring after the second sexual season and only 5 of these animals responded to treatment.

## ATRESIC FOLLICLES

When a ripe Graafian follicle fails to rupture and release the ovum, and is reabsorbed, it is called an atresic follicle. The animal shows the same outward symptoms that are shown when an ovum is released normally. Obviously conceptions do not occur following matings at these times. The frequency of this condition in cattle is not known. It has been found in four living heifers and in one dead cow in the Beltsville dairy herd.

## INFLAMMATION OF THE GENITAL ORGANS

Inflammation of the tubular portions of the genital organs may be recognized in the living animal when it is severe enough to cause gross changes in the tissues or secretions. Often the inflammation is so mild that it can not be detected readily, or it may have subsided, and the damage done is not easily recognized. Sometimes the inflammation spreads and causes damage to other organs, or it may spread from other organs to the genital organs and form adhesions between the organs involved, or tumors that interfere with the normal functions of the genital organs. Abscesses involving a part or all of the genital organs may develop, causing temporary sterility and in many cases permanent sterility. Injuries and the common pus-forming bacteria are responsible for most of these pathological inflammations. The treatment administered is the same as that for similar conditions in other parts of the body, in so far as the location and morphology of the organs allow. In the abortion-negative group 11 cases have been found, and in the abortion-positive group 50 cases have been encountered, since the separation of the groups.

## EXERCISE

Inflammation, ovarian cysts, excess fat, bodily inactivity, or old age may cause a loss of tone in the muscles and ligaments supporting the genital organs. Sometimes this lack of tone extends to the voluntary muscles of the body. The lack of tone in many cases is due primarily to senility, which is sometimes premature, or to asthenia. The weakness may be general, but is more often restricted to the genital organs.

The influence of exercise in correcting certain forms of sterility in 19 cows is shown in Table 12. Improvement in the condition of the genital organs was noted in all of the cows, except in the one affected with edema of the walls of the uterus, when the cows were forced to take exercise by being driven on a track for approximately two hours a day for periods varying from 30 to 156 days. It seems that forced exercise was directly responsible for the improvement that allowed normal conceptions in 6 of the 19 animals. Five more conceived later, and 8 remained sterile.

TABLE 12.—*Influence of forced exercise on sterility in cows*

Cow No.	Days exercised	Services before start of exercise	Services after start of exercise	Time between start of exercise and conception	Disturbances preventing conception
				Days	
441.....	136	11	3	58	Lack of muscular tone.
477.....	156	14	3	49	Do.
490.....	132	9	6	(1)	Do.
426.....	64	5	2	26	Tumors and lack of muscular tone.
609.....	63	13	2	110	Lack of muscular tone.
273.....	105	8	4	(1)	Do.
490.....	105	7	8	223	Do.
457.....	47	8	1	38	Do.
468.....	136	0	0	(1)	Inflammation of uterus, tubes, and ovaries, pus.
442.....	65	7	1	(1)	Inflammation of uterus.
631.....	105	9	7	(1)	Inflammation of uterus, abscess.
651.....	39	1	6	167	Inflammation around ovaries.
264.....	74	11	2	(1)	Edema walls of uterus.
462.....	186	6	4	(1)	Ovarian and vaginal cysts, inflammatory changes.
606.....	155	8	5	133	Ovarian cysts, soft uterus.
456.....	105	2	1	148	Ovarian cysts.
626.....	155	9	8	(1)	Heifer, apparently normal.
644.....	85	5	2	53	Apparently normal.
652.....	105	6	9	292	Do.

1 No conception.

## FEEDING SPROUTED OATS TO CORRECT STERILITY

In cases of sterility where no indication of pathological changes can be found in the genital organs and conception does not take place, the condition may be called a functional disturbance. The definite cause of such sterility is unknown. As previously mentioned, experiments including the feeding of sprouted oats are being carried on at the station in the study of these functional disturbances of the genital organs.

It has been found that for this purpose the oats are most effective when germinated until the sprouts extend through the grains from one-fourth to one-half inch and a mass of white roots is formed. Cattle eat oats germinated to this stage more readily than when the sprouts are longer. Quantities of sprouted oats equivalent to  $2\frac{1}{2}$  to 5 pounds of dry oats have been fed daily during the feeding period.

In sprouting oats, it has been found advantageous to place the desired amount of dry oats in a sack and soak for 24 hours in a tub or barrel of water to which a small amount of formalin (1 ounce of formalin to 50 gallons of water) has been added for the purpose of preventing mold. After the sack of oats is removed from the water, it is placed on the floor for 24 hours during warm weather and for 48 hours during cold weather, then the oats are spread in the pans or trays of an ordinary sprouter, or placed in drums, or spread to a thickness of about 2 inches on a clean floor. It requires approximately three days to produce sprouts one-fourth to one-half inch long from oats in this stage. During the sprouting period the oats must be kept moist, care being taken to prevent too much moisture in one place and drying in another. The oats seem to sprout more rapidly and evenly when kept at a temperature of  $75^{\circ}$  to  $80^{\circ}$  F. They may be fed as soon as the desired growth is obtained.

The advantage of sprouting oats in pans is that it facilitates feeding the desired amount to the animal. The advantage of a drum sprouter, where the oats are transferred from one drum to a similar drum on a lower level, is that the oats are easier to handle during the sprouting period. The turning of the oats breaks up mold growths, it also allows air to come in contact with more of the oat grains, and it helps to keep an even moisture throughout the mass of sprouting grain.

The plan has been to feed sprouted oats to cows that had been bred without results for some time but showed no pathological conditions, and to feed sprouted oats to heifers for approximately 90 days before they became of breeding age. A thorough physical examination is made of each animal to determine whether there are any pathological conditions that might prevent conception.

The experiment requiring the comparison of the results of genital activity of animals fed sprouted oats and animals not fed sprouted oats has not progressed far enough to be reported. In the results recorded, it has been assumed that animals which had to be bred four or more times after they began to eat sprouted oats were not benefited by this treatment.

Table 13 is a summary of the breeding records of animals that appear to have been benefited by sprouted oats, as shown by the small number of services required for conception after the animals were started on sprouted oats as compared with the number of sterile matings before sprouted oats were fed.

TABLE 13.—*Influence of sprouted oats fed to apparently normal animals that were temporarily sterile*

Class and cow No.	Services		Time between start of feeding sprouted oats and conception	Class and cow No.	Services		Time between start of feeding sprouted oats and conception
	Before start of feeding	After start of feeding			Before start of feeding	After start of feeding	
Abortion-negative.			Days	Abortion-positive:			Days
269.....	2	2	33	457.....	5	3	71
281.....	2	2	34	476.....	16	2	42
407.....	7	1	19	488.....	7	1	48
416.....	6	2	45	457.....	9	3	77
406.....	5	1	24	609.....	13	2	123
424.....	3	1	31	644.....	5	2	60
290.....	5	1	19	625.....	1	1	68
819.....	3	3	91	651.....	4	3	100
831.....	4	1	53				
631.....	5	1	24				
			5				

In addition to the animals listed in Table 13, 11 abortion-negative cows that had been bred an average of 4.45 times were fed sprouted oats, but it was found upon examination that these animals had conceived on an average of 12.91 days before the feeding began, also 3 abortion-negative heifers that had been bred 4 times each before being placed on the sprouted-oat ration were found to have conceived on an average of 12.33 days before the feeding began. Eleven abortion-positive cows that had been bred an average of 4.63 times were fed sprouted oats, but it was found upon examination that these animals had conceived on an average of 28.09 days before feeding began, also 2 abortion-positive heifers that had been bred 3 and 4 times, respectively, before being placed on the sprouted-oat ration were found to have conceived 21 and 24 days, respectively, before feeding began. It seems probable that sprouted oats may contain a vitamin, or a hormone in quantities sufficient either to prevent early abortions or reabsorption of the embryo, or to aid implantation of the newly fertilized ovum.

Three abortion-negative cows were fed sprouted oats before being bred. One of these cows conceived on the first mating, and the other two required two services each. These cows were fed 20 to 137 days, respectively, before becoming pregnant. Four abortion-positive cows were placed on the sprouted-oat ration before being bred. Two of these cows conceived on the first service, and the other two required two and three services, respectively. These cows were fed 15 to 46 days before conceiving.

Thirty abortion-negative heifers were fed sprouted oats before being bred. Twenty-four of these were fed approximately 90 days before they reached breeding age, and 6 were fed a shorter time. Seventeen conceived at the first mating, 4 at the second, and 9 at the third, making an average of 1.73 services for initial conception. One abortion-positive heifer which was fed sprouted oats before being bred, conceived at the first service.

In cases where more than three services were required for conception after the feeding of oats started, the conception was not attributed to any benefit derived from the use of sprouted oats. Cases in this class are described below.

Three abortion-negative and 8 abortion-positive cows whose genital organs appeared normal required four or more services for conception after being fed sprouted oats, also 18 abortion-negative and 2 abortion-positive heifers having normal genital organs required four or more services for conception.

Sprouted oats were fed to 3 abortion-negative and 16 abortion-positive cows which also received other treatment while showing pathological changes in the genital organs. One of the abortion-negative cows and 7 of the abortion-positive cows became pregnant; the others remained sterile.

In summarizing the results of feeding sprouted oats it appears that 57 females were directly benefited and 31 were not benefited, as judged by the number of services required to produce conception. It is not definitely known whether feeding sprouted oats was beneficial to the 27 females that conceived to a service just previous to the start of feeding. There is no evidence to show that sprouted oats were helpful to the cows showing pathological changes in the genital organs.

#### CONTROL OF ABORTION DISEASE

Abortion disease was very seriously interfering with the progress of the breeding and nutritional investigations in the Beltsville herd; therefore an attempt was made to control the disease by separating the abortion-positive animals from the abortion-negative animals and handling them in two separate herds. Diagnosis of the disease was made by the agglutination test.

In May, 1926, 71 abortion-positive females were moved to new quarters approximately one-half mile from the original barns. Because of certain experimental work that was in progress 14 abortion-positive females were kept in one of the original barns, but separate from abortion-negative animals, until October, 1926, when they were moved to the new quarters and placed with the other abortion-positive animals.

After the abortion-positive animals were moved, the barns were thoroughly scrubbed with hot water and soap and a disinfectant applied. The yards were scraped, and the scrapings and all litter were moved to cultivated fields. Two crews have been maintained, one for the abortion-negative herd, the other for the abortion-positive herd.

The same bulls have been used on abortion-negative and abortion-positive females with no apparent bad results to date. Breeding has always been done on neutral ground. Calves from the abortion-positive cows have been kept on the abortion premises and fed milk from the abortion-positive herd until they were 60 days old; then they were fed milk from the abortion-negative herd until they were moved to the negative premises 10 days later. All straw, manure, and dirt were cleaned from their bodies before they were placed in the barns on the negative premises. Only milk from the abortion-negative herd has been fed to animals at the abortion-negative part of the farm. All litter and waste from the abortion-positive herd has been moved to cultivated fields or placed on the abortion-positive premises. However, milk from the abortion-positive herd has been brought to the milk-handling room on the abortion-negative part of the farm,

and official testing of milk from abortion-positive animals has been done in the same building in which the milk-handling or dairy room is located.

Between May, 1926, when some of the abortion-positive animals were separated from the original herd, and October, 1926, when the remainder of the abortion-positive animals were moved away from the original barns, 24 animals in the abortion-negative herd reacted to the agglutination test and were added to the abortion-positive herd. Some of these animals may have been infected before the herds were separated, some may have become infected through calf manure that was placed on a pasture by mistake, and some may have become infected through the abortion-positive animals remaining at the original barns during the interval. In the following two years eight abortion-negative animals became abortion-positive and were moved from the original barns. Eleven animals became infected during the third year. During the fourth year no abortion infection occurred in the negative herd. A total of 43 females have become positive to the agglutination test for abortion disease since the herds were separated in May, 1926.

Possible sources of infection entering the abortion-negative herd have been the handling of the milk from the abortion-positive herd on the abortion-negative farm, the delivering of feeds and hauling of manure from the two herds by the same men and equipment; visitors coming into the abortion-negative herd after having been among the animals of the abortion-positive herd. The use of straw from dairy districts where abortion disease might exist is also a possible source of infection.

When infection does enter the abortion-negative herd, it takes some time to eliminate the disease again. An example of the difficulty encountered in preventing the spread of infection is that of a heifer which aborted in the pasture of the abortion-negative herd before it was known that she was infected.

The agglutination test was applied to the abortion-negative herd every 60 days during 1926, twice a year during 1927 and 1928, and every 60 days during 1929 and up to July, 1930.

Table 14 shows the number of animals that became infected in the abortion-negative herd in a 4-year period. A greater number of cows became positive immediately after the separation than at any time later. The number of females of breeding age has steadily increased in the abortion-negative herd.

TABLE 14.—Distribution of abortion-positive animals removed from the abortion-negative herd in a period of four years

Date animals were moved	Females in negative herd that became infected	Females that remained in negative herd	Date animals were moved	Females in negative herd that became infected	Females that remained in negative herd
May, 1926	85	71	October, 1928	3	107
June, 1926	6	73	January, 1929	5	113
July, 1926	9	65	February, 1929	1	109
September, 1926	7	65	March, 1929	2	108
November, 1926	1	78	May, 1929	1	118
March, 1927	1	81	June, 1929	2	120
June, 1927	1	80	May, 1930	0	139
May, 1928	4	107			

## OTHER ABNORMAL CONDITIONS ENCOUNTERED, TREATMENTS, AND FATALITIES

Disease or abnormal conditions encountered in the Beltsville dairy herds since the separation may be classed under the following headings: Nutritional disturbances, foreign bodies, lung troubles, injuries and lameness, miscellaneous troubles including umbilical hernia, umbilical infections, lumpy jaw, diphtheria, eczema, parasites, forage poisoning, lead poisoning, septicemia, retained placenta, difficult calving, and troubles of an undetermined nature.

The troubles and diseases encountered in the calves are listed in Table 15, while the troubles and diseases encountered in animals over 1 year of age are listed in Table 16.

TABLE 15.—*Morbid conditions encountered in calves*

Troubles encountered	Cases	Deaths	Troubles encountered	Cases	Deaths
Nutritional disturbances.....	132	24	Diphtheria.....	2	0
Lung troubles.....	82	26	Eczema.....	4	0
Udder troubles.....	2	0	Exposure to cold.....	1	1
Injuries and lameness.....	38	5	Anomalies.....	3	3
Umbilical hernia.....	4	1	Weak at birth.....	8	8
Umbilical infection.....	10	0	Undetermined.....	6	6

TABLE 16.—*Morbid conditions found in animals over 1 year old*

Conditions encountered	Animals	Cases	Deaths	Conditions encountered	Animals	Cases	Deaths
Nutritional disturbances.....	153	241	4	Eczema.....	5	5	0
Foreign bodies.....	17	17	17	Forage poisoning.....	1	1	0
Lung troubles.....	7	7	1	Lead poisoning.....	3	3	3
Udder troubles.....	76	81	0	Septicemia.....	8	6	5
Injuries and lameness.....	115	159	2	Retained placenta.....	54	64	0
Umbilical infection.....	1	1	0	Assistance to cows calving.....	30	32	0
Lumpy jaw.....	3	3	2	Undetermined.....	2	2	2

## NUTRITIONAL DISTURBANCES

Digestive disturbances encountered in the mature animals include refusal to eat, overloading of the rumen and its refusal to work, intoxication from eating moldy or spoiled feed, lack of moisture in the digestive tract, serious bloat, impaction, constipation, diarrhea, and in calves twisting of the abomasum, and so-called white scours. Treatment varies with each case and is directed at the removal of the undesirable substance from the digestive tract and the elimination of the cause.

Three of the four deaths among the mature animals were from bloat and one from a severe case of gastroenteritis. Of the 24 calves that died, 5 died of varying degrees of gastritis while being used for a feeding experiment, between the ages of 19 to 59 days. Twisting of the abomasum was responsible for the death of 2 calves at the ages of 24 and 60 days, respectively. The other 17 calves died of gastroenteritis, at ages ranging from 6 to 193 days.

Seven cows have been affected with a disease or disturbance that has not been diagnosed. They walked stiffly, showed pain at the slightest touch, some of them were unable to get up for several days,

their backs were drawn up in a hump or bent sidewise and other joints of the body were partly flexed, but the appetite was not noticeably disturbed. Three calves similarly affected showed the same symptoms accompanied by mild rickets. The symptoms were noticed in the cows within a month after freshening and in calves between 1 and 2 months of age. All of these animals responded readily when calcium lactophosphate or calcium chloride was administered in small doses daily.

#### FOREIGN BODIES

The foreign bodies most frequently found in Beltsville animals were pieces of wire and nails. In 12 of the 17 cases the diaphragm had been pierced. In 3 cows wires were found in the liver. One cow died as the result of wire passing from the stomach through the abdominal wall. Another animal had swallowed a metal burr that ruptured the fourth compartment of the stomach.

#### LUNG TROUBLES

Lung troubles include congestion and inflammation of the lungs and their coverings. The cow that died of pneumonia had been affected intermittently from calfhood to maturity. It is thought that most of the calves became affected from exposure to cold drafts of air. Light, cleanliness, ventilation, and an even temperature have been found to be most efficient aids in the treatment of lung troubles. The age of the 26 calves that died of lung troubles ranged from 13 to 304 days.

#### UDDER TROUBLES

Twenty-three cows in the abortion-negative herd, 33 cows in the abortion-positive herd, and 2 calves, were affected with mammitis. Some of the cases of mammitis in older cows appeared near the end of long lactation periods, and the cause has not been ascertained. Other cases of mammitis in cows apparently were the result of bruises and poor milkers. Udders were injured most frequently when cows were in oestrus. Udder injuries in the two calves may be attributed to other calves sucking them. The most satisfactory treatment applied in cases of mammitis has been the hastening of elimination, frequent milking, and massage.

Contagious pustular dermatitis has given practically no trouble in the Beltsville herds. It has been present in a very mild form in several barns but lasted only a short time.

#### INJURIES AND LAMENESS

Injuries included bruises and broken ribs from blows received by animals while fighting; bruises caused by running into fences and by striking the brisket on mangers and watering troughs; broken bones resulting from animals getting caught in partitions; foreign objects such as straw and splinters in the eyes; and puncture wounds made by forks and nails. Several calves were injured, some of them fatally, by being stepped on by their dams. Treatment to fit the conditions was given.

Injury to the lower jaw of a cow caused her death. A deposit of urine in the subcutaneous tissue and muscles throughout the lower part of the body, as a result of a rent in the urethra, was responsible for the death of a bull. The injury occurred during coitus. Injuries

such as broken vertebra in the back, crushed ribs, and bruised bodies were responsible for the deaths of five calves ranging in age from 3 to 337 days.

Most of the lamenesses were due to foot rot, stone bruises, and nail punctures. In the younger animals the so-called foot rot usually was located between the digits; and in the older, heavier animals the sole was more frequently affected. Three abortion-positive cows were affected with enlarged joints. Foot rot has been treated successfully by the use of formalin solution.

#### MISCELLANEOUS TROUBLES

Of the four cases of umbilical hernia, two were those of calves which were successfully treated by surgical interference, one was that of a grade bull calf which was disposed of without treatment, and one was that of a calf which died before it was 72 hours old.

Most of the umbilical infections in calves were found in one pen. Treatment with tincture of iodine has been successful. Thorough cleanliness has been an excellent preventive.

Treatment of lumpy jaw by the administration of potassium iodide was sufficiently successful to carry the animals affected through the experiments in which they were included.

Diphtheria in two calves was successfully treated by the discrete use of formalin solution and argyrol solution.

Eczemas were successfully treated by hastening elimination and the application of soothing ointments.

A case of apparent forage poisoning was successfully treated by dilution of the contents of the digestive tract and the administration of antitoxins. Recovery was slow, the animal taking six weeks to return to normal eating and drinking, and not gaining in flesh until five months later.

The eating of paint that had been spilled in a lot caused the death of three animals.

One calf died as a result of exposure to extreme cold when it was 316 days old.

An anomaly causing the death of three calves was the lack of a passage between the stomach and small intestines. These calves died on the second, ninth, and tenth days of life, respectively.

Septicemia having its source in the udder was responsible for the death of three cows. The source of the infection was not found in the other three cows that died of septicemia.

Removing the placenta by hand 48 hours after calving has been a satisfactory way of dealing with retained placenta in the Beltsville dairy herds.

Reasons for difficult births were abnormal presentation of the calf, lack of vigor in the dam, passages too small for a normal calf, and the calf being too large for a normal passage.

#### DISCUSSION AND SUMMARY

Records concerning fertility of cows and bulls, sterility, control of abortion disease by separating positive and negative animals, and the occurrence of other diseases in the animals at the United States Dairy Experiment Station at Beltsville, Md., are presented. Information is included on the comparative breeding efficiency and calving efficiency of abortion-negative and abortion-positive groups of animals.

The evidence presented shows that there is little difference in breeding efficiency between abortion-negative and abortion-positive animals when periods of four years are considered. The abortion-positive animals were somewhat more efficient when kept in a separate herd than when kept with the abortion-negative animals.

The percentage of heifers that conceived was as large as the percentage of cows that conceived, but more services were required for conception in heifers than were required in cows.

More services were required for conception in abortion-positive animals than in abortion-negative animals, both before and after separation of the two groups. The number of services for conception in abortion-positive animals after separation exceeded the number required before separation.

The least number of services required for conception was in the abortion-negative cows, and the greatest number was required by the abortion-positive heifers.

A study of the distribution of services shows that a little more than 40 per cent of the conceptions resulted from the first service, and a little more than 70 per cent of the conceptions resulted from the first three services.

A greater number of services were required for conceptions following abortions than were required for conceptions following normal calvings. This indicates that it takes longer for the genital organs to recuperate after an abortion than after a normal calving.

The number of mature cows that became sterile was larger than the number of immature cows.

More services were required for a conception in July, August, and September than in other months of the year.

Young bulls were more efficient than mature bulls when mated to fertile cows.

The percentage of live calves born in the abortion-negative group was lower after the separation of the groups than before, but higher than that in the abortion-positive group in either period. This decrease is probably due to the increase in number of calves born dead at the termination of first pregnancies and to the increase of abortions in old cows.

The abortion rate decreased in the abortion-positive group after separation from the regular herd, except when newly infected animals were added. There was no decrease in abortions during the 4-year period before separation. Abortions in the animals of the original abortion-positive group decreased rapidly after separation, and make up only 46.77 per cent of the total abortions in the abortion-positive herd.

In the abortion-positive females more abortions were found among first pregnancies than others. Fewer abortions were found among mature cows after separation of the groups than before.

Correct diagnoses are essential for the proper handling of sterility. Some of the morbid conditions of the genital organs that may be ascertained readily in the living animal are persistent corpora lutea, ovarian cysts, atresic follicles, and some inflammatory changes.

Data presented indicate that oestrus and successful breeding followed the removal of persistent corpora lutea in cows failing to come in heat.

Treatment of ovarian cysts was successful in mild cases, and unsuccessful in the majority of cases where nymphomaniac symptoms were present.

Forced exercise was beneficial in cases lacking muscular tone.

Data are presented showing the number of services before and after germinated or sprouted oats were fed to cows that were not conceiving but that had no indications of pathological conditions in the genital organs. Also, breeding data are given on heifers fed sprouted oats before being bred.

The number of females of breeding age in the abortion-negative herd, which includes the offspring from the positive herd, increased from 71 to 139 during the 4-year period May, 1926, to May, 1930.

The abortion-positive females decreased in number from 85 to 68 in the same period. This decrease came about through disposing of old, sterile, or unsound animals and also as a result of the fact that, since the offspring were transferred to the negative herd, there was no chance for increase in numbers except through the addition of newly infected animals from the negative herd.

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This bulletin is a contribution from

<i>Bureau of Dairy Industry</i> .....	O. E. REED, <i>Chief</i> .
<i>Division of Dairy Cattle Breeding, Feeding, and Management.</i>	R. R. GRAVES, <i>Principal Specialist in Dairy Cattle Breeding, Chief</i> .

**END**