Table 3.—The performance of two groups of ewes of different breeding and origin.

	RXPR Backcross	Grade Rambouillet
	1955 results	
Number of ewes	98	100
Number of ewes mated	80	96
Number of ewes that lambed	57	80
Number of lambs born	73	91
Number of lambs 20 days of age	47	77
Percent lambs born dead or lost	36	15
Percent lamb crop	48	77
	1956 results	
Number of ewes	97	98
Number of ewes mated	92	94
Number of ewes that lambed	78	84
Number of lambs born	99	115
Number of lambs at 20 days of age	77	104
Percent lambs born dead or lost	22	10
Percent lamb crop	79	106

increase in the percentage of multiple births. The results obtained in the comparison of the part Panama ewes with the grade Rambouillet ewes is more difficult to interpret. The difference in performance may be due to the breeding of the sheep or it may be due to the way the sheep were handled before they were obtained for the experiment. A conclusion can be drawn however, i.e., different groups of ewes perform quite differently under the same conditions. Therefore, it is imperative that the cause or causes of these differences in performances be determined.

Reproductive Efficiency of Range Beef Cows

DOYLE CHAMBERS, GARY O. CONLEY and J. A. WHATLEY, Jr.

The number of beef cows two years of age and older in Oklahoma on January 1, 1957 was estimated by the United States Department of Agriculture to be more than one and one-fourth million head. These cows are being kept for the production of beef calves, most of which are marketed at weaning time either as feeder calves or as fat slaughter calves. In this system of production the success of the operation depends greatly upon the costs of maintaining the cow herd and the productivity of the individual cows in the herd.

In a recent survey conducted by the Research Committee of the American National Cattlemen's Association it was reported that only 79 per cent of the beef cows and heifers bred for 1954 calving actually dropped live calves and that only 63 percent of them raised calves to weaning. Other estimates by the United States Department of Agriculture indicate that, for the ten years 1945-54, 84 percent of cows on

hand on January first calved. This was somewhat higher than the 1954 survey estimate.

Oklahoma calf crop percentage for the above ten-year period was estimated at 86 percent which was a bit higher than the national average and was considerably above some of the states in the Western and Southern regions. No reliable estimates of the percentage of cows actually weaning calves are available for Oklahoma, but it is probable that no more than 75 to 80 percent of them raise calves. If we could assume that it costs $64.00 per year to maintain a brood cow, and that an eighty percent calf crop is weaned, this would mean that the cost of each calf is $80.00. This does not include costs of producing replacement females which is related to the length of productive life of the brood cow. It is quite obvious, however, that factors of major importance in cow productivity would include regularity of reproduction, length of productive life, and the mothering ability of the brood cow including milking capacity.

According to the 1954 survey, referred to above, more than one-half of the cows culled from breeding herds were removed because of age and nearly one-third of the cows culled were removed because the cows were "dry" at weaning time. This indicates that little opportunity exists for selection of cows for other productive traits.

It is obvious that a high percentage calf crop is an essential feature of any successful cow-calf system of beef production. It is also highly desirable that these calves be dropped in the shortest possible period of time to simplify management of the herd and aid in marketing of the calves. Because of the importance of reproductive regularity to the beef cattle breeder, information is needed upon the influence of heredity and various environmental factors upon this particular factor of cow productivity.

Before one can conduct studies of factors influencing the reproductive efficiency of beef cows, he must devise methods for measuring differences among individuals. Calf crop percentage is a measure which can be used in the evaluation of the influence of certain environmental factors upon groups of cows, but is of much less value when trying to determine the influence of hereditary factors upon reproductive efficiency.

If individual selection is to be effective there must be heritable individual differences which one can detect by some means. This presents a problem to beef cattle producers because most beef cattle are pasture-mated during a restricted breeding season with very little information upon the breeding behavior of individual animals. One knows the period during which the cow was exposed to a bull and the date upon which she calves each year. He does not often know the reasons for her failure to conceive if she does not produce a full-term calf each year.

Nature of This Study

During the past year a study of the reproductive performance of some 325 beef cows which had been in the various herds of the Oklahoma

Agricultural Experiment Station during the past four to nine years was conducted to determine the repeatability of two different measures of reproductive efficiency. Two of the herds were located at the Ft. Reno Livestock Experiment Station; one of the herds was at the Lake Carl Blackwell Range area; and the other herd was maintained at a sub-station near Wilburton.

The experimental treatments differed from herd to herd and from one group to another within each of the herds, but all of the cows in this study were pasture-mated during a limited breeding season. The breeding season began about the first of May and ended during the early part of August each year. Fifteen to twenty cows and one bull was the usual size of the breeding group. Cows which failed to conceive during the breeding season were not exposed to a bull again until the following year.

Herd A was located at Ft. Reno and it contained three lines of registered Herefords and one line of registered Angus. These cows were treated alike so far as nutritional and management practices were concerned, but two of the lines were being developed by inbreeding while the other two lines were being developed by outbreeding. The two inbred lines contained cows which varied in ages while the two outbred lines contained cows all of which calved first in 1952 at three years of age.

Herd B was a high grade Hereford herd located also at Ft. Reno. These cows were all dropped in 1948 and half of the cows on each of the three different levels of supplemental winter feeding was bred to calve first at two years of age and half was bred to calve first at three years of age.

Herd C at the Lake Carl Blackwell area and Herd D at the Wilburton Station contained cows which were on various mineral supplementation treatments. These studies were initiated with pregnant high grade Hereford heifers to calve first at three years of age.

The two measures of reproductive performances studied in these data were calving intervals and successful exposures.

A calving interval is the length of time in days between consecutive calves from the same cow. In this particular study because of the restricted breeding season, calving intervals which were extended to near two years because of the failure of a cow to calve one year were eliminated from the analysis because it was assumed that, if year long breeding had been followed, these cows could have had calving intervals much shorter than the two-year intervals imposed by the short breeding season.

A successful exposure was a period of time in days from the time the open cow was exposed to a bull until she calved the next year. It was assumed that the more efficient reproducers would conceive more quickly after they were put into the breeding herds and that they would

consequently calve earlier the following year. The distribution of the data in this study is given in Table 1.

The number of cows and the number of calving intervals were fewer than the number of cows with successful exposures. A cow and her records could be used if she had as many as two calves in her lifetime in the case of successful exposures, but she must have had at least three calves in three consecutive years to have the minimum of two calving intervals required for a study of repeatability for that trait.

Table 1.—Number of records in this study.

Herd	No. of Years	Calving Intervals[1]		Successful Exposure[2]	
		No. of Cows	No. of Intervals	No. of Cows	No. of Calves
A	5	61	175	99	351
B	6	94	411	109	558
C	9	42	238	58	372
D	4	54	157	59	211
Total		251	981	325	1,492

[1] A calving interval is the length of time between consecutive calves of a cow.
[2] A successful exposure refers to the interval of time from the date upon which the breeding season began to the date upon which the cow calved.

Results of the Study

The average length of the 981 calving intervals of the 251 cows included in this study was 364 days with a standard deviation of 28 days. This short interval and its small variability were due to the limited breeding season and to the elimination of records of two year intervals which resulted when a cow failed to calve during a year. If the cows had been bred year long, there would have been a longer average calving interval and the intervals would have been more variable than these.

Among the cows whose records are included in this study there was an average calf crop of 94 percent. Only 12 percent of the cows which failed to calve once failed to calve a second time during the period of these records. These excellent results are biased upward by the initial selection of pregnant heifers for the initiation of two of the herds, by the selection of some of the data imposed by the nature of the study, and by the good management practices to which the cows were exposed.

The calving intervals were analyzed by an analysis of variance and the intraclass correlations were obtained. The repeatability of calving interval derived in this manner was —.09 with a 95 percent confidence interval of —.02 to —.16. This estimate is in line with other estimates in the literature and indicates that, under conditions of a limited breeding season, calving interval is not likely to be of any use to breeders as a measure of reproductive performance for which they may effectively select brood cow replacements. It might perhaps be

of more value in herds where year-long breeding is a practice, but data of that kind need to be studied.

It was thought that the period of time from the first exposure of an open cow to a bull until she calved might be a more refined measure of breeding efficiency for cows bred in a restricted season than was calving interval. The 1492 such intervals from successful exposure until calving averaged 309 days with a standard deviation of 27 days. Analysis of the variance of these intervals was calculated for each herd separately. The repeatability estimates obtained from the intraclass correlations ranged from +.06 to +.22 among the four herds with the pooled estimate of +.14 (Table 2a). When the analysis was made on an intra-season, intra-lot (treatment or line) basis, the repeatability estimates ranged from +.10 to +.30 with a pooled estimate of +.25 (Table 2b). This increased repeatability indicated that the environmental sources of variation associated with the different seasons and treatments were exerting a significant effect upon the interval from exposure to calving.

It was thought that perhaps the first record of a heifer might be a less accurate predictor of future performance than later records. The data were analyzed again after removing the first interval from the records of each cow. It will be noted from Table 2c that the repeatability of the interval from exposure to calving was estimated at +.38 by cause it would be expected that cows which have been open for the longer period of time before being put with a bull would more likely be bred earlier than one calving nearer the time of first exposure to the breeding pen, it was decided to adjust the records of all cows for differences among them for days from calving to first exposure. The average number of days from calving until exposure to the bull was 56 days in this study. This adjustment resulted in a repeatability estimate of +.33 which is shown in Table 2d.

Although the repeatability estimates for the interval from exposure to the bull until calving were not extremely high in these data, they were positive and they were large enough that one might expect to considering only records produced subsequent to the first record. Be-

Table 2.—Repeatability estimates of the interval from exposure to calving.

Method[1]	Herd A	Herd B	Herd C	Herd D	All Herds Pooled
(a)	.20	.12	.06	.22	.14
(b)	.25	.30	.10	.27	.25
(c)	.44	.26	.26	.65	.38
(d)	.40	.20	.20	.59	.33

[1] (a) Intra-class correlation uncorrected for temporary environmental variance.
(b) Intra-class correlation corrected for temporary environmental variance.
(c) Intra-class correlation corrected for temporary environmental variance, omitting the first record.
(d) Intra-class correlation corrected for temporary environmental variance, omitting the first record and corrected for days calving to exposure.

be able to select effectively for earlier calving cows. This would result in a more uniform group of calves so far as age is concerned and would perhaps be to the advantage of the breeder in the management of his cow herd and in the marketing of his calves.

These data were not suitable for a study of factors which might be responsible for "skip-breeders" because so few animals of that kind were available for observation. There is a real need for information of that type. Until suitable measures of reproductive efficiency are developed and until the importance of genetic and environmental factors has been determined, one cannot intelligently determine the amount of emphasis which should be placed upon reproductive performance in a selection program.

Genetic Aspects of Cancer Eye in Cattle[1,2]

DAVID E. ANDERSON[3] and DOYLE CHAMBERS

Cancer eye in cattle results in a significant economic loss each year to the livestock producer. The disease reduces productivity by shortening the life span of an animal. Diseased animals may die, may require treatment, or may need to be removed from the herd before their productive lives are completed, thus lowering the efficiency of production. It has been estimated that animals with cancer eye leave the herd about one year earlier than unaffected animals; and that in the southwestern states about 3 to 10 percent of the animals are removed from the herd each year because of the disease.

The salvage value of these culled animals and possibly of treated ones is reduced because entire carcasses or parts of carcasses may be condemned at slaughter, depending upon the extent of the disease and condition of the affected animal. The average annual loss from such condemnations alone is in excess of one million dollars. A reduction in the incidence of the disease obviously would be of economic concern to the livestock industry.

Materials and Methods

The animals included in this study were grade and purebred Hereford cattle from Oklahoma, Texas and New Mexico. A total of 2613 animals from seven herds were involved in the different phases of study.[4]

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