



A genetic history of the line 1 Herefords at the United States Range Livestock Experiment Station,
Miles City, Montana
by Robert C Church

A THESIS Submitted to the Graduate Faculty In partial fulfillment of the requirements for the degree
of Master of Science in Animal Industry
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Abstract:

This study was undertaken to analyze the results of twelve years of Inbreeding of a line of beef cattle In which selection of sires was based primarily on their record of performance. The cattle are owned by the Montana Agricultural Experiment Station and were raised at the United States Range Livestock Experiment Station at Miles City, Montana. The two half-brother foundation sires of the line were unrelated to the foundation cows. It was originally planned to carry out half-brother sister matings but due to natural causes this plan could not be followed entirely. The bull offspring of the line wore first selected and tested in the feed lot; second, selected on their test results and types; and third, those selected were bred to a random-selected group of cows from the station herd. Eight randomly-selected steers from these matings were then tested in the feed lot and the line herd sires were selected on the basis of their steer progeny test results.

Seven factors were studied in the steer progeny performance results. These were average birth weight, average weaning weight, average final weight, average daily gain on feed, average weaning score, weighted slaughter grade, and weighted carcass grade. There, were five factors studied from each bull's record of performance. These were birth weight, weaning weight, final weight, daily gain on feed, and weaning score. Statistical analyses of the sires regression on his steer offspring were made in regard to birth weight, weaning weight, and final weight.

The rate of gain on feed has increased through the years in both the bulls and their steer offspring. The line was found to be more closely related to one of the two foundation sires through more of one's daughters being selected for replacements in the line. The line is not what would be considered an intensely inbred line. It is hoped that the results of this line will encourage other breeders of cattle to follow a similar breeding program.

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A THESIS

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at

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ABSTRACT

This study was undertaken to analyze the results of twelve years of inbreeding of a line of beef cattle in which selection of sires was based primarily on their record of performance. The cattle are owned by the Montana Agricultural Experiment Station and were raised at the United States Range Livestock Experiment Station at Miles City, Montana. The two half-brother foundation sires of the line were unrelated to the foundation cows. It was originally planned to carry out half-brother sister matings but due to natural causes this plan could not be followed entirely. The bull offspring of the line were first selected and tested in the feed lot; second, selected on their test results and types; and third, those selected were bred to a random-selected group of cows from the station herd. Eight randomly-selected steers from these matings were then tested in the feed lot and the line herd sires were selected on the basis of their steer progeny test results.

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INTRODUCTION

In 1931 the Bureau of Animal Industry of the United States Department of Agriculture began a series of projects to develop lines of inbred cattle for the purpose of crossing. These lines were to be selected for superiority in rate of gain, weaning weight, fertility and other factors of economic importance to the rancher.

The development of inbred lines of beef cattle where selection is based on record of performance is entirely new in the history of beef cattle breeding. Inbred lines of beef cattle have been developed since the beginning of the historical record of beef cattle, and most of our present day pure breeds of animals were founded through rather intense inbreeding, but to base selection entirely on record of performance combined with inbreeding is a new phase in the beef cattle industry. Gudgell and Simpson in this country inbred to Anxiety 4th and at one time had one of the most intensely inbred herds in history (12). The United States Range Livestock Experiment Station, Miles City, Montana in cooperation with the Montana Agricultural Experiment Station in 1936 undertook to produce an inbred line of cattle. Line 1 was developed at the Station and has proven to be an exceptionally productive strain of cattle.

It is the purpose of this study to present a genetic history of the Line 1 Herefords at the Range Station and to give the record of performance of this line to the present time. It is hoped that a study of the results of this line of Herefords will encourage other breeders to undertake such a breeding program in their own herds and thus make available to the

industry more breeding cattle that have a higher economic value to the commercial producer.

REVIEW OF LITERATURE

Willham (14), in his genetic history of Hereford Cattle in the United States found within the breed an inter se relationship of 8.8 per cent in 1930. The inbreeding coefficient for the Hereford Cattle was 8.1 per cent. Another of his findings was that Beau Brummel a grandson of Anxiety 4th had a relationship of 24.6 per cent to the breed in 1930. Willham's techniques of computation were based on a random sampling of the breed.

It is a noteworthy fact that the present day breeds were founded by the crossing of lines that were developed through the use of rather close inbreeding. Wright (17), reported that the Dutchess line of Shorthorns as bred by Thomas Bates was maintained with an average inbreeding coefficient of 40 per cent. The relationship to Colling's bull Favourite through eight generations fell gradually from 76 per cent to 57 per cent. Wright stated that this high degree of inbreeding could lead to success only in the hands of an exceptional cattle judge.

Lush, et al. (7), found in their study of the Holstein Fresian Cattle that there is a tendency for the breed to form into families, but that these families are broken up because the more popular families are used for outcrossing and the less popular ones are discarded or are outcrossed with sires of the other families. They also found that the higher producers of the breed were no more inbred to or more closely related to remote ancestors but that they were more closely related to more recent ancestors.

Lush (6), reported that a herd of cattle was 16.9 per cent inbred after twenty years as a closed herd. The coefficient of inbreeding was kept low through the use of two herd sires in the two preceding generations.

He presented this paper as a practical demonstration that a moderate-sized herd could follow this breeding policy and still keep the coefficient of inbreeding low, conserve fairly well desirable characteristics of an early ancestor, and also maintain a fairly high average individual merit.

Lush and Anderson (8), found in their study of Poland-China swine that the breeding systems used for 44 years probably eliminated about 10 per cent of the heterozygosity found in the foundation animals. To quote Lush and Anderson, "About six-tenths of one per cent of the existing heterozygosity has been lost per generation. This is about one-twentieth as fast as heterozygosity would be lost in a one-sire-herd and about one-tenth as fast as it would be lost in a herd permanently closed to outside blood but with two equally used sires in service each generation."

It was determined by Comstock and Winters (2), that through selection in the early stages of inbreeding the effects of 15 per cent inbreeding per generation could be offset in the case of growth and $2\frac{1}{2}$ per cent in the case of number of litter. They also found that inbreeding effected fertility more than it did growth rate and therefore advocated that everything possible should be done to make selection for fertility more possible.

Macaulay (10), in his corn breeding experiments, found that through inbreeding and strict selection he was able to increase uniformity within the strain, produce an earlier maturing strain, and increase the productivity of the strain.

Knapp, et al. (4), state that eight steers were sufficient to test a bull's ability to transmit efficiency of feed utilization. They also

determined that a 168 day feeding period was sufficient to determine the variations between progeny groups, provided the differences in initial weights were taken into consideration.

MATERIAL AND METHODS

The data used in this study were collected at the United States Range Livestock Experiment Station, Miles City, Montana, and cover the period 1936-49. The bulls and cows of Line 1 are registered Herefords and were all raised on the station except for the foundation sires of the line, Advance Domino 20th and Advance Domino 54th. These two bulls were purchased from Deberard Brothers, Martin, Colorado, in 1934 and 1935.

1. Management—The breeding herds at the station are made up in the station office. The line cow herds are selected on a relationship and performance basis. Knapp et al (5) in their study on the growth and production efficiency of Hereford cattle on the range found that the age of a cow has an effect on the weaning weight of the calf, therefore the test herds* are made up of randomized within-age groups. To do this the cows are arranged according to their number which in effect arranges them according to age. The cow cards are then dealt out in sequence to the number of herds required for the testing. The cows are separated into breeding herds between the 10th and 15th of June. Prior to 1946 the bulls were turned in with the cows on July 1st and taken out August 15th but since 1946 they have been turned in June 15th and taken out August 1st, thereby giving a six weeks breeding season. The registered herds are thrown together into one pasture and the unregistered herds into another at the end of the breeding season.

The calving season, up to 1947, covered the period from April 1st through the last of May, but since 1947 has commenced March 20th and ended

*Grade and unregistered purebreds are used for testing sires.

approximately May 15th. The cows are divided into two herds and each herd is placed in a large pasture to calve. Each pasture has one rider who finds the calves as they are dropped, identifies the mother by her hip brand, eartags the calf, dehornes all heifer calves with dehorning paste, and records in his book the cow's number, calf's number, sex of the calf, and the breeding herd to which the cow belongs. The calves are branded during the last week in June and the eartag number is tattooed in both ears of the calf.

The registered herd is gathered between the last week of August and the first week of September and the bull calves are sorted out by lines. The most promising bull calves are kept and the remainder are castrated. The calves are put back with the cows on pasture until approximately October 20th, at which time all calves on the station are weaned. The exact date of weaning is the nearest Monday to October 20th. Usually about ten days following weaning the bull and steer calves selected for record-of-performance testing are placed on feed.

The record-of-performance grain ration for both bulls and steers consists of 6 parts corn, 3 parts dried molasses beet pulp, 1 part wheat bran, 1 part linseed oil meal, and $\frac{1}{2}$ part alfalfa leaf meal. The roughage consists of alfalfa hay. The steers and bulls were individually fed until the 1945-46 feed period, at which time the steers were put on a lot feeding basis and the bulls were continued on individual feeding. The bulls were fed for 196 days and the steers for 252 days. The steers were marketed in St. Paul, Minnesota and market and slaughter data were obtained.

In the fall subsequent to weaning the cows are pastured in one large pasture and then between December 15th and January 10th (the exact date depending on general weather conditions) they are moved onto winter pasture. The winter pastures are very rough and broken, being typical badland country, and afford good shelter for the cows. The thin cows are cut out and fed a supplement of cake* and hay while the other cows receive cake only.

The cows are gathered about the middle of March and the hip brands are clipped so they can be read. The weights of the cows are taken in the spring just before calving and in the fall just after weaning.

2. A Brief Description of Record of Performance Methods---The record of performance methods used in this experiment are herewith reproduced in part from A. H. D. Mimeograph No. 37 (13).

GENERAL PRINCIPLES

1. From birth to weaning all calves in any one herd will be fed alike within reasonable limits as far as possible without extra expense.
2. Females that do not produce enough milk to feed their own calves will be culled.
3. No male calf whose dam does not give sufficient milk for his development will be saved for breeding purposes.
4. Young stock will be handled similarly as to housing and grazing.
5. Young stock will be scored at a standard age or weight. The recommended time of scoring will necessarily differ, depending upon the environmental conditions under which the animals are raised.

*Cottonseed cake or beet pulp pellets.

The following performance factors were studied in 8 random-selected steers from each bull: average birth weight, average weaning weight, average final weight, average daily gain on feed, average weaning score, weighted slaughter grade, and weighted carcass grade. The same factors were studied in the bulls except for slaughter and carcass grade.

The bulls to be used in the test herds are first selected on the basis of their record of performance results and are then given a visual appraisal for type and conformation. Each bull is bred to a test herd of 30 random-selected cows and the following year 8 of each bull's steer offspring are randomly selected to be fed for 252 days. The bulls that will eventually be used in the Line 1 herd are then selected on the basis of their steer offspring record of performance results.

3. Methods Employed for Calculating Inbreeding and Relationship--The methods used in this study for determining inbreeding and relationship in Line 1 are those recommended by Wright et al. (18)

RESULTS OF STUDY

1. The Breeding Program---(see figure 1) which illustrates the line of descent of Line 1. In 1934 and 1935 the half-brothers Advance Domino 20th and Advance Domino 54th were purchased from Fred C. Deberard, Martin, Colorado. These two bulls were bred to a group of station owned cows. The cows were mostly the progeny of 3 bulls previously used, Colonel Perfection, Domino Perfection, and Blanchard 40th.

Prairie Domino and Alton Domino were the only sons of Advance Domino 20th that were used extensively, but the female offspring of Advance Domino 20th proved to be excellent mothers. Advance Domino 54th proved to be an excellent producer of sons, the best three L1B Domino 1st, L1B Domino 2nd, and Clayton Domino, being out of daughters of Advance Domino 20th. Of the three bulls mentioned, L1B Domino 2nd was outstanding, and like his sire produced many excellent bulls, the best of which were Carson Domino, Chico Domino (died after producing seven sons), Chase Domino and two other bulls Cobleigh Domino and Cougar Domino not being used in Line 1. Chase Domino produced an excellent son in L1 Domino 10th and he is being used in the present Line 1A herd.

In 1948 it was decided to divide Line 1 into 3 sublines. Line 1A was to be tested and selected on the sib-test program, with Line 1B and Line 1C on the progeny test program as the basis of selection.

2. Inbreeding---Culley writing in 1794 said: "The great obstacle to the improvement of domestic animals seems to have arisen from a common and prevailing idea amongst breeders that no bull should be used on the

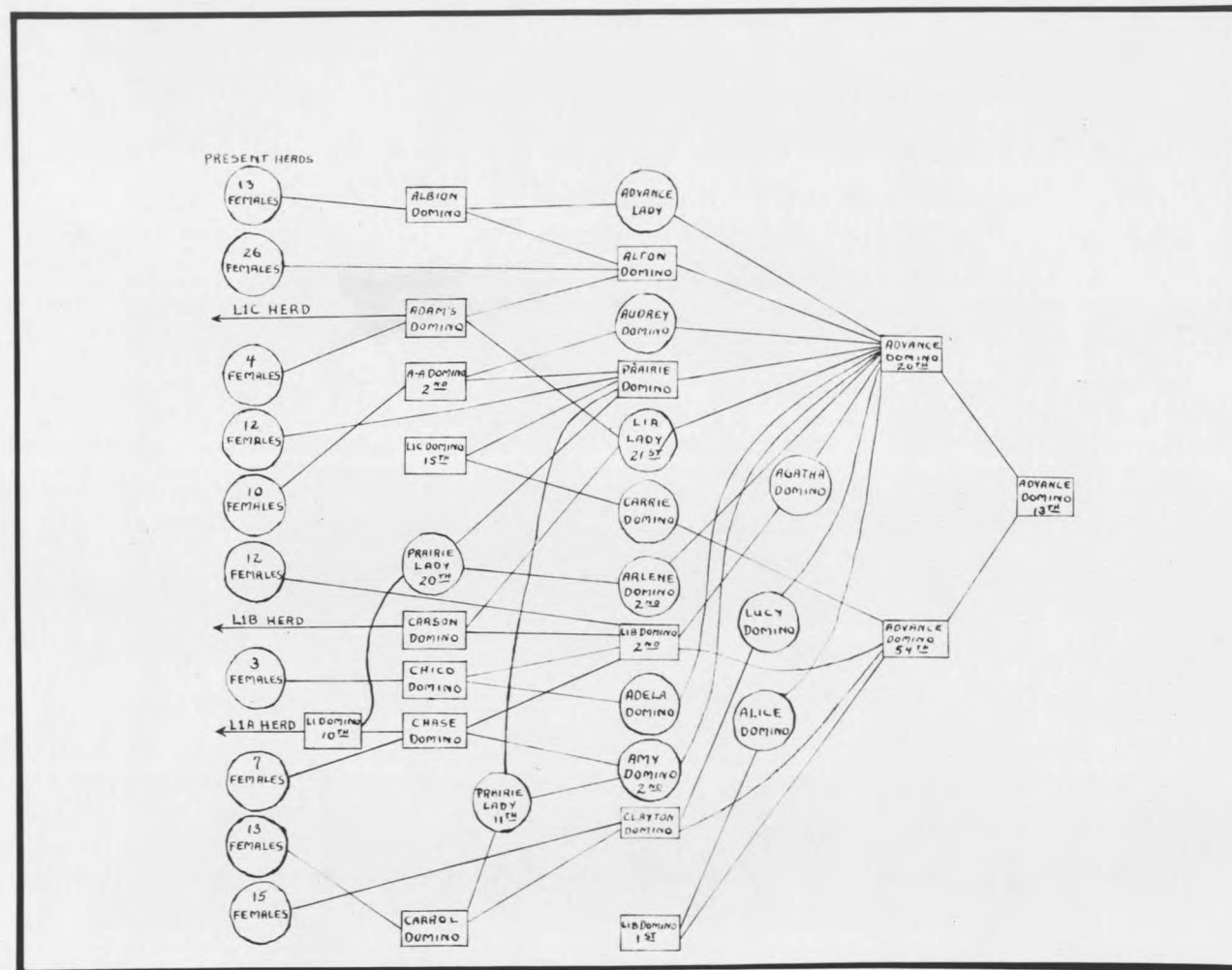


figure 1. The line of descent of the more important individuals in the Line 1 Herefords at the United States Range Livestock Experiment Station, Miles City, Mont.

same stock more than three years, and no tup* more than two; because (they say) if used longer, the breed will be too near akin, and liable to disorders; some have imbibed the prejudice so far as to think it irreligious, and if they were by chance in possession of the best beast on the island would by no means put a male and female together that had the same dam. Mr. Bakewell has not had a cross for upward of 20 years, his best stock has been bred by the nearest affinities, yet they have not decreased in size, neither are they less hardy, or more liable to disorder, but on the contrary, have kept in a progressive state of improvement."(11)

The above quoted statement is a good example of the ill-repute that inbreeding had amongst the breeders of that day, and as a matter of fact has carried over to some of the modern day breeders.

Robert Bakewell, an Englishman, born in 1725, was one of the first known breeders to make constructive use of inbreeding. In his breeding work with the old Longhorn cattle, Leicester sheep, and Shire horses he used such principles as: "Like produces like or the likeness of some ancestor; inbreeding produces prepotency and refinement; breed the best to the best." Bakewell did not base all of his selection on type along but it known to have carried on feeding trials to a limited extent. Because of his success through applying the principles he advocated, many of the breeders of that day studied and adopted his methods. In this way a number of the present day English breeds were founded. (9)

According to Lush (9), the more important reasons for inbreeding are:

*Ram

1. It is necessary if relationship to a desirable ancestor is to be kept high.
2. It helps uncover rare recessives so that they may be culled from the breed.
3. It forms uniform and distinct families so that interfamily selection may be possible in a more effective way than if inbreeding were not practiced.
4. It increases prepotency.
5. It is sometimes economical, especially if the present sire is of such merit that it will be difficult to find as good a one for a successor.

The harmful effects of inbreeding vary, according to experiments carried out by some of the more prominent workers in this field. Castle (1), found in his work with *Drosophila* that breeding brother and sister for fifty-nine generations did not reduce vigor or fecundity of the race. When a loss in vigor or fecundity was observed he selected from the more vigorous broods and in this way obviated this loss. Hays (3), writing on the rat inbreeding work of Helen King reports that after fifteen generations of inbreeding, and through careful selection, the inbred males were 18 per cent heavier than the non-inbred check rats. The inbred females were 3.7 per cent heavier at one year of age than the non-inbred control rats. The inbred females also had .8 more offspring per litter. With no selection and after 13 years of inbreeding of guinea pigs Wright (15), found a decline in vigor in all characteristics. In a later experiment by Wright (16), in which he crossed unrelated inbred lines he found that

the crossbreds were distinctly superior to their inbred parents in nearly all of the characteristics of vigor. In the application of the above to livestock Wright says: "Crosses among these inbred lines ought to give a full recovery of whatever vigor has been lost by inbreeding, and particular crosses may safely be expected to show a combination of desired characters distinctly superior to the original stock. Thus a crossbred stock can be developed which can be maintained at higher level than the original stock, a level which could not have been reached by selection alone."

Line 1 Herefords at Miles City has been inbred since 1937, the data for this paper being complete only up through 1948, or over a period of 12 years (1936-1948). The original plan was to carry on half-brother sister matings, with 4 years as the average length of each generation. If this plan had been strictly adhered to, the expected inbreeding coefficient as of 1948 would have been approximately 22 per cent. In this case the line would have decreased 7.33 per cent in heterozygosity per generation or 1.8 per cent per year. Because of unpredictable circumstances such as selection, culling, and death in the line, the above plan could not be strictly adhered to. The actual inbreeding as of 1948 (see Table I) was 15.95 per cent or approximately three-quarters of the expected inbreeding. The actual inbreeding (5.5 years to the generation) was 7.31 per cent per generation and the actual inbreeding per year was 1.329 per cent. It may be observed from the actual inbreeding of 15.95 per cent that Line 1 is not what would be considered an intensely inbred line.

3. Coefficients of Relationship—The relationship of the Line 1 herd

TABLE I. THE INBREEDING AND RELATIONSHIP COEFFICIENTS OF LINE 1
HEREFORDS BY THE YEARS.

	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Coef. of Inbreeding	0.00	0.74	0.26	4.83	4.29	12.50	7.28	12.54	12.71	12.29	13.59	13.46	15.95
Coef. of Relation- ship to:													
Advance Domino 20	33.6	37.5	33.1	42.0	39.3	37.9	41.8	41.3	45.3	44.1	43.1	43.5	44.0
Advance Domino 54	28.9	28.7	30.7	44.6	36.6	24.6	39.2	30.0	25.0	29.5	35.8	30.0	27.1
n*	16	17	22	24	35	28	22	40	30	43	23	38	61

*n Number of coefficients calculated each year.

to Advance Domino 20th and Advance Domino 54th was calculated (see Table I) and it was found that the coefficient of relationship to Advance Domino 20th was 44 per cent and to Advance Domino 54th it was 27.1 per cent.

4. Record of Performance Results—(see Tables II-XX) The record of performance data that are collected (page 12) on the bulls and their steer offspring are an excellent indication of the inherent ability of the sire to pass on to his offspring his own productive capacity. Knapp in a recent paper (as yet unpublished)* pointed out in his analysis of relationship between conformation and ability to gain that visual appraisal is ineffective in regard to selecting for ability to gain.

L1B Domino 2nd has proven to be the best bull that has ever been used at the Range Station. His own record of performance results showed a final weight of 858 pounds with a daily rate of gain on feed of 2.28 pounds. This bull's eight steer offspring that were tested averaged 1033.6 pounds at final weight at the end of the 252 day feeding period and their daily rate of gain on feed was 2.28 pounds. L1B Domino 2nd had nineteen sons on record of performance tests and they averaged 909.6 pounds at final weight with a 2.32 pound daily rate of gain on feed. A son of L1B Domino 2nd, Chase Domino, proved an excellent sire in that he passed on his inherited gaining ability to his offspring. Chase Domino weighed 993 pounds after his feeding period and gained 2.55 pounds per day while on feed. He sired nine bull offspring that were tested and whose average final weight was 916.3 pounds with an average daily rate of gain on feed of 2.19 pounds. The present herd sire in L1A, L1 Domino 10th, is a son

*Knapp, Bradford Jr. Unpublished data.

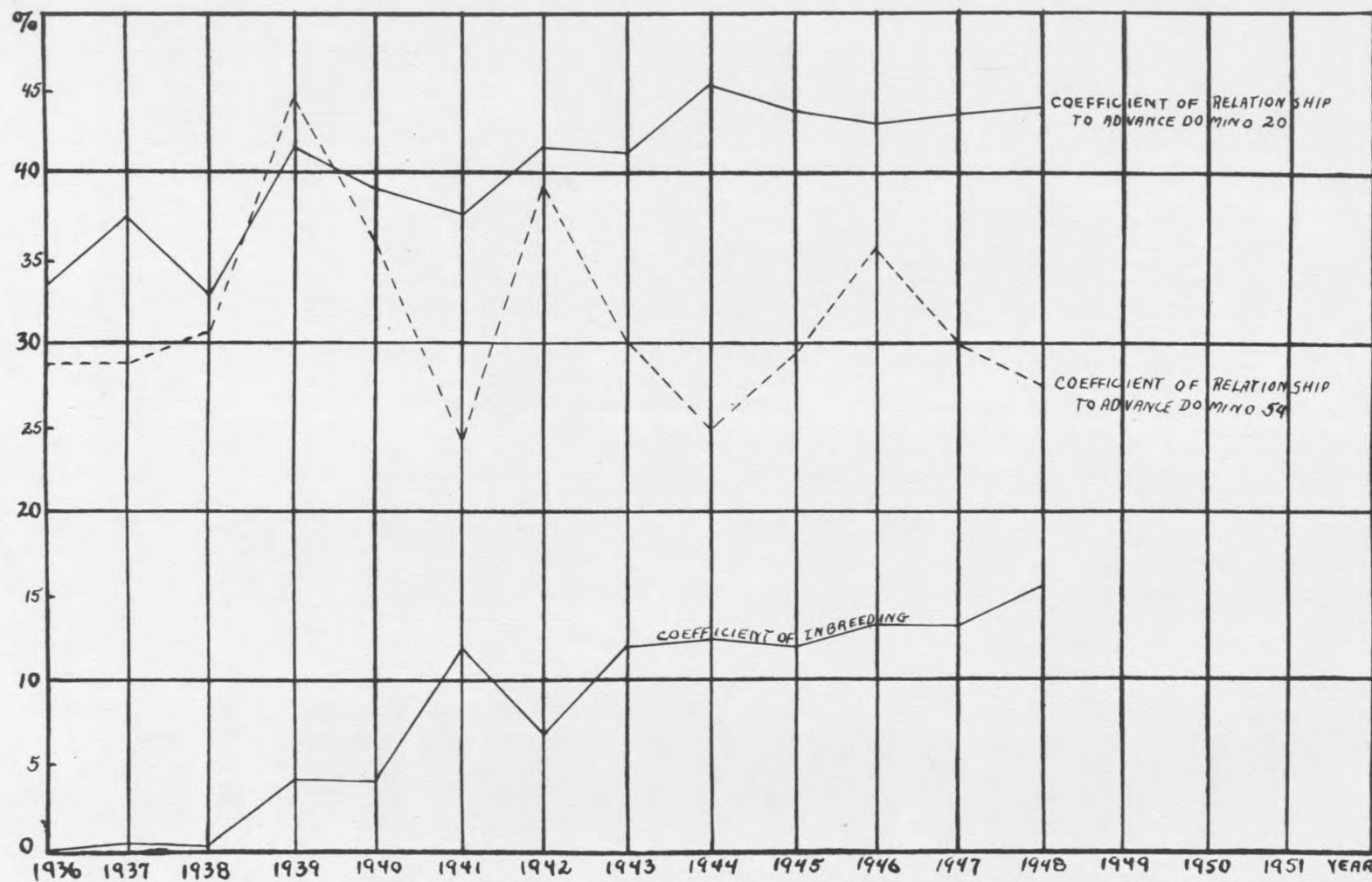


figure 2. The coefficient of inbreeding and the relationship of Line 1 Herefords to Advance Domino 20th and Advance Domino 54th by the years.

of Chase Domino and his final weight after feed was 1063 pounds with a daily rate of gain on feed of 2.64 pounds.

Clayton Domino, a son of Advance Domino 54th, produced a number of good offspring, both male and female. His own final weight was 885 pounds with a daily rate of gain on feed of 1.92 pounds. Seventeen sons of this bull averaged 873.7 pounds at final weight with a daily rate of gain on feed of 2.19 pounds. The six steer offspring of Clayton Domino that were tested averaged 978.7 pounds at final weight with an average daily rate of gain on feed of 2.09 pounds. A son of Clayton Domino used in the herd, Carrol Domino, weighed 934 pounds at final weight with a 2.22 pound daily rate of gain on feed. Five steer offspring of this bull averaged 1016.2 pounds at final weight with an average daily rate of gain on feed of 2.38 pounds.

The 161 Line 1 bulls that have been on record of performance tests during the period 1939-49 averaged 2.03 pounds daily rate of gain on feed. During this period the daily rate of gain on feed has fluctuated year to year but on the average there has been a definite increase in this important factor. The 373 steer offspring of Line 1 bulls that have been tested averaged 2.02 pounds daily rate of gain on feed during the ten year period. As in the bulls the daily gains on steers has fluctuated year to year but all in all there has been a definite increase in rate of gain on feed.

It can be readily seen from the records of Line 1 bulls that they have proven to be quite prepotent in regard to such economically important factors as weaning weight, final weight, and daily rate of gain on feed.

Although type is not the primary criteria for selection, it is not wholly disregarded. A combination of good record of performance results and good type is selected for.

5. Relationship Between Sire Performance and Offspring Performance[#]

Figures 3, 4, and 5 illustrate the regression of sire on steer offspring in regard to birth weight, weaning weight, and final weight. The b^* value for regression of sire's birth weight on steer offspring's birth weight is .129. This indicates that if one bull had a birth weight of 85 pounds, his offspring would be expected to weigh 82.15 pounds at birth, and if another bull had a birth weight of 95 pounds his offspring's birth weight would be expected to be 83.44 pounds. The regression coefficient of the sire's weaning weight on his offspring's weaning weight was .309. This would indicate that a bull weighing 400 pounds at weaning weight would have 384.5 pound offspring at the offspring's weaning weight, or a bull that weighed 500 pounds at weaning weight would have offspring that would be expected to weigh 415.4 pounds at weaning time. The b value for the regression of the sire's final weight on the final weight of his offspring was .511. According to this value for b it would be expected that a bull that weighed 880 pounds at final weight would produce offspring that averaged 937.21 at final weight. A bull that weighed 980 pounds at final weight would be expected to sire offspring that would average 988.31 pounds at final weight. This probably would not be the case in regard to

Calculated by a method used by Bradford Knapp Jr., Animal Husbandman,

U. S. Range Livestock Experiment Station, Miles City, Montana.

* Regression coefficient.

final weight because the steer offspring were fed 56 days longer than their sires.

In the above examples it simply means that in the case of birth weight, for every 10 pounds difference in the birth weight of two bulls there would be expected a 1.29 pound difference between the average birth weight of the two bull's offspring. The same is true for weaning weight and final weight except that for every 100 pounds difference in two bull's weaning weights there would be expected a 30.9 pound difference in their averaged offspring's weaning weights and a 51.1 pound difference between the averaged final weight of each bull's offspring.

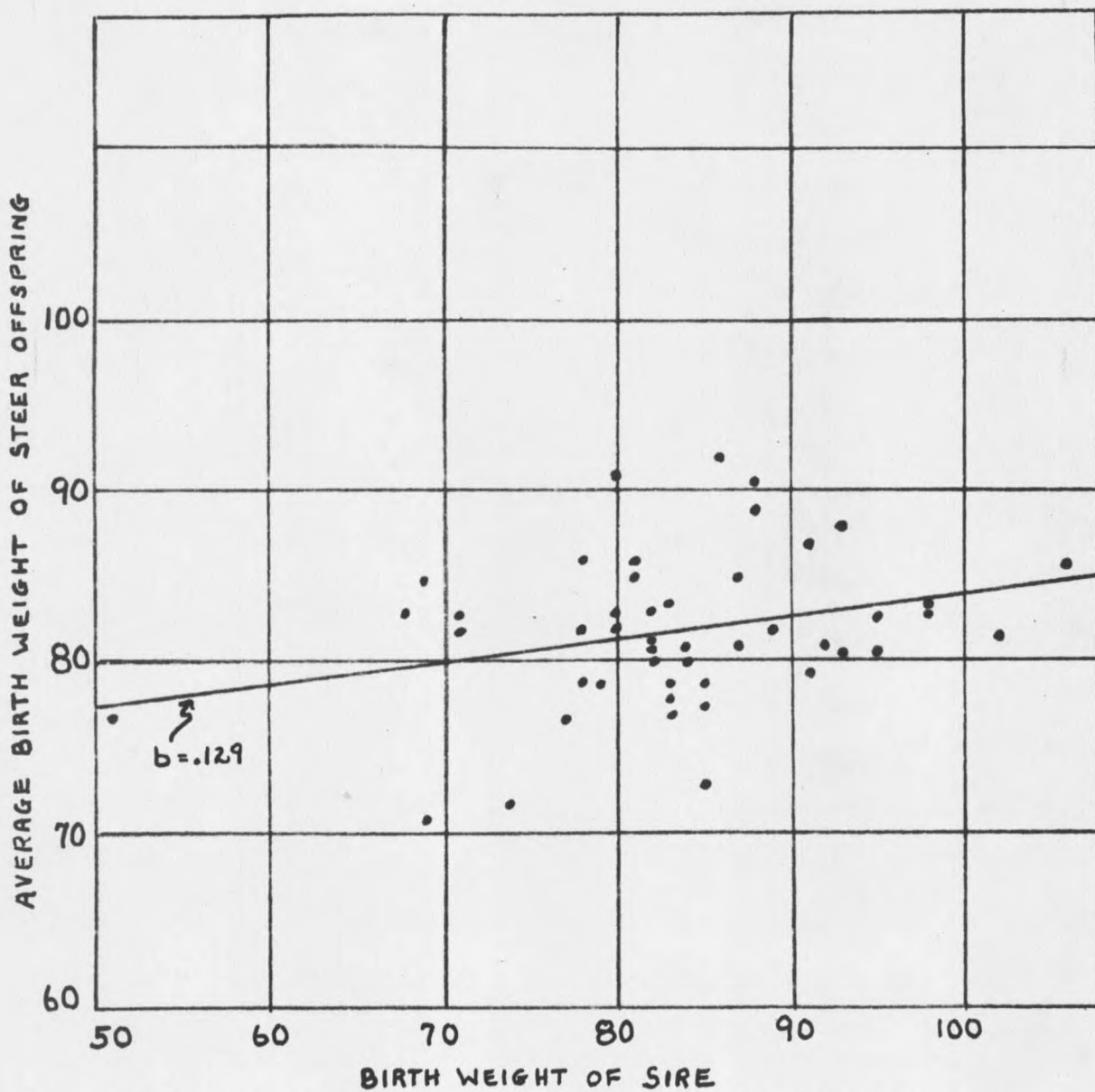


figure 3. Regression of Line 1 bull's birth weight on their steer offspring's average birth weight.

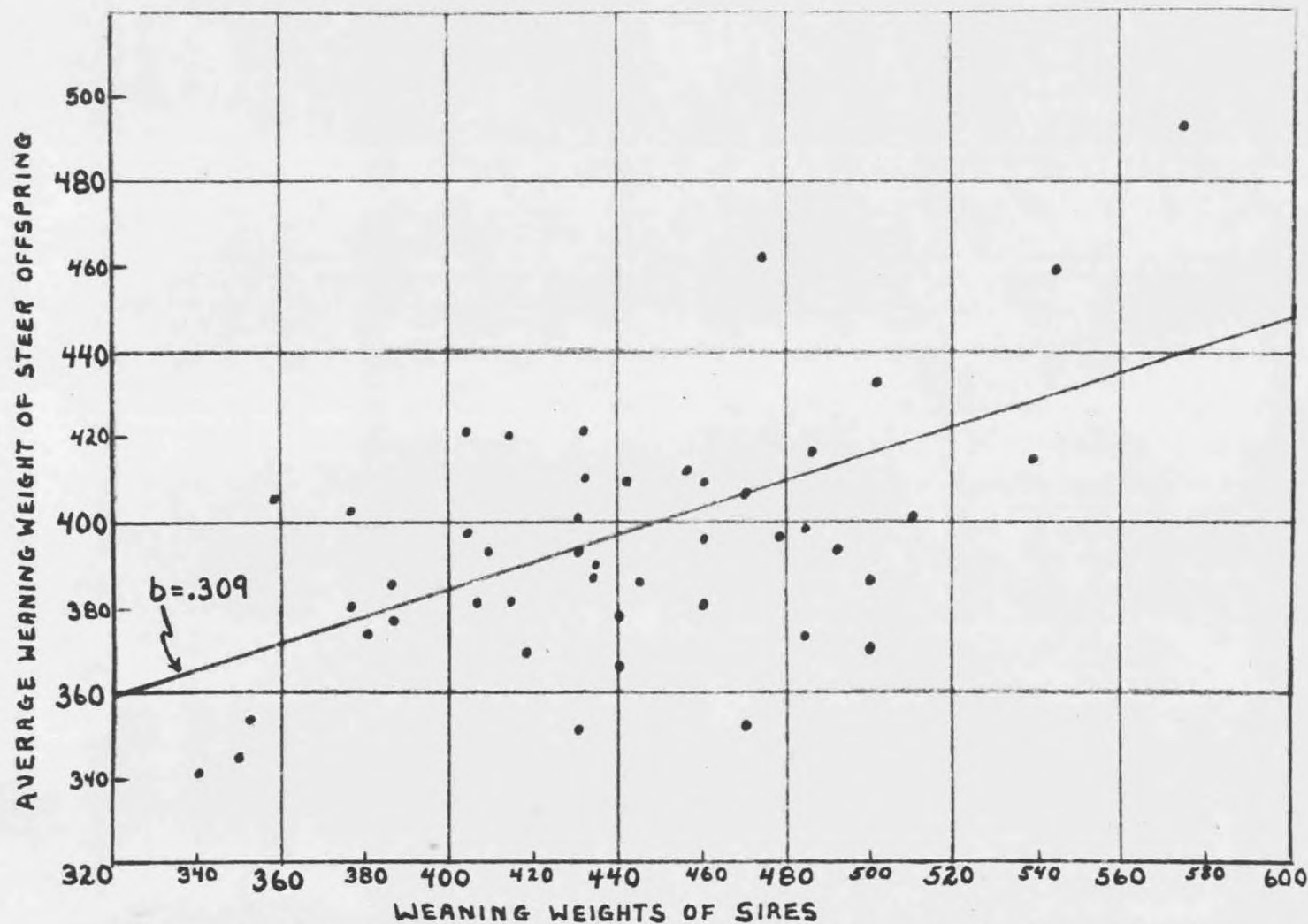


figure 4. Regression of Line 1 bull's weaning weight on their steer offspring's average weaning weight.

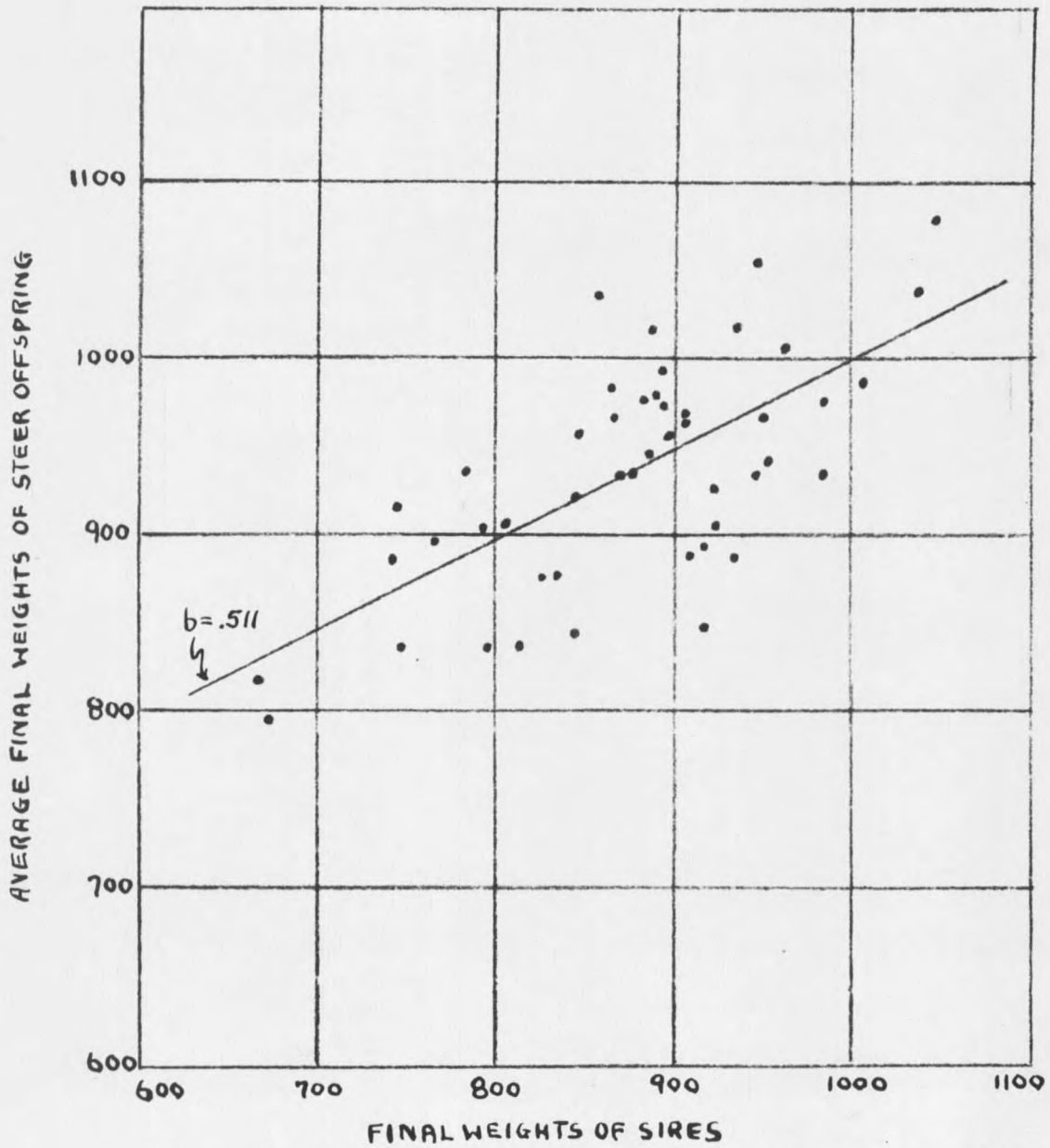


figure 5. Regression of Line 1 bull's final weight on their steer offspring's average final weight.



figure 6. Advance Domino 54th, purebred Hereford bull and one of the two foundation sires of Line 1 Herefords at the United States Range Livestock Experiment Station, Miles City, Montana. Most of the better bulls used in this line were either sons or grandsons of this bull.



figure 7. Purebred Hereford bull Advance Domino 20th is a half-brother of Advance Domino 54th and is the other of the two foundation sires. This bull produced many good female offspring. The dams of such bulls as L1B Domino 2nd and Clayton Domino were daughters of Advance Domino 20th.

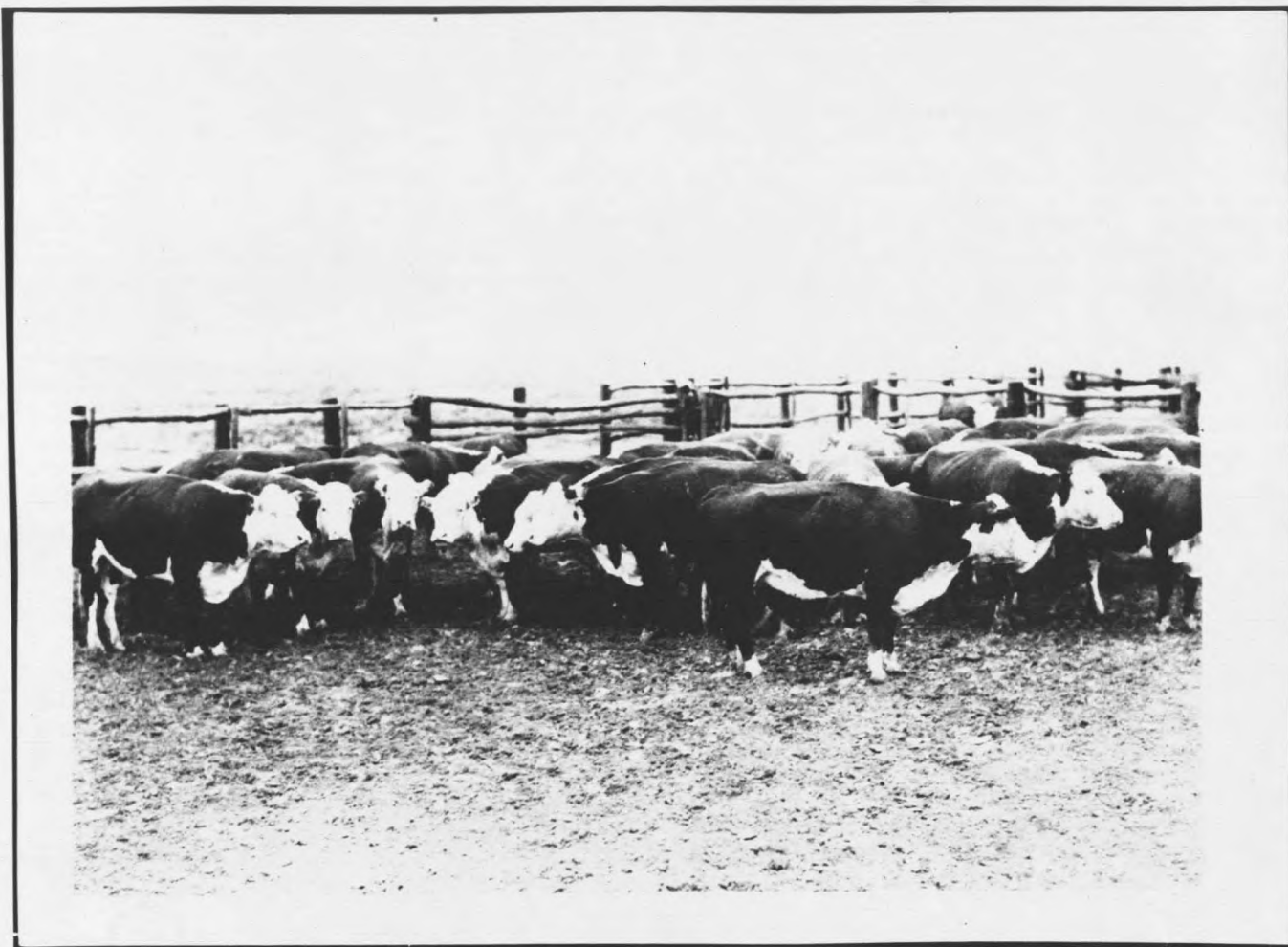


figure 8. A representative group of purebred Hereford cows used as foundation females in the Line 1 Herefords at the Range Station in Miles City, Montana.

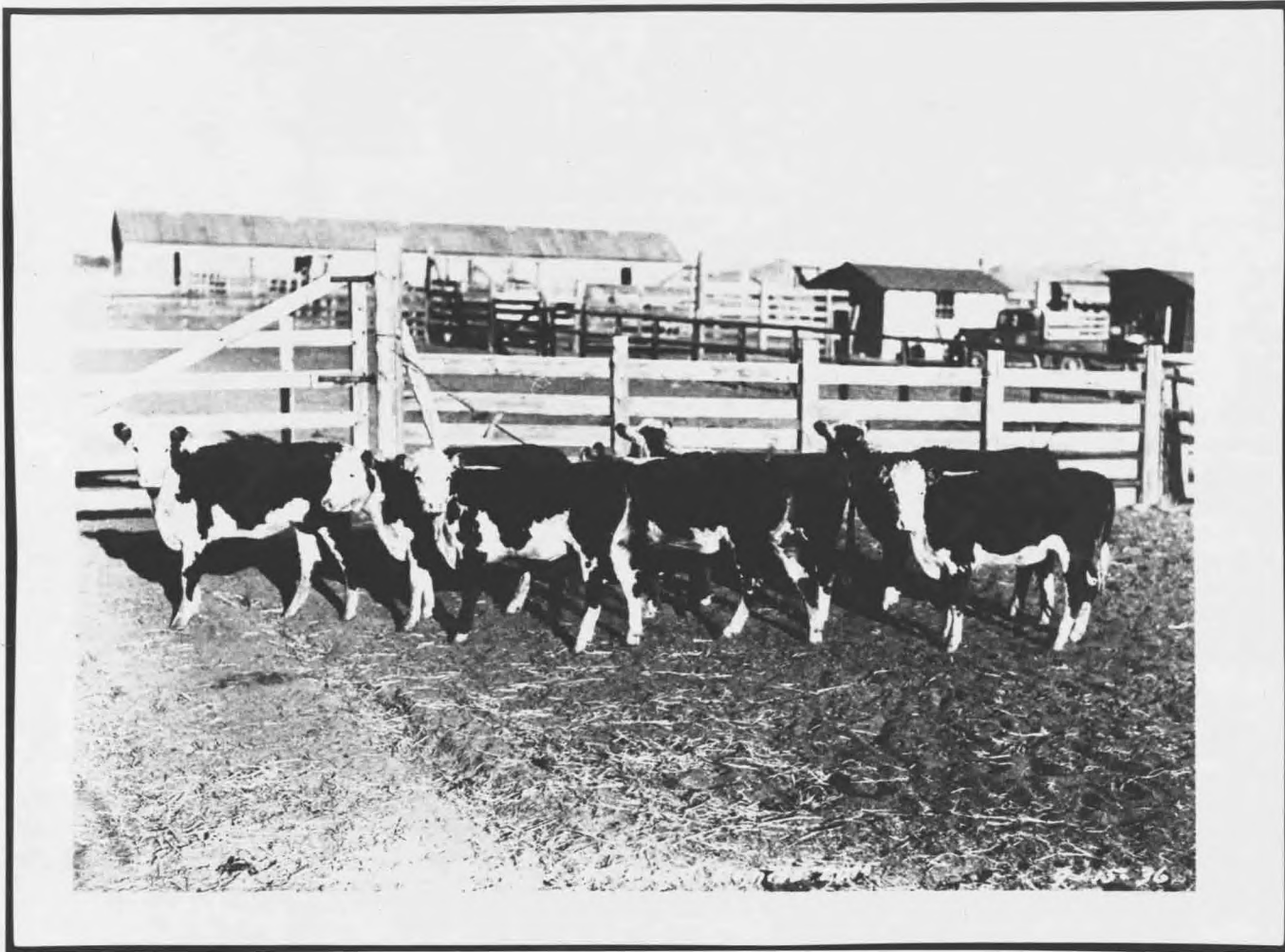


figure 9. A group of purebred Hereford heifers sired by Advance Domino 20th.



figure 10. This is Clayton Domino a purebred Hereford bull that sired many good males and females in Line 1.

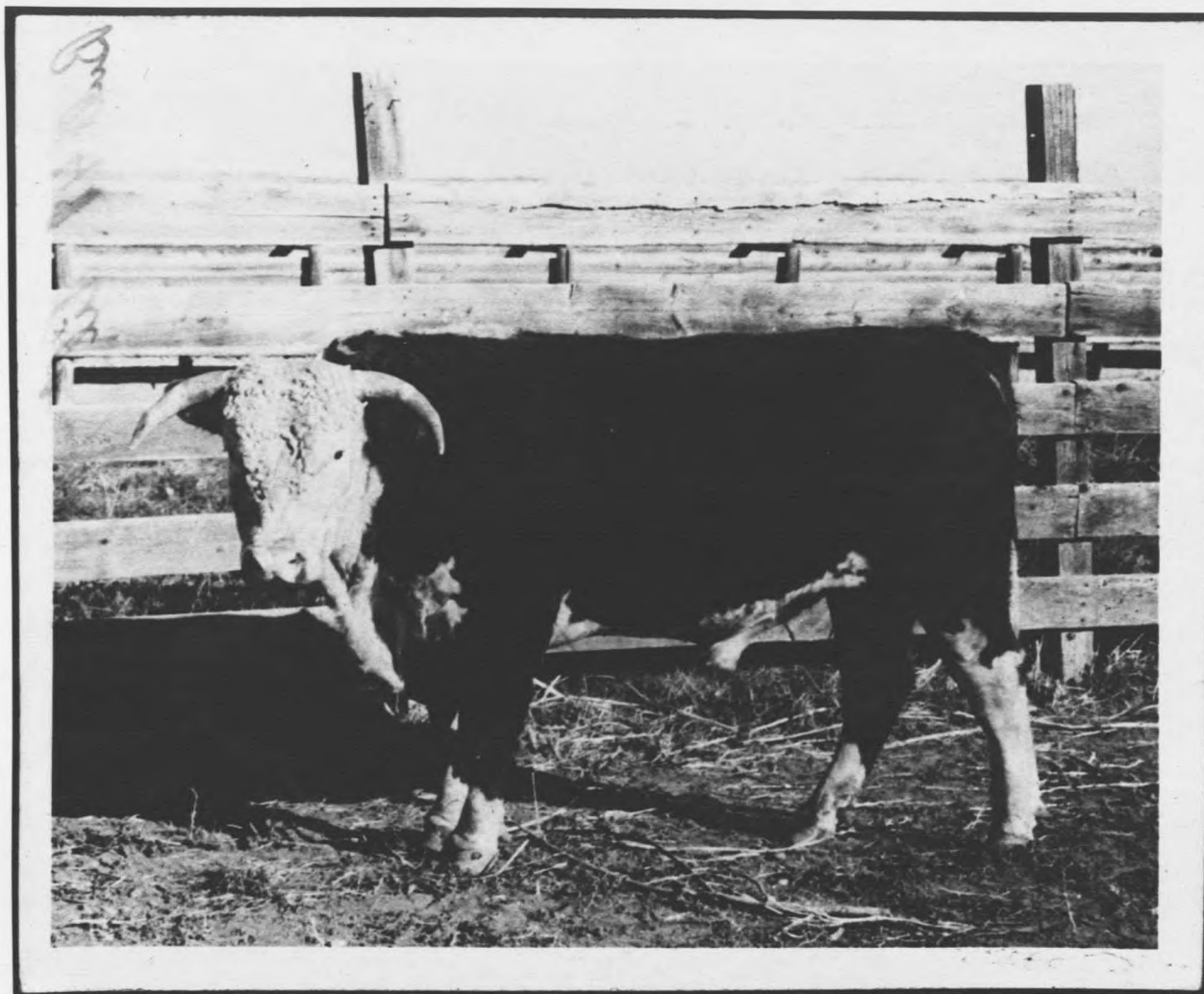


figure 11. Purebred Hereford bull L1B Domino 2nd has proven to be the best bull ever used at the Range Station. This bull had a daily gain on feed of 2.28 pounds, his son Chase Domino had a daily gain on feed of 2.25 pounds and his grandson L1 Domino 10th had a daily gain on feed of 2.64. L1B Domino 2nd was a son of Advance Domino 54th.

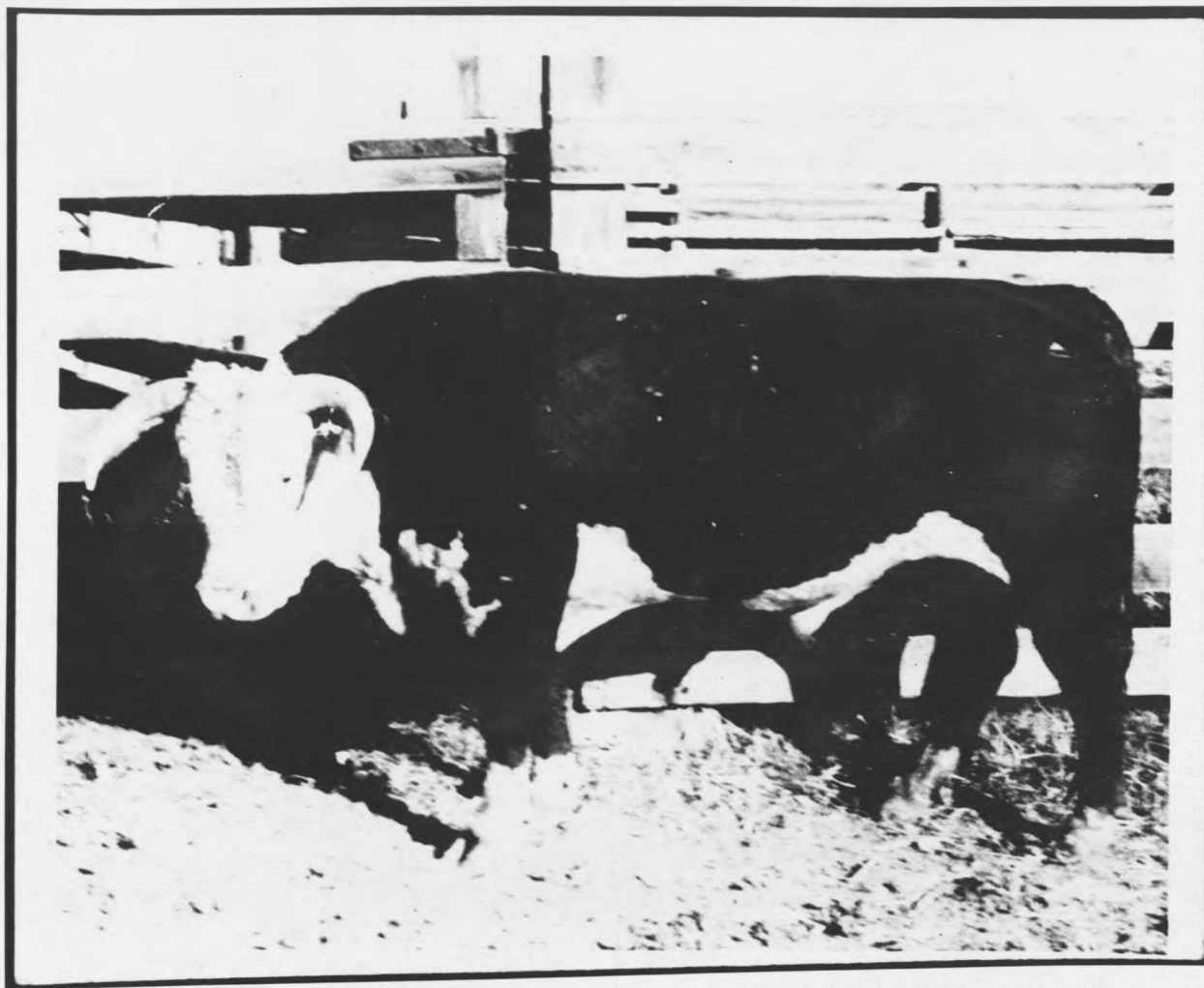


figure 12. Alton Domino, a purebred Hereford bull that was used in the Line 1 herd at the Range Station. This bull like his sire, Advance Domino 20th, produced many very good female offspring.

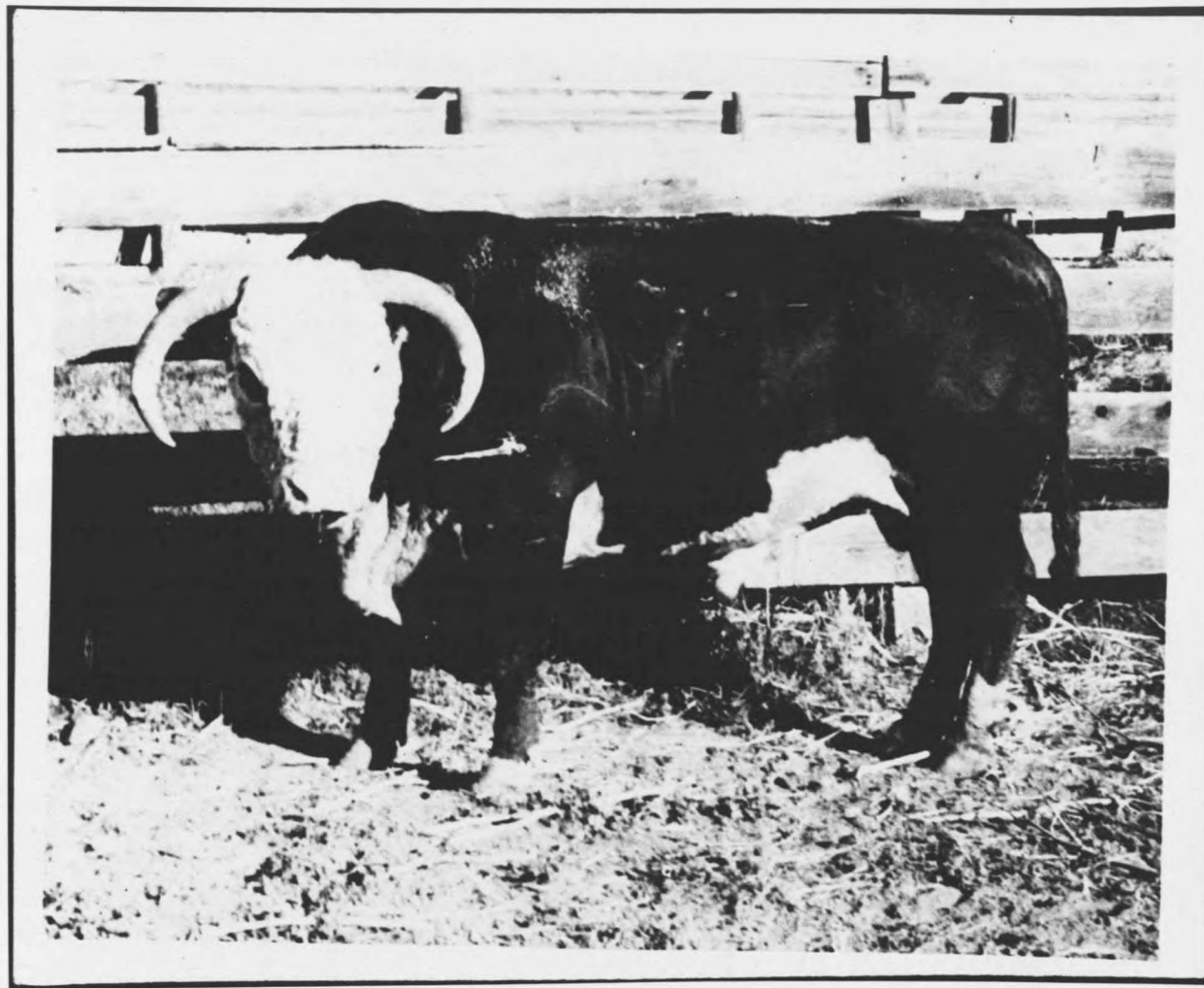


figure 13. Prairie Domino, a purebred Hereford bull used in Line 1 produced many very good female offspring. This bull, like Alton Domino was sired by Advance Domino 20th.

TABLE II. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS DURING A 196 DAY FEEDING* PERIOD (1939-1940)

	Alton	Arab	Circle	Cactus
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	2996	3102	2987	3015
	Advance	Advance	Advance	Advance
Sire of bull.....	Domino 20	Domino 20	Domino 54	Domino 54
Birth weight (lbs.).....	84	78	87	71
Weaning weight (lbs.).....	441	368	559	409
Final weight (lbs.).....	878	727	1055	791
Daily gain on feed (lbs.).....	1.95	1.60	2.21	1.71
Weaning Score (%).....	70.75	59.25	80.88	67.88

Table II. continued:

	Clark	Clayton	Casper	Cyrus
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	3027	3079	3114	3148
	Advance	Advance	Advance	Advance
Sire of bull.....	Domino 54	Domino 54	Domino 54	Domino 54
Birth weight (lbs.).....	81	87	86	91
Weaning weight (lbs.).....	482	456	433	399
Final weight (lbs.).....	879	885	848	785
Daily gain on feed (lbs.).....	1.77	1.92	1.85	1.72
Weaning Score (%).....	69.5	79.94	70.44	69.0

*Individually fed

TABLE III. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS DURING A 196 DAY FEEDING* PERIOD (1940-1941)

	Alton	Alpine	L1B	L1B
Name.....	<u>Domino 2</u>	<u>Domino 2</u>	<u>Domino 1</u>	<u>Domino 2</u>
Number.....	3181	3336	3362	3453
	Advance	Advance	Advance	Advance
Sire of bull.....	Domino 20	Domino 20	Domino 54	Domino 54
Birth weight (lbs.).....	51	76	87	88
Weaning weight (lbs.).....	418	428	460	404
Final weight (lbs.).....	742	800	834	858
Daily gain on feed (lbs.).....	1.64	1.92	1.89	2.28
Weaning Score (%).....	74.00	71.00	73.00	75.00

Table III. continued:

	L1B	L1C	L1C
Name.....	<u>Domino 4</u>	<u>Domino</u>	<u>Domino 2</u>
Number.....	3476	3458	3490
	Advance	Prairie	Prairie
Sire of bull.....	Domino 54	Domino	Domino
Birth weight (lbs.).....	90	82	81
Weaning weight (lbs.).....	404	410	370
Final weight (lbs.).....	768	784	716
Daily gain on feed (lbs.).....	1.85	1.91	1.76
Weaning Score (%).....	71.00	85.00	81.00

*Individually fed

TABLE IV. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS DURING A 196 DAY FEEDING* PERIOD (1941-1942)

	A-A	A-A	A-A	C-C
Name.....	<u>Domino</u>	<u>Domino 2</u>	<u>Domino 3</u>	<u>Domino</u>
Number.....	3627	3634	3776	3781
	Advance	Advance	Advance	Advance
Sire of bull.....	Domino 20	Domino 20	Domino 20	Domino 54
Birth weight (lbs.).....	82	83	86	90
Weaning weight (lbs.).....	490	470	425	459
Final weight (lbs.).....	815	842	718	810
Daily gain on feed (lbs.).....	1.66	1.90	1.49	1.79
Weaning score (%).....	85	81	72	73

Table IV. continued:

	C-C	A-A	C-C
Name.....	<u>Domino 2</u>	<u>Domino 4</u>	<u>Domino 3</u>
Number.....	3825	3826	3837
	Advance	Advance	Advance
Sire of bull.....	Domino 54	Domino 20	Domino 54
Birth weight (lbs.).....	89	69	89
Weaning weight (lbs.).....	363	349	353
Final weight (lbs.).....	671	669	735
Daily gain on feed (lbs.).....	1.57	1.63	1.95
Weaning score (%).....	76	75	76

*Individually fed

TABLE V. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS DURING A 196 DAY FEEDING* PERIOD (1942-1943)

	L1A	L1A	L1A	L1A
Name.....	<u>Domino 1</u>	<u>Domino 2</u>	<u>Domino 6</u>	<u>Domino 3</u>
Number.....	3956	3989	4032	4045
	Advance	Advance	Advance	Advance
Sire of bull.....	Domino 20	Domino 20	Domino 20	Domino 20
Birth weight (lbs.).....	83	77	69	75
Weaning weight (lbs.).....	418	430	404	400
Final weight (lbs.).....	712	796	764	728
Daily gain on feed (lbs.).....	1.51	1.85	1.89	1.71
Weaning score (%).....	80	80	80	75
Coeff. of inbreeding.....	.0627	.0627	.0627	.0627

Table V. Continued:

	L1A	L1A	L1B	L1B
Name.....	<u>Domino 4</u>	<u>Domino 5</u>	<u>Domino 5</u>	<u>Domino 6</u>
Number.....	4058	4108	3964	4065
	Advance	Advance	Advance	Advance
Sire of bull.....	Domino 20	Domino 20	Domino 54	Domino 54
Birth weight (lbs.).....	74	74	78	84
Weaning weight (lbs.).....	394	340	444	470
Final weight (lbs.).....	695	671	805	842
Daily gain on feed (lbs.).....	1.55	1.69	1.85	1.88
Weaning score (%).....	77	71	81	81
Coeff. of inbreeding.....	.0627	.1958	.0627	.0627

*Individually fed

Table V. Continued:

	L1B	L1B	L1C	L1C
Name.....	<u>Domino 7</u>	<u>Domino 8</u>	<u>Domino 3</u>	<u>Domino 4</u>
Number.....	4167	4172	3918	3953
	Advance	Advance	Prairie	Prairie
Sire of bull.....	Domino 54	Domino 54	Domino	Domino
Birth weight (lbs.).....	82	80	82	81
Weaning weight (lbs.).....	414	390	500	430
Final weight (lbs.).....	744	649	860	748
Daily gain on feed (lbs.).....	1.73	1.34	1.86	1.64
Weaning score (%).....	82	82	81	74
Inbreeding (Coeff.).....	.0627	.0627	.0312	.1328

Table V. Continued:

	L1C	L1C	L1C
Name.....	<u>Domino 5</u>	<u>Domino 6</u>	<u>Domino 7</u>
Number.....	4051	4181	4190
	Prairie	Prairie	Prairie
Sire of bull.....	Domino	Domino	Domino
Birth weight (lbs.).....	81	79	89
Weaning weight (lbs.).....	434	352	384
Final weight (lbs.).....	734	618	787
Daily gain on feed (lbs.).....	1.58	1.37	2.08
Weaning score (%).....	81	76	80
Inbreeding (Coeff.).....	.1406	.1406	.0468

*Individually fed

TABLE VI. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS DURING A 196 DAY FEEDING* PERIOD (1943-1944)

Name.....	Albert	Arthur	Alonzo	Alan
Number.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
	4291	4346	4377	4468
	Alton	Alton	Alton	Alton
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	91	82	75	82
Weaning weight (lbs.).....	460	430	454	440
Final weight (lbs.).....	917	921	866	909
Daily gain on feed (lbs.).....	2.35	2.43	2.10	2.40
Weaning score (%).....	83	75	81	76
Inbreeding (Coeff.).....	.1562	.1406	.1328	.1562

Table VI. Continued:

Name.....	Calvin	L1C	L1C
Number.....	<u>Domino</u>	<u>Domino 8</u>	<u>Domino 9</u>
	4434	4396	4536
	Clayton	Prairie	Prairie
Sire of bull.....	Domino	Domino	Domino
Birth weight (lbs.).....	68	67	78
Weaning weight (lbs.).....	352	420	386
Final weight (lbs.).....	749	835	811
Daily gain on feed (lbs.).....	1.97	2.04	2.16
Weaning score (%).....	66	82	73
Inbreeding (Coeff.).....	.1991	.1562	.1562

*Individually fed

TABLE VII. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS DURING A 196 DAY FEEDING* PERIOD (1944-1945)

	Abbot	Alva	Acton	Adam's
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	4745	4782	4796	4841
	Alton	Alton	Alton	Alton
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	80	70	74	97
Weaning weight (lbs.).....	428	400	470	500
Final weight (lbs.).....	791	785	836	986
Daily gain on feed (lbs.).....	1.90	1.82	2.00	2.44
Weaning score (%).....	78.58	77.67	75.00	85.00
Inbreeding (Coeff.).....	.1406	.1250	.1250	.1562

Table VII, Continued:

	Akron	Alberton	Allbright	Alcazar
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	4849	4867	4880	4902
	Alton	Alton	Alton	Alton
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	78	67	71	77
Weaning weight (lbs.).....	430	440	440	424
Final weight (lbs.).....	824	871	932	828
Daily gain on feed (lbs.).....	1.97	2.15	2.36	2.14
Weaning score (%).....	87.67	80.92	88.00	81.75
Inbreeding (Coeff.).....	.1328	.1328	.1406	.1484

*Individually fed

Table VII. Continued:

	Alder	Aldrich	Ashland	Albert
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	4911	4957	4975	5000
	Alton	Alton	Alton	Alton
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	77	84	78	76
Weaning weight (lbs.).....	410	376	416	402
Final weight (lbs.).....	767	724	828	821
Daily gain on feed (lbs.).....	1.70	1.76	2.12	2.08
Weaning score (%).....	77.75	81.25	79.33	84.75
Inbreeding (Coeff.).....	.1448	.1250	.1250	.1562

Table VII. Continued:

	Alsberg	Albion	Cooley	Cedric
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	5030	5064	4810	4871
	Alton	Alton	L1B	L1B
Sire of bull.....	Domino	Domino	Domino 2	Domino 2
Birth weight (lbs.).....	70	83	96	90
Weaning weight (lbs.).....	396	380	380	440
Final weight (lbs.).....	760	904	797	841
Daily gain on feed (lbs.).....	1.89	2.58	2.07	2.13
Weaning score (%).....	84.75	80.25	77.58	80.50
Inbreeding (Coeff.).....	.1250	.1406	.1328	.1406

Table VII. Continued:

	Comache	Culver	Clinton	Conner
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	4879	4892	4959	4979
	L1B	L1B	L1B	L1B
Sire of bull.....	Domino 2	Domino 2	Domino 2	Domino 2
Birth weight (lbs.).....	95	87	78	79
Weaning weight (lbs.).....	430	420	434	406
Final weight (lbs.).....	895	841	891	883
Daily gain on feed (lbs.).....	2.27	2.06	2.37	2.32
Weaning score (%).....	83.67	83.33	76.33	83.75
Inbreeding (Coeff.).....	.1406	.1250	.1250	.1406

Table VII. Continued:

	Greston	L1C	L1C	L1C
Name.....	<u>Domino</u>	<u>Domino 16</u>	<u>Domino 12</u>	<u>Domino 13</u>
Number.....	5046	4765	4945	4977
	L1B	Prairie	Prairie	Prairie
Sire of bull.....	Domino 2	Domino	Domino	Domino
Birth weight (lbs.).....	85	86	83	83
Weaning weight (lbs.).....	414	424	500	410
Final weight (lbs.).....	800	872	986	825
Daily gain on feed (lbs.).....	2.04	2.34	2.38	2.07
Weaning score (%).....	84.75	71.83	88.75	81.75
Inbreeding (Coeff.).....	.1250	.0625	.0312	.1562

*Individually fed

Table VII. Continued:

	L1C	L1C	L1C	L1C
Name.....	<u>Domino 18</u>	<u>Domino 14</u>	<u>Domino 15</u>	<u>Domino 16</u>
Number.....	5017	5033	5061	5080
	Prairie	Prairie	Prairie	Prairie
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	81	79	93	86
Weaning weight (lbs.).....	418	402	432	410
Final weight (lbs.).....	840	873	888	809
Daily gain on feed (lbs.).....	2.24	2.35	2.42	2.03
Weaning score (%).....	79.67	82.42	79.92	81.92
Inbreeding (Coeff.).....	.1406	.1094	.0475	.1406

Table VII. Continued:

	Caine	Carrol	Cobb
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	4795	4916	4948
	Clayton	Clayton	Clayton
Sire of bull.....	Domino	Domino	Domino
Birth weight (lbs.).....	69	88	61
Weaning weight (lbs.).....	390	486	350
Final weight (lbs.).....	840	934	815
Daily gain on feed (lbs.).....	2.15	2.22	2.29
Weaning score (%).....	76.17	81.08	68.50
Inbreeding (Coeff.).....	.1054	.1025	.1094

*Individually fed

TABLE VIII. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS
DURING A 196 DAY FEEDING* PERIOD (1945-1946)

	Alfred	Auburn	August	Akron
Name	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	5354	5440	5513	5580
	A-A	A-A	A-A	A-A
Sire of bull.....	Domino 2	Domino 2	Domino 2	Domino 2
Birth weight (lbs.).....	83	71	84	95
Weaning weight (lbs.).....	460	390	410	376
Final weight (lbs.).....	921	785	838	867
Daily gain on feed (lbs.).....	2.34	2.02	2.19	2.40
Weaning score (%).....	82	78	72	82
Inbreeding (Coeff.).....	.0312	.1523	.1367	.1054

Table VIII., Continued:

	Avon	Carson	Chase	Coulee
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	5591	5281	5304	5330
	A-A	L1B	L1B	L1B
Sire of bull.....	Domino 2	Domino 2	Domino 2	Domino 2
Birth weight (lbs.).....	86	91	87	87
Weaning weight (lbs.).....	342	538	442	478
Final weight (lbs.).....	757	1007	993	922
Daily gain on feed (lbs.).....	2.02	2.45	2.55	2.25
Weaning score (%).....	73	88	81	88
Inbreeding (Coeff.).....	.1406	.0937	.0937	.1640

*Individually fed

Table VIII. Continued:

	Crow	Cherokee	Chico	Gody
Name.....	Domino	Domino	Domino	Domino
Number.....	5421	5432	5441	5447
	L1B	L1B	L1B	L1B
Sire of bull.....	Domino 2	Domino 2	Domino 2	Domino 2
Birth weight (lbs.).....	84	83	103	99
Weaning weight (lbs.).....	400	450	510	470
Final weight (lbs.).....	829	933	1024	920
Daily gain on feed (lbs.).....	2.18	2.41	2.66	2.23
Weaning score (%).....	85	83	89	87
Inbreeding (Coeff.).....	.0937	.1093	.0937	.1640

Table VIII. Continued:

	Crescent	Apache	Archer	Astor	Acme
Name.....	Domino	Domino	Domino	Domino	Domino
Number.....	5539	5322	5351	5360	5514
	L1B	Alton	Alton	Alton	Alton
Sire of bull.....	Domino 2	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	106	80	80	85	81
Weaning weight (lbs.).....	414	358	386	434	376
Final weight (lbs.).....	887	847	870	899	826
Daily gain on feed (lbs.).....	2.41	2.43	2.28	2.38	2.35
Weaning score (%).....	80	74	76	81	74
Inbreeding (Coeff.).....	.1406	.1406	.1367	.1406	.1445

TABLE IX. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS DURING A 196 DAY FEEDING* PERIOD (1946-1947)

	Carlson	Copping	Cooper	Chester
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	5699	5708	5907	5954
	Clayton	Clayton	Clayton	Clayton
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	81	80	98	80
Weaning weight (lbs.).....	475	542	510	492
Final weight (lbs.).....	901	889	948	952
Daily gain on feed (lbs.).....	2.17	2.03	2.32	2.39
Weaning score (%).....	79	74	70	79
Inbreeding (Coeff.).....	.0938	.1563	.1016	.1016

Table IX. Continued:

	Canyon	Coffee	Cotner	Carr
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	5995	6032	6039	6070
	Clayton	Clayton	Clayton	Clayton
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	92	85	89	85
Weaning weight (lbs.).....	502	484	477	484
Final weight (lbs.).....	961	950	905	914
Daily gain on feed (lbs.).....	2.45	2.59	2.36	2.39
Weaning score (%).....	80	73	70	81
Inbreeding (Coeff.).....	.1016	.1016	.0938	.0938

*Individually fed

Table IX. Continued:

	Clyde	Cobleigh	Cougar	Casey
Name	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	6091	5644	5774	5905
	Clayton	L1B	L1B	L1B
Sire of bull.....	Domino	Domino 2	Domino 2	Domino 1
Birth weight (lbs.).....	78	93	102	80
Weaning weight (lbs.).....	436	575	544	490
Final weight (lbs.).....	858	1046	1039	876
Daily gain on feed (lbs.).....	2.24	2.52	2.61	2.19
Weaning score (%).....	65	84	80	68
Inbreeding (Coeff.).....	.1953	.1406	.1406	.1094

Table IX. Continued:

	Anthony	Anzio	Aasheim	Abner
Name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Number.....	5804	6075	6103	6111
	A-A	A-A	A-A	A-A
Sire of bull.....	Domino 2	Domino 2	Domino 2	Domino 2
Birth weight (lbs.).....	78	86	82	75
Weaning weight (lbs.).....	465	474	432	285
Final weight (lbs.).....	857	947	865	745
Daily gain on feed (lbs.).....	2.09	2.61	2.41	2.38
Weaning score (%).....	83	71	67	46
Inbreeding (Coeff.).....	.1406	.1719	.1328	.1328

TABLE X. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS DURING A 196 DAY FEEDING* PERIOD (1947-1948)

	L1	L1	L1	L1
Name	<u>Domino 1</u>	<u>Domino 2</u>	<u>Domino 3</u>	<u>Domino 4</u>
Number.....	6130	6159	6191	6194
	L1B	L1B	Clayton	Clayton
Sire of bull.....	Domino 2	Domino 2	Domino	Domino
Birth weight (lbs.).....	68	90	81	88
Weaning weight (lbs.).....	400	448	470	437
Final weight (lbs.).....	877	859	882	772
Daily gain on feed (lbs.).....	2.31	2.18	2.08	1.83
Weaning score (%).....	75	75	83	69
Inbreeding (Coeff.).....	.1875	.1406	.1719	.1875

Table X. Continued:

	L1	L1	L1	L1
Name.....	<u>Domino 6</u>	<u>Domino 7</u>	<u>Domino 10</u>	<u>Domino 11</u>
Number.....	6373	6527	6193	6288
	Clayton	Clayton	Chase	Chase
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	65	76	85	85
Weaning weight (lbs.).....	400	408	542	444
Final weight (lbs.).....	790	793	1063	861
Daily gain on feed (lbs.).....	1.92	1.96	2.64	2.12
Weaning score (%).....	77	70	80	76
Inbreeding (Coeff.).....	.1953	.1914	.1171	.1171

*Individually fed

Table X, Continued:

	L1	L1	L1	L1
Name	<u>Domino 12</u>	<u>Domino 13</u>	<u>Domino 14</u>	<u>Domino 15</u>
Number.....	6413	6443	6494	6131
	Chase	Chase	Chase	Chico
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	73	78	92	78
Weaning weight (lbs.).....	460	444	465	408
Final weight (lbs.).....	846	902	903	895
Daily gain on feed (lbs.).....	1.93	2.26	2.21	2.45
Weaning score (%).....	78	76	78	70
Inbreeding (Coeff.).....	.1094	.1055	.1095	.1406

Table X, Continued:

	L1	L1	L1	L1
Name	<u>Domino 16</u>	<u>Domino 17</u>	<u>Domino 18</u>	<u>Domino 19</u>
Number.....	6188	6246	6248	6277
	Chico	Chico	Chico	Chico
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	72	86	79	104
Weaning weight (lbs.).....	486	440	484	510
Final weight (lbs.).....	953	839	897	961
Daily gain on feed (lbs.).....	2.41	2.04	2.07	2.22
Weaning score (%).....	78	73	74	78
Inbreeding (Coeff.).....	.1484	.1328	.1094	.0759

Table X. Continued:

	L1	L1	L1	L1
Name	<u>Domino 22</u>	<u>Domino 23</u>	<u>Domino 24</u>	<u>Domino 25</u>
Number	6434	6495	6125	6216
	Chico	Chico	Adams	Adams
Sire of bull	Domino	Domino	Domino	Domino
Birth weight (lbs.)	89	95	88	87
Weaning weight (lbs.)	452	434	462	473
Final weight (lbs.)	937	879	884	918
Daily gain on feed (lbs.)	2.40	2.15	2.12	2.10
Weaning score (%)	75	75	74	73
Inbreeding (Coeff.)	.1523	.1172	.2266	.2266

Table X. Continued:

	L1	L1	L1	L1	L1
Name	<u>Domino 26</u>	<u>Domino 27</u>	<u>Domino 28</u>	<u>Domino 29</u>	<u>Domino 30</u>
Number	6254	6366	6368	6369	6441
	Adams	Adams	Adams	Adams	Adams
Sire of bull	Domino	Domino	Domino	Domino	Domino
Birth weight (lbs.)	91	91	84	88	91
Weaning weight (lbs.)	486	463	444	440	450
Final weight (lbs.)	892	899	1005	888	942
Daily gain on feed (lbs.)	2.06	2.21	2.72	2.37	2.35
Weaning score (%)	76	76	77	76	76
Inbreeding (Coeff.)	.1250	.0625	.2266	.2188	.2188

TABLE XI. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 BULLS DURING A 196 DAY FEEDING* PERIOD (1948-1949)

	L1	L1	L1	L1
Name.....	<u>Domino 31</u>	<u>Domino 32</u>	<u>Domino 33</u>	<u>Domino 34</u>
Number.....	8102	8247	8388	8061
	Carrol	Carrol	Carrol	Carson
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	88	75	95	83
Weaning weight (lbs.).....	595	456	464	535
Final weight (lbs.).....	1016	735	883	873
Daily gain on feed (lbs.).....	2.01	1.43	2.36	1.91
Weaning score (%).....	85	83	77	86
Inbreeding (Coeff.).....	.0859	.1513	.1094	.0781

Table XI. Continued:

	L1	L1	L1	L1
Name.....	<u>Domino 35</u>	<u>Domino 36</u>	<u>Domino 37</u>	<u>Domino 38</u>
Number.....	8063	8120	8122	8177
	Carson	Carson	Carson	Carson
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	80	79	85	94
Weaning weight (lbs.).....	438	432	524	442
Final weight (lbs.).....	822	714	832	831
Daily gain on feed (lbs.).....	2.10	1.35	1.92	1.97
Weaning score (%).....	75	78	79	71
Inbreeding (Coeff.).....	.0859	.1094	.1094	.0938

*Individually fed.

Table XI. Continued:

	L1	L1	L1	L1
Name.....	<u>Domino 39</u>	<u>Domino 40</u>	<u>Domino 41</u>	<u>Domino 42</u>
Number.....	8183	8196	8241	8054
	Carson	Carson	Carson	Chase
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	77	85	76	91
Weaning weight (lbs.).....	502	500	452	484
Final weight (lbs.).....	780	800	761	894
Daily gain on feed (lbs.).....	1.63	1.69	1.62	2.13
Weaning score (%).....	81	77	81	81
Inbreeding (Coeff.).....	.1758	.1094	.1094	.1016

Table XI. Continued:

	L1	L1	L1	L1
Name.....	<u>Domino 43</u>	<u>Domino 44</u>	<u>Domino 45</u>	<u>Domino 46</u>
Number.....	8176	8342	8348	8114
	Chase	Chase	Chase	Adams
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	84	88	95	81
Weaning weight (lbs.).....	480	377	530	440
Final weight (lbs.).....	898	784	996	802
Daily gain on feed (lbs.).....	2.01	2.06	2.32	1.84
Weaning score (%).....	78	77	86	73
Inbreeding (Coeff.).....	.1094	.1367	.0847	.1250

Table XI. Continued:

	L1	L1	L1	L1
Name.....	<u>Domino 47</u>	<u>Domino 48</u>	<u>Domino 49</u>	<u>Domino 50</u>
Number.....	8216	8232	8336	8385
	Adams	Adams	Adams	Adams
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	88	80	94	86
Weaning weight (lbs.).....	478	504	431	473
Final weight (lbs.).....	817	801	819	754
Daily gain on feed (lbs.).....	1.99	1.58	2.06	1.63
Weaning score (%).....	77	74	74	70
Inbreeding (Coeff.).....	.2031	.1094	.1953	.1250

Table XI. Continued:

	L1	L1	L1	L1
Name.....	<u>Domino 51</u>	<u>Domino 52</u>	<u>Domino 53</u>	<u>Domino 54</u>
Number.....	8035	8053	8180	8331
	Albion	Albion	Albion	Albion
Sire of bull.....	Domino	Domino	Domino	Domino
Birth weight (lbs.).....	89	78	95	76
Weaning weight (lbs.).....	540	412	486	474
Final weight (lbs.).....	868	772	886	822
Daily gain on feed (lbs.).....	2.03	1.97	2.19	2.09
Weaning score (%).....	73	68	82	74
Inbreeding (Coeff.).....	.0859	.2187	.1172	.1094

Table XI. Continued:

	L1	L1	L1	L1
Name	<u>Domino 55</u>	<u>Domino 56</u>	<u>Domino 57</u>	<u>Domino 58</u>
Number	8339	8345	8346	8376
	Albion	Albion	Albion	Albion
Sire of bull	Domino	Domino	Domino	Domino
Birth weight (lbs.)	82	80	90	76
Weaning weight (lbs.)	514	435	437	476
Final weight (lbs.)	755	858	867	846
Daily gain on feed (lbs.)	1.53	2.30	2.28	2.26
Weaning score (%)	79	81	74	78
Inbreeding (Coeff.)	.0938	.1328	.1328	.0781

TABLE XII. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 STEERS
DURING A 252 DAY FEEDING* PERIOD (1939-1940)

	Prairie	Chief
Sire's name.....	<u>Domino</u>	<u>Domino</u>
Sire's number.....	1894	1986
Number of steers.....	7	8
Birth weight (lbs.)#.....	79.4	83.8
Weaning weight (lbs.)#.....	404.3	440.1
Final weight (lbs.)#.....	875.6	916.1
Daily gain on feed (lbs.)#.....	1.68	1.69
Weaning score (%).....	78.1	74.5
Slaughter grade".....	16.7	16.9
Carcass grade".....	15.9	16.6

TABLE XIII. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 STEERS
DURING A 252 DAY FEEDING* PERIOD (1941-1942)

	Curtis	Chinook	Alton	Clayton
Sire's name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Sire's number.....	2717	2736	2996	3079
Number of steers.....	8	8	8	6
Birth weight (lbs.)#.....	84.3	85.6	81.1	85.2
Weaning weight (lbs.)#.....	408.1	412.5	409.4	452.5
Final weight (lbs.)#.....	936.5	876.0	931.6	978.7
Daily gain on feed (lbs.)#.....	2.10	1.84	2.07	2.09
Weaning score (%).....	72.6	78.5	78.3	79.7
Slaughter grade".....	16.0	17.0	16.0	14.7
Carcass grade".....	15.8	12.3	12.4	12.0

*Individually fed

#Average

"Weighted average

TABLE XIV. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 STEERS DURING A 252 DAY FEEDING* PERIOD (1942-1943).

	Cactus	Alton	L1B	L1C
Sire's name	<u>Domino</u>	<u>Domino 2</u>	<u>Domino 2</u>	<u>Domino</u>
Sire's number	3015	3181	3453	3458
Number of steers	8	8	8	5
Birth weight (lbs.)#	82.9	77.1	89.9	85.8
Weaning weight (lbs.)#	394.4	370.5	410.6	422.0
Final weight (lbs.)#	902.0	884.3	1033.6	938.4
Daily gain on feed (lbs.)#	1.86	1.88	2.28	1.89
Weaning score (%)	75.8	70.8	73.4	76.0
Slaughter grade"	14.8	12.5	12.3	12.0
Carcass grade"	14.3	11.5	13.5	13.6

TABLE XV. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 STEERS DURING A 252 DAY FEEDING* PERIOD (1943-1944)

	A-A	L1B
Sire's name	<u>Domino 2</u>	<u>Domino 1</u>
Sire's number	3634	3362
Number of steers	8	8
Birth weight (lbs.)#	83.6	81.4
Weaning weight (lbs.)#	407.1	396.9
Final weight (lbs.)#	920.4	878.5
Daily gain on feed (lbs.)#	1.98	1.86
Weaning score (%)	75.3	72.8
Slaughter grade"	13.5	14.3
Carcass grade"	12.8	14.8

*Individually fed

#Average

"Weighted average

TABLE XVI. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 STEERS
DURING A 252 DAY FEEDING* PERIOD (1944-1945)

	A-A	L1A	L1A
Sire's name.....	<u>Domino 4</u>	<u>Domino 2</u>	<u>Domino 6</u>
Sire's number.....	3826	3989	4032
Number of steers.....	7	8	7
Birth weight (lbs.)#.....	70.7	76.8	84.7
Weaning weight (lbs.)#.....	347.9	351.9	399.9
Final weight (lbs.)#.....	817.1	836.0	892.6
Daily gain on feed (lbs.)#.....	1.86	1.92	1.96
Weaning score (%).....	75.1	74.5	86.0
Slaughter grade".....	13.7	15.5	15.4
Carcass grade".....	12.6	15.5	14.3

Table XVI. Continued:

	L1B	L1B
Sire's name.....	<u>Domino 5</u>	<u>Domino 6</u>
Sire's number.....	3964	4065
Number of steers.....	8	8
Birth weight (lbs.)#.....	82.4	80.0
Weaning weight (lbs.)#.....	387.3	352.0
Final weight (lbs.)#.....	905.6	842.8
Daily gain on feed (lbs.)#.....	2.06	1.95
Weaning score (%).....	82.9	72.1
Slaughter grade".....	15.3	14.5
Carcass grade".....	16.0	15.5

*Individually fed

#Average

"Weighted average

TABLE XVII. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 STEERS DURING A 252 DAY FEEDING* PERIOD (1945-1946)

	Albert	Arthur	Alan	Calvin
Sire's name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Sire's number.....	4291	4346	4468	4434
Number of steers.....	8	8	8	7
Birth weight (lbs.)#.....	79.6	83.0	80.9	83.9
Weaning weight (lbs.)#.....	380.3	393.4	379.0	355.3
Final weight (lbs.)#.....	847.3	902.9	889.9	846.9
Daily gain on feed (lbs.)#.....	1.85	2.02	2.03	1.95
Weaning score (%).....	73.3	75.9	77.4	71.9
Slaughter grade".....	16.5	14.3	14.5	15.4
Carcass grade".....	16.3	13.5	15.3	16.3

Table XVII. Continued:

	L1C	L1A	L1B
Sire's name.....	<u>Domino 9</u>	<u>Domino 5</u>	<u>Domino 7</u>
Sire's number.....	4536	4108	4167
Number of steers.....	8	8	8
Birth weight (lbs.)#.....	79.5	72.6	80.3
Weaning weight (lbs.)#.....	386.3	343.1	420.6
Final weight (lbs.)#.....	836.5	797.3	919.9
Daily gain on feed (lbs.)#.....	1.79	1.80	1.98
Weaning score (%).....	75.6	68.0	78.9
Slaughter grade".....	15.5	13.3	12.3
Carcass grade".....	14.5	15.8	13.8

*Lot feeding

#Average

"Weighted average

TABLE XVIII. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 STEERS
DURING A 252 DAY FEEDING* PERIOD (1946-1947)

	Adams	Allbright	Albion	Comanche
Sire's name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Sire's number.....	4841	4880	5064	4879
Number of steers.....	8	5	6	7
Birth weight (lbs.)#.....	83.3	81.8	77.3	80.3
Weaning weight (lbs.)#.....	387.1	366.4	374.5	401.1
Final weight (lbs.)#.....	975.1	887.4	968.8	972.3
Daily gain on feed (lbs.)#.....	2.33	2.07	2.36	2.27
Weaning score (%).....	68.3	69.6	66.5	68.1
Slaughter grade".....	13.8	14.0	14.7	12.6
Carcass grade".....	12.3	11.2	11.7	11.1

Table XVIII. Continued:

	Clinton	Conner	LIC	LIC	Carrol
Sire's name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino 12</u>	<u>Domino 15</u>	<u>Domino</u>
Sire's number.....	4959	4979	4945	5061	4916
Number of steers.....	8	8	8	8	5
Birth weight (lbs.)#.....	85.9	78.9	78.8	87.6	90.6
Weaning weight (lbs.)#.....	391.4	382.0	370.5	413.9	416.6
Final weight (lbs.)#.....	990.9	977.4	935.8	1013.3	1016.2
Daily gain on feed (lbs.)#.....	2.38	2.36	2.24	2.38	2.38
Weaning score (%).....	69.3	66.3	61.8	71.9	68.6
Slaughter grade".....	14.8	13.3	14.5	12.8	15.2
Carcass grade".....	13.3	12.3	12.5	13.8	13.2

*Lot feeding

#Average

"Weighted average

TABLE XIX. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 STEERS
DURING A 252 DAY FEEDING* PERIOD (1947-1948)

	Alfred	Akron	Carson	Crescent
Sire's name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Sire's number.....	5354	5580	5281	5539
Number of steers.....	7	8	8	8
Birth weight (lbs.)#.....	79.3	82.5	87.1	85.6
Weaning weight (lbs.)#.....	408.4	403.9	414.6	382.0
Final weight (lbs.)#.....	928.7	968.4	987.3	944.4
Daily gain on feed (lbs.)#.....	2.06	2.24	2.27	2.23
Weaning score (%).....	74.9	73.1	75.1	72.0
Slaughter grade".....	16.0	13.8	14.8	15.5
Carcass grade".....	15.4	14.3	15.0	15.3

Table XIX. Continued:

	Apache	Archer	Astor	Acme
Sire's name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Sire's number.....	5322	5351	5360	5514
Number of steers.....	7	8	8	7
Birth weight (lbs.)#.....	91.1	82.8	77.6	85.3
Weaning weight (lbs.)#.....	406.0	377.0	388.9	381.9
Final weight (lbs.)#.....	957.0	932.6	952.5	876.3
Daily gain on feed (lbs.)#.....	2.19	2.20	2.24	1.96
Weaning score (%).....	73.6	71.1	72.4	72.3
Slaughter grade".....	14.3	15.5	15.0	17.1
Carcass grade".....	14.9	14.5	13.8	16.6

*Lot feeding

#Average

"Weighted average

TABLE XX. SUMMARY OF RESULTS, RECORD OF PERFORMANCE OF LINE 1 STEERS DURING A 252 DAY FEEDING* PERIOD (1948-1949)

	Cooper	Chester	Canyon	Coffee	Cotner
Sire's name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Sire's number.....	5907	5954	5995	6032	6039
Number of steers.....	8	7	6	7	8
Birth weight (lbs.)#.....	83.0	81.9	81.3	79.3	82.0
Weaning weight (lbs.)#.....	400.6	393.9	433.0	398.6	396.8
Final weight (lbs.)#.....	934.0	940.3	1004.2	965.4	965.8
Daily gain on feed (lbs.)#.....	2.12	2.17	2.27	2.25	2.26
Weaning score (%).....	75.6	76.1	78.12	73.0	75.4
Slaughter grade".....	17.5	14.9	14.7	15.4	14.8
Carcass grade".....	17.3	16.9	16.3	17.1	16.8

Table XX. Continued:

	Carr	Cobleigh	Cougar	Anzio	Aasheim
Sire's name.....	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>	<u>Domino</u>
Sire's number.....	6070	5644	5774	6075	6103
Number of steers.....	8	4	4	7	7
Birth weight (lbs.)#.....	73.1	80.5	81.5	92.1	80.9
Weaning weight (lbs.)#.....	373.8	493.0	459.5	463.6	422.4
Final weight (lbs.)#.....	892.6	1078.8	1039.8	1053.7	981.4
Daily gain on feed (lbs.)#.....	2.06	2.32	2.30	2.34	2.22
Weaning score (%).....	72.8	80.0	78.3	79.3	77.1
Slaughter grade".....	15.3	14.0	15.0	13.7	13.7
Carcass grade".....	17.5	16.5	16.5	17.1	17.1

*Individually fed

#Average

"Weighted average

DISCUSSION

Selection is probably the simplest and most widely used tool of the animal breeder to improve his stock. Most selection as used by the present day animal breeders, especially those breeding purebred beef cattle, is based on the conformation of the animal and little or none on the growth ability of the animal. Selection must eventually come to be based on economic values rather than beauty and symmetry as displayed by show ring conformation. The most important points to the commercial producer are weight for age, rapid and economical gains on feed, conformation that will at least command a reasonably high price per pound, and ability of the animal to stay on feed.

Inbreeding has been in ill-repute with nearly all breeders of beef cattle since almost the beginning of time. Some few breeders have used inbreeding successfully and most of the breeds of beef cattle were first purified by the use of inbreeding. It is well known among all breeders that inbreeding will purify the strain and thereby fix those characters which are desirable. At the same time, inbreeding also fixes those characteristics considered undesirable. As stated above, the Gudgell and Simpson herd at Independence, Mo. had one of the most intensely inbred herds in the country and as a result they produced nearly all of the great sires of the breed today. It is not known how much emphasis Gudgell and Simpson placed on some measures of performance but it is known that their show ring record was not as good as many other breeders at the same time.

Inbreeding combined with selection on economic value is a new step

in beef cattle breeding and Line 1 is probably unique in this respect at the present time. As the inbreeding progressed, the performance of the line has also improved but this is more due to rigorous culling and selection rather than any lack of regression due to inbreeding. In fact, to date the regression due to inbreeding has been quite low and with the high heritability of most of the growth measures the line can withstand a much higher rate of inbreeding without loss than it is possible to inbreed cattle. For example, it was found that the average regression of daily gain due to inbreeding was -0.002 pounds per day. The heritability of daily gain in the feed lot was reported by Knapp and Clark to be 65 per cent. The bulls selected each year have gained almost 0.2 pounds per day more than the average of all bulls fed. The line could therefore withstand inbreeding far in excess of the rate which it is possible to inbreed. L1B Domino 2nd had an average daily gain of 2.28, his son Chase Domino had a daily gain of 2.55 and his grandson L1 Domino 10th had a daily gain of 2.64. Thus, the second generation bull was .36 pounds per day better in daily gain than his grandsire. If it were possible to continue such rate of progress, the line could withstand approximately 50 per cent increase in inbreeding per generation. Such a rate of inbreeding is impossible in cattle.

SUMMARY

The foundation sires of Line 1 Herefords at the United States Range Livestock Experiment Station were Advance Domino 20th and Advance Domino 54th. These two bulls were bred to a group of registered Hereford cows at the Station. The original breeding program called for half-brother sister matings but due to such things as culling, selection, and death this plan could not be strictly adhered to.

The Line was started in 1936 and the inbreeding coefficient as of 1948 was found to be 15.95 per cent. If the original breeding program had been followed the expected inbreeding coefficient as of 1948 would have been approximately 22 per cent.

The coefficient of relationship to Advance Domino 20th was found to be 44 per cent and to Advance Domino 54th 27.1 per cent.

The average length of generation within the line was found to be 5.5 years.

L1B Domino 2nd proved to be the best bull ever used in Line 1. He produced many good sons the best of which was Chase Domino. Chase Domino had an excellent son in L1 Domino 10th and he is now the herd sire in subline 1A.

Clayton Domino produced a number of very good offspring.

There have been 161 Line 1 bulls tested up to 1948 and their average daily gain on feed was 2.03 pounds.

There have been 373 steer offspring of Line 1 bulls tested up to 1948 and their average daily gain on feed was 2.02 pounds.

The regression coefficient for the sire's birth weight on his steer

offspring's birth weight was found to be .129.

The regression coefficient for the sire's weaning weight on his steer offspring's weaning weight was found to be .309.

The regression coefficient for the sire's final weight on his steer offspring's final weight was found to be .511.

This study clearly indicates that when inbreeding is combined with selection based primarily on record of performance of bulls it is possible to increase productivity within a line of beef cattle.

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