of pelleting ($5.00 per ton), the lambs fed the pelleted rations lost more money than the lambs fed the mixture.

4. A concentrate to roughage ratio of 50 : 50 (Lot 1 and 2) produced greater gains with less feed per cwt. gain than a ratio of 65 percent concentrate and 35 percent roughage (Lot 7 and 8).

5. All lots of lambs lost from $.63 per head to $1.55 per head. Even with excellent gains and feed efficiency, it is almost impossible to profitably feed lambs in dry-lot without a positive margin of two cents per pound considering selling price over delivered purchase price.

Progeny Testing Beef Bulls for Growth

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Growth rate is one of the important economic traits in beef cattle. It is a trait which can be expressed by bulls, steers, and heifers. Under standard conditions on suitable tests, differences in growth rate among individuals have been reported to be highly heritable. In 1955 (Okla. Agr. Exp. Sta. Misc. Pub. 43) data were presented which indicated that different beef bulls, when bred to cows with similar records of productivity, sired calves which differed markedly in ability to gain weight under comparable conditions. In 1956 (Okla. Agr. Exp. Sta. Misc. Pub. 45) it was shown that bull calves which gained the most rapidly on a five month post-weaning growth test were the most efficient in the use of feed. No antagonisms were found between post-weaning rate of gain and pre-weaning growth rate or between growth rate and appraisals of these bulls at the end of the test by experienced livestock judges.

Most of the heritability estimates for growth rate in beef cattle have been based upon differences in growth rate which have been observed between groups of offspring sired by different bulls. These estimates have usually been higher than the few estimates reported based upon data from selection experiments.

Experimental Procedure

In 1956 a cooperative agreement was reached between the Ft. Reno Livestock Experiment Station and the Federal Reformatory located near Ft. Reno which permitted the progeny testing of a number of

herd and the others were bulls which had either been purchased by the reformatory or had been produced in that herd. During the years 1956 through 1959, a total of 18 different bulls produced in the experimental herd were bred to 20-25 Angus cows each. Complete gain records were available for each of these bulls and comparable records were obtained from their offspring. It was possible therefore to obtain heritability estimates by relating the growth rate of the progeny to that of their sires. In addition to the 18 groups sired by experimental bulls, data were obtained for 16 additional sire progeny groups, some of these being from repeat matings of some sires.

The measures of growth rate considered in this report were: the adjusted 210 day weights, the average daily gain on a five month post-weaning feed lot test, and the 365 day weights. Because the analyses were to compare the average performance of offspring produced in a single season to the performance of their sires which were also contemporaries, adjustments of the data were made in the following manner. The adjusted 210 day weights of the bulls and of their offspring were obtained as follows: Weaning weight minus birth weight divided by age in days at weaning multiplied by 210 plus birth weight. The 210 day weights of the heifer progeny were adjusted to a steer equivalent by adding the difference between steer and heifer calves to the heifer weights. The progeny which were out of cows less than five years of age were adjusted to a mature equivalent by a similar procedure. The bulls, which were selected for these progeny tests, were with one exception from mature cows and no age-of-dam adjustments were made.

Since the calves in this study were put on post-weaning gain tests on the day they were weaned, average daily gain was obtained by subtracting from the final feed lot weight, the actual weaning weight and dividing by the number of days on feed. The final feed lot weight was obtained after a shrink of about 18 hours. In the first two years the progeny groups contained both steer and heifer calves. The steers gained 0.28 of a pound per day more than their half-sisters and this amount was added to the gain of the heifers to adjust for sex-effect.

The 365 day weight was obtained by adding to the adjusted 210 day weight of each sire the number of pounds equal to 155 multiplied by his own average daily gain on post-weaning test. The 365 day weights for each progeny group was obtained by adding the number of pounds equal to 155 multiplied by average daily gain of the calves on post-weaning test to the adjusted 210 day weight of the entire group of calves by that sire at weaning time.

The 18 different bulls which were progeny tested during this study were selected from a total of 48 produced in this line during the years of 1954 through 1957. Three bulls were dropped in the fall of 1956; the others were dropped during the spring of each year, raised by their dams without creep feed, weaned in early October, and fed for five months immediately following weaning. They were individually self-fed a complete mixed ration which contained the following ingredients: 350 pounds ground whole ear corn, 200 pounds cottonseed hulls, 100

pounds chopped alfalfa hay, 100 pounds whole oats, 100 pounds wheat bran, 100 pounds cottonseed oil meal, and 50 pounds blackstrap molasses. They had access to their feeders overnight and ran in a common lot with access to water during the day.

The progeny produced in the Federal Reformatory herd were dropped in the early spring and had access to a creep feed until weaned at about seven months of age. At weaning time the number of calves to be put on post-weaning gain tests was determined for each sire; they were the calves of proper sex nearest the average calving date. During the first two years calves of both sexes were fed; during the last two years, steers only were fed because some of the better heifer calves were being retained as herd replacements.

The sire progeny groups were self-fed the same ration used in testing their sires. The chief difference was that they were fed in groups and had access to the feeders continuously during the feeding period. They were fed by sex and sire groups for the first two years. The last two years they were fed in two large pens with equal numbers of calves by each sire in each pen.

Results and Discussion

It was mentioned earlier that the 18 bulls which sired calves in this study were selected from 48 which were produced and tested in the same period of time. All of the bulls selected were by a single sire and were from cows which were related because of a common grandsire. They were therefore related and the inbreeding averaged about seven percent for the selected group. The 18 bulls selected for the tests were 37 pounds heavier than the average for the group at 210 days; they gained 0.11 of a pound per day faster on the post-weaning test than the average for all 48 bulls and they were 54 pounds heavier at 365 days of age. Other traits for which selection was practiced included conformation, disposition, and color.

Table 1 gives the average performance records of the 34 sire progeny groups included in this test. The sires with three-digit identification were produced in the experimental herd at Ft. Reno. The differences among sire progeny groups within each year were very striking and economically important. The extreme differences in average 210 day weights were 59, 34, 55, and 73 pounds in the 1957, 1958, 1959, and 1960 calf crops, respectively. The average feeder grades likewise varied among groups from a low of 9.0 (high good) to slightly over 11.0 (average choice). The samples of calves which were on the post-weaning gain tests likewise differed widely in rate of gain. Differences within each year ranged from 0.27 to 0.65 of a pound per day between the extreme sire groups. Some exceptions can be found, but as a rule the sires producing the heavier calves at weaning also produced the faster gaining calves on the post-weaning test. The gross correlation between the average adjusted 210 day weights and the average daily gain on

Table 1.—Average Performance Records of Sire-Progeny Groups by Birth Year of Progeny

Year	Sire	Progeny — 210 Days			Feeding Test		365 Day
		No.	Weight (lbs.)	Grade[1]	No.	Average Daily Gain (lbs.)	Weight (lbs.)
1957	2	22	462	10.6	6	2.09	786
	5	21	454	9.1	10	2.43	831
	7	20	463	10.5	6	2.31	821
	15	18	444	10.5	6	1.89	737
	17	16	469	11.0	6	2.31	827
	114	23	483	11.2	12	2.23	829
	264	20	503	10.4	14	2.39	873
1958	5	19	481	9.5	5	2.07	802
	6	25	492	10.6	10	2.34	855
	7	20	482	11.2	5	2.21	825
	115	22	501	11.1	10	2.15	834
	155	22	481	10.7	10	2.09	805
	175	21	467	11.2	10	2.08	789
	185	17	467	11.2	8	2.20	808
1959	6	16	488	10.7	5	2.54	882
	21	17	472	10.4	7	2.19	811
	264	22	509	10.1	7	2.58	909
	046	17	460	10.8	6	2.19	799
	066	14	473	9.9	3	2.33	834
	096	22	489	10.2	6	2.51	878
	196	21	512	10.5	7	2.56	909
	406	14	463	10.6	4	2.13	793
	426	19	497	9.6	8	2.56	894
	436	16	515	9.9	6	2.51	904
1960	6	21	485	10.0	5	2.44	863
	21	15	450	9.8	4	1.96	754
	22	15	454	10.6	4	2.36	820
	24	17	478	10.3	5	2.27	830
	264	17	523	10.0	5	2.47	906
	047	18	483	10.4	6	2.51	872
	157	16	501	9.6	7	2.61	906
	187	16	483	9.0	8	2.28	836
	327	18	508	10.2	8	2.38	877
	337	13	466	9.9	8	2.26	816

[1] Grade Code: 9.0 (high good); 10.0 (low choice); 11.0 (average choice)

groups within seasons amounted to 136, 66, 116, and 152 pounds per head in 1957, 1958, 1959, and 1960, respectively. If one applies the appropriate economic data to these differences, he finds that the values of different sires can vary markedly even among closely related individuals which have already been selected for these traits.

Table 2 presents the individual performance records of the 18 sires and the average performance of their offspring for the three measures of growth considered in this study. The high heritability of these traits can be seen by ranking within each season the records of the different sires and their progeny. For example, note that in 1954, sire 264 was heavier and gained more rapidly than sire 114 and that

the progeny of sire 264 produced in 1957 were likewise heavier and gained more rapidly. This is generally true but a few notable exceptions occur. In 1955, sire 185 was heavy at 210 days but sired calves which were light at the same age. Note, however, in this case that the average daily gain of the calves was high for this group.

These relationships between the performance of the sires and that of their offspring are given in Figures 1, 2, and 3 for 210 day weights, average daily gain in the feed lot, and 365 day weights, respectively. Each dot represents the average weight or gain for a progeny group sired by a bull whose weight or gain is given along the horizontal axis of the figure. These dots have been plotted without regard to year of test, but the regression line has been computed from an intra-season analysis and represents the average relationship which exists between the measures of growth in the sires and their offspring. The more closely the dots approach the line, the more accurate has been the prediction of the genetic value of a sire from his own performance. Likewise the larger the value of "b" and the steeper the regression line the more highly heritable was the trait.

From these observations one can see that in general the selection of the heavier and faster gaining bulls resulted in increasing the growth rate of their progeny, but there would have been a few disappointments.

Table 2.—Individual Performance Records of Bulls Used in the Progeny Test and the Average Performance of Their Offspring

		Sire Performance				Progeny Performance		
Year	No.	210 Day Weight (lbs.)	Average Daily Gain (lbs.)	365 Day Weight (lbs.)	Year	210 Day Weight (lbs.)	Average Daily Gain (lbs.)	365 Day Weight (lbs.)
1954	114	527	2.69	944	1957	483	2.23	829
	264	574	3.31	1087		503	2.39	873
1955	115	502	2.56	899	1958	501	2.15	834
	155	448	2.53	840		481	2.09	805
	175	481	1.98	788		467	2.08	789
	185	565	2.56	962		467	2.20	808
1956S	046	493	2.36	859	1959	460	2.19	799
	066	504	2.39	874		473	2.33	834
	096	586	2.69	1003		489	2.51	878
	196	575	2.90	1025		512	2.56	909
1956F	406	502	2.44	880	1959	463	2.13	793
	426	485	2.62	891		497	2.56	894
	436	609	2.44	987		515	2.51	904
1957	047	490	2.92	943	1960	483	2.51	872
	157	537	3.21	1035		501	2.61	906
	187	534	2.82	971		483	2.28	836
	327	533	2.76	961		508	2.38	877
	337	499	2.53	891		466	2.26	816

A few bulls with above average records in this group sired offspring below average in this same trait. Likewise a number of cases occurred in which two bulls with quite comparable performance records sired groups of calves which differed to an appreciable extent. This represents the opportunity for gain from progeny testing. In herds with average performance using many sires, the indications of this study were that they have much to gain by selecting the better performing bulls on their own performance. For herds already at a high level of performance for these traits the progeny testing of a number of the higher performing prospects may prove profitable, particularly if that herd is using few sires extensively. This often happens in larger purebred herds. These herds depend for their progress upon the picking of a few sires which are considerably above average in merit and they cannot afford to make the mistake of selecting a bull which breeds below average.

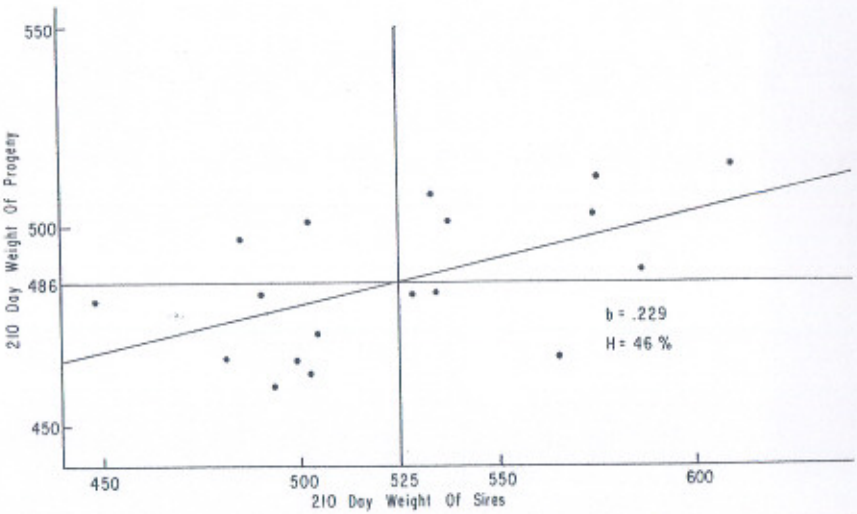

Figure 1. Regression of 210 day weight of progeny on the 210 day weight of sire.

Note in Figure 1 that two bulls, whose weaning weights were below average of those selected, sired calves with above average weaning weights. Seven bulls whose weaning weights were below average sired calves with below average weaning weights. Six bulls which were above average in weight at 210 days sired calves which were likewise above average in weight, while three others which were above average sired calves below average. Only one of the better bulls was particularly out of line with expectation. The heritability for 210 day weight was estimated to be 46 percent from these data. This is somewhat higher than has been reported in most studies, but it could be due to the better control of the environmental factors affecting this trait by the type of analysis used. It could also be due to the fact that the progeny were

creep-fed and that both sires and offspring were nursing cows which gave more milk than was provided in other data. The higher plane of nutrition may have permitted a greater expression of genetic factors for growth. It is of course possible that the high estimate is due to random fluctuation due to the small number of sires.

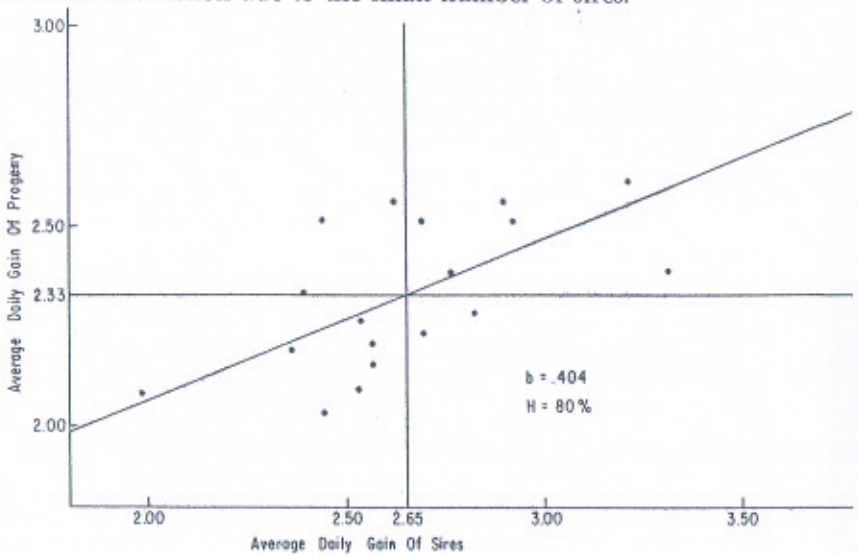

Figure 2. Regression of average daily feed lot gain of progeny on average daily feed lot gain of sire.

Very much the same picture is shown for rate of feed lot gain (Figure 2) and 365 day weight (Figure 3). About the same number of bulls produced calves whose records were in line with sire performance. Heritability for rate of feed lot gain was estimated to be 80 percent which again is somewhat higher than many estimates reported. Again there was reason to expect it to be high in this study since the sires and their progeny were tested on the same kind of ration and the same testing procedures were followed for all groups. The heritability of 365 day weight was estimated to be 54 percent which is in fairly close agreement with most other studies. In view of the limited number of sires (only 18 over a four year period) the standard errors for each of the heritability estimates were large and one could not be confident that the estimates really differ from others published. These were, however, the first to have been reported from data obtained in this manner. The results encourage the use of individual performance tests for the initial selection of sires, but also point out the opportunities for more effective selections following properly designed progeny tests.

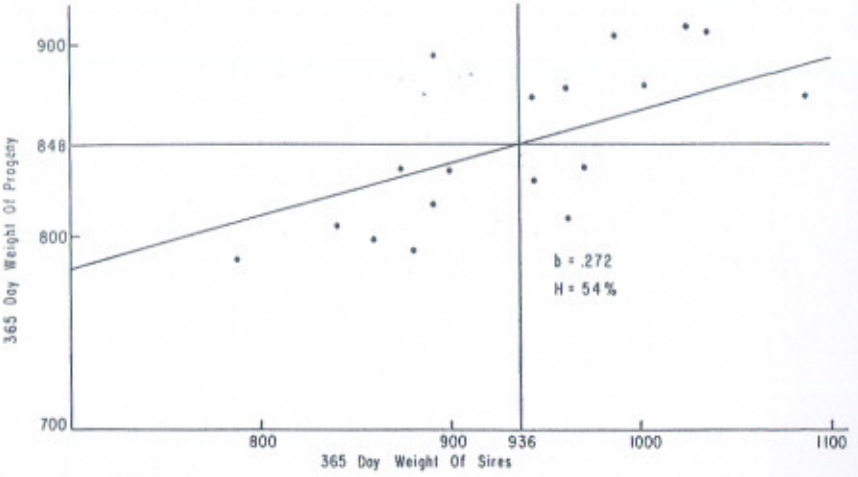

Figure 3. Regression of 365 day weight of progeny on the 365 day weight of sire.

Summary

A study was made of the 210 day weights, average daily gain on post-weaning tests, and 365 day weights for 34 sire progeny groups. The sire progeny groups were composed of 630 calves at weaning time and 236 calves on post-weaning gain tests. Eighteen of the sire progeny groups were the offspring of bulls for which the same traits had been measured under approximately the same conditions. Heritability estimates based upon the intra-season regression of progeny average performance upon sire performance were .46, .80, and .54 for 210 day weight, average daily feed-lot gain, and 365 day weight, respectively.