

Birth weights were reduced by the low level treatment in all cases. Low level heifers calved at about 3 weeks later than the medium level heifers, with less difference being noted between medium and high level heifers, or among older heifers. High winter feed levels resulted in heavier calves at weaning, but the cost of producing 100 lbs. of calf was markedly in favor of the lower levels of winter feed.

When total return minus costs were considered, little difference was noted between winter treatments with the exception of the very high level, which showed negative profit. Body measurements taken up to 1½ years of age show that winter treatment did not greatly affect skeletal development of the heifers. At 4½ years of age, consecutive low planes of winter nutrition had reduced body weight of the females by only 33 lbs.

Development of Replacement Beef Heifers for Expression of Maternal Traits

*Doyle Chambers,
Joe Armstrong, D. F. Stephens*

Some traits of economic importance in the production of beef cattle are reproductive efficiency, mothering ability, longevity of productive life, rate and efficiency of gain, and carcass worth. The relative importance of the above factors can be expected to vary with the quality of cattle and the particular phase of the operation under consideration, but calf-crop percentage weaned and average weaning weights have been shown in one study to be of most importance in high grade Hereford cattle when the calves are finished to choice grade by full-feeding in dry-lot immediately following weaning. The first three factors listed above (reproductive efficiency, mothering ability and length of productive life) will become increasingly more important if the trend continues toward the slaughter of more youthful cattle to meet the consumer's demand for lean tender beef.

A number of studies have shown that the beef cow tends to repeat her performance from year to year when it is measured by adjusted weaning weights of her calves so that one may well cull the poor producing cows after one or two calves. It has likewise been shown in at least one study that the selection of replacement females from above average cows will be effective in improving the weaning weights in a herd. Although it has been shown that it may be economically sound to cull open cows prior to the wintering period, genetic studies do not indicate that much improvement in the hereditary worth of the herd may be expected as a result of this selection. Some traits, however, which affect longevity of productive life have been shown to be controlled to an appreciable extent by genetic factors.

The more highly heritable economic traits in beef cattle are those which have been measured precisely under uniform environmental con-

ditions and which are expressed quantitatively, like rate of gain during certain periods of the growth or fattening period, efficiency of feed conversion, and certain of the carcass traits.

The purpose of this paper is to report some observations made on the productivity of beef heifers produced in the Hereford and Angus breeds at the Ft. Reno Livestock Research Station from 1953 through 1957 and to show implications of these results in a performance testing program.

Development of the Replacement Heifers

A total of 183 heifer calves were selected at weaning time during the five years covered by this report for a post-weaning gain test of approximately five months. They had been dropped during February, March, and April and were weaned in early October when they were about seven months of age. They had not been creep-fed during the suckling period. The number of heifers retained each year along with their average unadjusted weaning weights are given in Table 1. Average weaning weights varied widely from year to year because of seasonal differences, age differences of their dams, and some disproportion in the number of heifers from the various lines of breeding from year to year.

Table 1.—Summary of Weights and Gains of Heifers to First Breeding Season.

	Birth Years of Heifers				
	1953	1954	1955	1956	1957
Number on post-weaning test	33	32	43	37	38
Ave. weaning wt. (lbs.)	464	389	453	443	394
Ave. daily gain on test (lbs.)	1.52	2.18	1.78	0.53	1.20
Number at first breeding	32	27	38	37	33
Ave. age at first breeding (mos.)	27	15	15	15	15
Ave. wt. at first breeding (lbs.)	895	776	799	658	688

The heifers dropped in 1953, 1954, and 1955 were self-fed a complete mixed ration in dry-lot for approximately five months immediately following weaning. The ration varied slightly from year to year but contained approximately 60 percent concentrate and 40 percent roughage. The ration contained about 10 percent digestible protein and 64 percent TDN. The daily gains varied from 1.52 to 2.18 but at the end of each test the heifers were weighing from 700 to 725 pounds on the average, and they were approaching choice slaughter grade.

The heifers dropped in 1956 and 1957 were weaned at approximately seven months of age and were from the same lines of breeding.

They had not been creep-fed. Instead of feeding these heifers in dry-lot to make near maximum gains, the 1956 heifers were wintered on native dry grass and a limited amount of silage and one pound of cottonseed meal per head per day, and they gained 0.53 of a pound per day during the five month post-weaning period. The 1957 heifers were wintered on excellent wheat pasture and gained 1.20 pounds per day during the five-month winter period.

Following the five month feeding period which ended in early March each year the heifers were turned into pastures which usually furnished plenty of green feed during late March and April. Except for the 1953 heifers which were held open until they were 27 months of age, the heifers were put in breeding pastures when they were approximately 15 months of age. They were exposed to bulls during May, June, and July each year. The 1953 heifers weighed 895 pounds at 27 months of age when they were first put in the breeding pastures. The 1954 and 1955 heifers weighed 776 and 799 pounds, respectively, at 15 months of age and the 1956 and 1957 heifers weighed 658 and 688 pounds, respectively, at 15 months of age when they were first exposed to the bulls. During October each year pregnancy examinations were conducted and the number of bred heifers determined at that time. The heifers were wintered on stubble fields and wheat pasture for their second and succeeding winters, and no additional grain or protein was fed. Alfalfa hay was fed for brief periods when pastures were covered with snow or ice. They were calved during the late winter and early spring and raised their calves without creep feed.

The Reproductive Performance of the Heifers

Of the 97 heifers which had been dropped in 1953, 1954, and 1955 and which had been on full-feed for 154 days following weaning, 84 (87 percent) were found to be pregnant at the end of the first breeding season; 77 (79 percent) of them calved the following spring, and 55 (57 percent) of them weaned calves. There were 70 of the 1956 and 1957 heifers which were exposed to a bull when they were 15 months of age and 59 (84 percent) of them were found to be pregnant at the end of the breeding season. Fifty-eight (83 percent) of them calved, and 48 (69 percent) of them weaned calves.

There were 83 of the full-fed heifers exposed to a bull for their second breeding season. Seventy-one percent of them were diagnosed pregnant; 65 percent of them calved; and 55 percent weaned a calf. There were 30 heifers in the 1956 group which were bred for a second calf; 90 percent were pregnant and calved; and 70 percent weaned calves. The full-fed heifers which were bred for third and fourth calves performed somewhat better, but the number in the fourth breeding season was only 23 of the 59 which were in this group originally.

The full-fed heifers had a total of 258 breeding exposures from 1955 through 1958 and 209 (81 percent) of the heifers were diagnosed pregnant about two months after the breeding season ended. One hun-

dred and ninety-five (76 percent) of them calved; and 149 (58 percent) weaned calves. The heifers on the lower level of feeding had a total of 100 breeding exposures and 86 were diagnosed pregnant; 85 calved; and 69 raised calves to weaning. The complete summary of the reproductive data given above is presented in Table 2. Perhaps it should be repeated that the 1953 and 1954 heifers were bred first to calve in the spring of 1956, and that they were therefore producing their first calves in the same season. The heifers dropped in 1955, 1956, and 1957 produced their first calves in 1957, 1958, and 1959, respectively.

Table 2.—Reproductive Performance of Heifers.

Year of Calving	Birth Years of Heifers				
	1953	1954	1955	1956	1957
1956					
No. Bred	32	27			
No. Pregnant	27	24			
No. Calved	23	22			
No. Weaned	16	18			
1957					
No. Bred	32	21	38		
No. Pregnant	19	19	33		
No. Calved	16	17	32		
No. Weaned	13	15	21		
1958					
No. Bred	19	16	30	37	
No. Pregnant	14	14	21	29	
No. Calved	13	13	21	28	
No. Weaned	10	10	18	24	
1959					
No. Bred	10	13	20	30	33
No. Pregnant	8	13	17	27	30
No. Calved	8	13	17	27	30
No. Weaned	6	10	12	21	24

The calf crop percentage weaned was not considered satisfactory for any of the groups, although it was expected that heavy losses would be encountered in the calving of the two-year-old heifers. In addition to this loss, however, a large number of calves were lost to calf scours, respiratory infections, lead poisoning, coyotes, and to an unidentified disease which caused the death of some calves within a few hours of parturition.

It is interesting to note that higher fetal death losses occurred in the groups of heifers which had been full-fed during their post-weaning test. In the over-all summary about 5 percent more of the heifers in the lower level groups were diagnosed pregnant; 9 percent more of them calved; and 11 percent more raised calves to weaning time. This occurred in spite of the fact that the lower-level heifers were calving for

the first or second time, while some of the higher level heifers had an opportunity to produce calves for the third and fourth time. Culling of the poor producing and barren heifers of the high-level groups had occurred during the latter two years, while practically no culling of the lower-level heifers had occurred during the period covered in this report.

The Mothering Ability of the Heifers

The weaning weights of calves are known to be influenced not only by genetic factors for growth transmitted by both the sire and dam, but they are markedly influenced by the amount of milk provided by the dam. The weaning weights of calves produced by the same cow are known to increase with her age to five or six years, and some data indicate that the weights of calves from two-year-olds are some 80 to 100 pounds less than those of mature cows. Wide differences exist in the average weaning weights of calves produced by different cows even when they are contemporaries in production. These differences are highly repeatable and at least moderately heritable. This means that if one is to make selections most effectively, he needs to develop replacement heifers for maximum expression of this trait and control non-hereditary variables as much as possible when the trait is being appraised.

The average 210-day weights of the calves produced by each of the heifer groups are given in Table 3. These show that the 1953, 1954, and 1955 heifers, which had been full-fed for a period of five months immediately following weaning, did not perform satisfactorily as mother cows. The 1956 and 1957 heifers, which were wintered at a lower level, weaned 48 calves as two-year-olds which averaged 420 pounds at 210 days of age while the 55 calves weaned by the 1953, 1954, and 1955

Table 3.—Average 210-Day Weights of Calves Produced.

Year of Calving ¹	Birth Years of Heifers				
	1953	1954	1955	1956	1957
1956					
No. Weaned	16	18			
Ave. wts. (lbs.)	393	362			
1957					
No. Weaned	13	15	21		
Ave. wts. (lbs.)	393	374	297		
1958					
No. Weaned	10	10	18	24	
Ave. wts. (lbs.)	400	438	360	423	
1959					
No. Weaned	6	10	12	21	24
Ave. wts. (lbs.)	474	444	414	456	416

¹ Calves produced by mature cows were approximately 20 pounds heavier in 1956 and 1959 than those produced by the same cows in 1957 and 1958.

heifers averaged only 346 pounds at the same age. The 21 calves raised by the 1956 heifers as three-year-olds weighed 456 pounds while the 46 calves weaned by the 1953, 1954, 1955 heifers weighed 374 pounds. This difference of approximately 80 pounds per calf, favoring the lower level of feeding, could have been influenced by seasonal differences between the years in which the two groups produced their first and second calves. If we compare the age groups producing calves in the same season, however, it will be noted that the 1956 heifers, as two-year-olds in 1958, were producing calves as heavy as the 1953 and 1954 heifers producing their third calves at the same time. The 1957 group calving first in 1959 produced calves which were as heavy as the calves produced by the 1955 heifers in the same season. The second calves produced by the 1956 heifers weighed 456 pounds in 1959 which is as heavy as those produced by the 1953 and 1954 heifers producing their fourth calves in the same year, even though considerable culling of the latter two groups had already occurred by this time.

Summary

Although the experiment from which these observations were made was not designed specifically to determine the effects of level of feeding of replacement heifers from 7 to 12 months of age, the reproductive history and weaning weights of calves from heifers developed under full-feeding indicate that considerable damage to the full expression of these important maternal traits may have been caused by such a practice. Heifers which were produced by the same breeding stock and which were developed at a lower level of nutrition performed more satisfactorily in the same traits. These results suggest that breeders need to consider seriously performance testing procedures which are adopted for the development of replacement heifers. If the observations of this study are confirmed by better controlled experimentation, there is a real need to determine the nature and extent of damage which may occur under various developmental systems for replacement heifers and to determine the earliest age at which this may occur. Genetic differences will be manifest only when heifers are developed in a way that is conducive to the expression of the traits.

Pelleted Prairie Hay For Wintering Calves

A. B. Nelson and R. D. Furr

Research at many institutions has indicated that pelleting of certain beef cattle rations will result in increased gain and improved efficiency of gain. Apparently the greatest response from pelleting has been with rations containing a high proportion of roughages. Within the roughages, a greater response occurs when those of poorer quality are fed.