RELATIONSHIP BETWEEN CERTAIN CONFORMATION TRAITS OF A SIRE AND THE CONFORMATION AND CARCASS CHARACTERISTICS OF HIS PROGENY

by

EUGENE ROSS

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Approved by:

Don L. Good

Major Professor

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INTRODUCTION

The beef cattleman is constantly striving to find a way to improve efficiency of production and quality of his product. A way is needed to objectively identify and produce lean, meaty type cattle which yield carcasses demanded by the trade, and at the same time, be practical, profitable, and efficient in production.

Ultrasonics and x-rays have been tried, but their practical use is yet to be established. Visual appraisal of animals at the market place and stock shows is made by trained men in an effort to identify the live animal that will yield a lean meaty high quality carcass. This method, although not perfect, is still the best and most commonly used in the industry. Indeed, the industry at all levels, i.e., producer, packer, processor, and consumer would benefit from a more objective measure that would aid in selecting breeding stock which would pass on to their progeny desired traits.

This study was conducted to determine if live characteristics of a bull can be used to predict the live and carcass characteristics of his progeny. In addition, certain live characteristics of the progeny were studied to determine if they can be used to predict the carcass characteristics of that animal.

REVIEW OF LITERATURE

Several methods of evaluating sires have been proposed. Lush (1922) stated that no score card or standard based on conformation could ever be so accurate that the future performance of individual steers could successfully be predicted from it. Lush (1932) further stated that steers which gain the same may be of many different shapes. The most important measurements for indicating high dressing percent and meat carcass value are a large heart girth in connection with a shallow chest, a wide loin and large flank girth, a large initial weight, small paunch girth, head narrow at the eyes, and short height over hips.

However Lush (1932) found that meat value per steer was correlated with body length (.75), chest depth (.71), width at the eyes (.68), flank girth (.78), heart girth (.84), paunch girth (.72), width of loin (.72), width of chest (.62), cannon circumference (.81), width at thurls (.77) and width at hooks (.82).

Black _et al._ (1936) collected data on 14 beef Shorthorn calves, 32 Milking Shorthorn calves, 20 Hereford calves and 6 dairy-bred calves which had been weaned at a constant age (252 days) and slaughtered at a constant weight. A study of the correlations shows that weaning weight is negatively correlated (-.62) with fatness, and positively correlated (.66) with pounds of carcass per 100 pounds of total digestible nutrients. Average daily gain from birth to weaning is negatively correlated from weaning to slaughter (-.36). Gains from birth to weaning were highly correlated with the pounds of milk received during that period. (Correlation coefficient not given). Feeder grade was highly correlated (.73) to percent edible carcass. Slaughter grade and carcass grade were highly correlated to the percent edible meat with correlation coefficients of .81 and .82, respectively.

However, Knapp _et al._ (1939) concluded that scoring as a technique of evaluation of differences of animals is subject to considerable error and its value is probably very doubtful when the differences between animals is very small. But when the population to be studied shows large differences, the scoring technique is undoubtedly the simplest way to evaluate differences in conformation. Knapp et al. (1939) further concluded that slaughter tests used in their experiment repeatedly showed material differences between the progeny of two bulls, yet scores and grades failed to show real differences.

Black et al. (1938) using 50 head of steers of beef, dual purpose, and dairy breeds, found that height at withers (with weight nearly constant) was one of the best measures of performance, although length of body had a higher correlation with efficiency of gain and average daily gain than did the height at withers. Black et al. (1938) also found that efficiency of gain is correlated with width of shoulder (.45), ratio of body weight to height (.44) and slaughter grade (.50). Percentage of fat in the carcass was found to be correlated with width of shoulder (.41), width of chest (.58), ratio of heart girth to height (.76), and slaughter grade (.82). Percentage of total edible meat was correlated with width of shoulder (.44), width of chest (.58), ratio of heart girth to height (.76) and slaughter grade (.83). Slaughter grade was correlated with heart girth (.39), width of shoulder (.61), width of chest (.66), and ratio of heart girth to height (.82).

Hankins et al. (1943) made a study of the muscle-bone ratio in 135 steers, 55 of which were beef Shorthorns and 80 were dual-purpose Shorthorns. They found no significant correlation within type between muscle-bone ratio and percent of separable fat in the carcass. In addition, Hankins et al. (1943) found no close relationship between live animal measurements and the muscle bone ratio, indicating that selection could not be effectively made on the basis of conformation as evaluated by such measurements.

Again Knapp (1946) using data on the performance of approximately 600 steers from 70 different Hereford sires indicated that growth and efficiency were highly heritable. Live animal scores, grades, and certain carcass characteristics were less heritable than growth and efficiency. Knapp (1946) concluded there was ample opportunity for further selection in these traits. Dressing percentage was found to be only slightly heritable; whereas gain in the feed lot was approximately 85 percent heritable. Heritability of gain in the feed lot increased as the feeding period progressed. According to Knapp (1946), since post-weaning growth rate was estimated to be 80 to 95 percent heritable, the unbiased comparative feeding of prospective herd bulls after weaning is to be recommended. Knapp (1946) further suggested that selection for conformation points may be done at two or three different times in the animal's life.

Knapp and Nordskog (1946) continued the study of beef cattle performance and used 177 steer calves from 23 sires at the U. S. Range Livestock Experiment Station, Miles City, Montana, to estimate hereditary effects on weights, gains, and efficiency of gain. Two methods were used, namely: the intra-sire correlation obtained by analysis of variance and the progeny on sire regression obtained by covariance analysis.

Heritability obtained from intra-sire correlations for the various weights and gains were: birth weight, 23 percent; weaning weight, 12 percent; final feed lot weight, 81 percent; gain in the feedlot, 99 percent; and efficiency of gain, 75 percent. Heritabilities obtained from progeny: sire regressions were: birth weight, 42 percent; weaning weight 0 percent; final weight 69 percent; daily gain, 46 percent; and efficiency of gain, 54 percent. When adjustments were made for yearly differences in feeding of the sires, heritability was estimated to be 34 percent for birth weight, 30 percent for weaning weight, 94 percent for final weight, 97 percent for daily gain, and 48 percent for efficiency of gain. The authors pointed out that the estimate of heritability seemed higher than reasonable and the cause or causes of these high estimates were not known.

In addition Knapp and Nordskog (1946) made further measurements of heredity using the same animals as those used for the previous study on weight and gains. In this study, heritability was estimated by the use of the paternal half-sib correlation from analysis of variance and in addition from the sire: offspring regression in the case of score at weaning.

Heritabilities obtained by intra-sire correlations for the characteristics studied were: score at weaning 53 percent, slaughter grade 63 percent, carcass grade 84 percent, dressing percentage 1 percent, and area of eye muscle 69 percent. It was concluded by Knapp and Nordskog (1946) that though heritability of the measures of quality of the carcass appears to be lower than the measures of growth, there is ample opportunity for selection for these quality characteristics.

Ray and Gifford (1949) studied the possibilities of classifying animals during a lifetime when evaluated by a fixed standard for type and body conformation. Seven groups--Excellent, Very Good, Good Plus, Good, Good Minus, Fair and Poor were used with the "Good" group representing the average of the breed. In a period between 1940 and 1949, 239 different animals in the Arkansas Station herd were rated semi-annually. Eight different judges made classifications. Ratings were made on general appearance, breed type, head and neck, forequarters, body, hind quarters, disposition and overall classification. Analysis of the 2886 classifications indicated close agreement between judges on the Final Classification given individual animals.

(Correlations ranged from .68 to .97). The authors concluded that high repeatability of ratings given individual animals indicated that (1) the same standard was used during all stages of development, (2) most animals remained in or near the same classification during lifetime and (3) seasonal differences in condition or finish had little influence on classification ratings.

Patterson et al. (1949) studied performance-testing and progeny-testing of beef breeding stock as an aid to selection. Six to ten young progeny per sire were fed the same growing ration under similar conditions. Records taken were initial and final weights, body type, and certain body measurements on 814 young bulls and 104 heifers during the seven years. The intra-year half-sib correlation of gain for bulls was +.26 while that for heifers was +.30. Patterson et al. (1949) concluded that this experiment indicated that the ability for rapid gain is highly heritable. Selection based upon performance of the individual should thus prove effective in improving rate of gain in beef cattle. Practically no relationship existed between type score and gain (r = .04). The correlation between initial grade and initial weight was -.24, while initial grade and final grade were fairly highly correlated (r = +.72).

Revised heritability estimates based on the progeny of 64 to 110 Hereford sires, calculated by Knapp and Clark (1950) at the U. S. Range Livestock Experiment Station, Miles City, Montana, from half-sib correlations were: birth weight, 53; weaning weight, 28; final feed lot weight at 15 months, 86; gain on feed, 65; weaning score, 28; slaughter steer grade, 45; carcass grade, 33; and area of eye muscle, 68 percent. Estimates based on sire: offspring regression were 92 percent for final weight at 15 months and

77 percent for rate of gain in the feed lot. Lower fudical limits of heritability (P .01) based on the half-sib correlation method were: birth weight, 26; weaning weight, 7; final weight, 54; gain in the feed lot, 37; weaning score, 4; slaughter grade, 19; carcass grade, 10; and area of eye muscle, 31 percent. According to Knapp and Clark (1950), these figures indicated a relatively large influence of heredity on growth after weaning. Growth measures were more highly influenced by heredity than were measures of quality and conformation. Woodward and Clark (1950) conducted a study to determine whether the relative performances of sires would be similar when bred to different cows and in herds subjected to different environmental conditions and management procedures. The steer progenies of eleven bulls, the dams of which were randomly selected from balanced age-groups, (each bull was placed in a pasture with only the cows assigned to his herd), were fed out at the Miles City Station one year and at the Branch Station at Harve the next. There was no significant difference in the birth weights between calves sired at Miles City and calves sired at Harve, but there was a significant difference between sire groups. Variation in environmental conditions, as expected, affected rate of gain, but sires producing fast gaining calves at one station tended to do the same at the other station. There was no significant difference between stations in average daily gains in the feed lot. There was a significant difference between sire groups and a sire X station interaction. Hence, some of the sire groups made fast gains at Bozeman, where this one group was fed, and slow gains at Miles City. With other sire groups, the reverse was true.

Willey _et al._ (1951) stated that "regular" type steers made more total and daily feed lot gains than "compress" steers. The "regular" type calves were taller at the shoulders, longer of body, greater in depth of chest, and greater in distance from chest floor to ground than were the "compress". There was a slight, but non-significant, difference in efficiency of feed utilization in favor of "regular" type calves. Of the percentage of wholesale cuts studied, only the shank was significantly different. The percentage of this cut from the regular type steers was greater. Stonaker et al. (1952) made a similar study and found that the comprest steers, when individually fed to low choice slaughter grade, gained as efficiently as conventional-type steers. The conventional-type steers, according to Stonaker, et al. (1952) ate more, gained more per day, and reached the slaughter grade of low choice weighing about 20 percent more than the comprest steers. Differences in rate of gain and slaughter weights were highly significant. Dressing percentages were consistently and significantly different. Conventional-type steers dressed 1 percent higher. Comprest-type steer carcasses were graded the same on finish but about 20 percent higher on compactness. The comprest carcasses weighed, on the average, 394 pounds; whereas the conventional-type carcasses averaged 498 pounds. The percentages of major cuts in the carcasses of the two types were similar.

Gifford et al. (1951) using four judges, studied the possibilities of using classification on Hereford cows. Numerical values on a score card were used by the judges. They were: 100-90, Excellent; 90-80, Very Good; 80-70, Good Plus; 70-60, Good; 60-50, Good Minus; 50-40, Fair; 40-30, Poor. Good was designated to represent the breed average. Within-season correlations indicated that judges were in general agreement on the points of conformation scored. Judges seemed to agree more closely for items on which they must consider the entire animal. The correlations between repeated scores of a cow by the same judge were generally between 0.4 and 0.5 using this method of classification. According to Gifford et al. (1951), significant differences among the judges existed, but they were of minor importance in determining the total variance in conformation scores.

Koch (1951) indicated that repeatability of cow production is high enough to permit reasonably accurate selection of cows for high life-time production on the basis of the first calf weaned. Seven-hundred forty-five Hereford calves from 180 Line I cows which calved at the Miles City Station during the period 1938-1948 were used in this experiment. The extent to which the weaning weight of calves is a permanent characteristic of range Hereford cows, as determined from this study, is 0.52, according to Koch.

Using data from 620 weaning weights and 620 birth weights of calves at the Stillwater, Oklahoma Station and the weaning and birth weight of 98 calves from the Fort Reno, Oklahoma Station, Botkin and Whatley (1953) concluded that considerable progress can be made in selecting the most productive cows on the basis of their first records, particularly by using weaning weights. Estimates of repeatability in this work were as follows: for weaning weight 0.43 and 0.49, for birth weight 0.18 and 0.14, and for gain from birth to weaning 0.38. Correlations between first and second records for all three traits were determined for the group of cows at Fort Reno. Correlations were as follows: for weaning weight, 0.66, for birth weight, 0.25, and for gain from birth to weaning, 0.69.

Kincaid, et al. (1952) found that average estimates of heritability of rate of gain from the progeny of fast and slow gaining bulls in a three-year study for steers and heifers was 22 and 12 percent, respectively. The progeny feeding tests included 15 (steers) in 1949-50, 30 steers in 1950-51, and 36 steers in 1951-52. The heifer progenies with completed tests on pasture, 16 in 1950 and 39 in 1951 gave respective estimates of 0 and 20 percent.

Koger and Knox (1952) using weaning scores from 715 Angus calves and their dams obtained the following heritability estimates for scores on grade and type, based on within-year regressions of offspring on dam and half-sib correlations: overall weaning score, 50 and 30 percent; low-set score, 46 and 13 percent; thickness score, 15 and 10 percent; and smoothness score, 15 and 18 percent. The analysis of records from 1,257 range Hereford calves and their dams resulted in heritability estimates for grade of 24 and 23 percent, based on half-sib correlation and intra-sire regression of off-spring on dam, respectively.

Yao et al. (1953), as a result of studying data from 101 beef Shorthorn steers and 62 Milking Shorthorn steers, stated that circumference measurements were positively correlated with slaughter grade, carcass grade, and dressing percentage. But, height and length measurements were negatively correlated with slaughter grade. Measurements of head width and circumference were negatively correlated with average daily gain.

Dawson et al. (1955), using data from 58 Milking Shorthorn steers, 1943 through 1949, found that slaughter grade, carcass grade, and dressing percentage had a heritability estimate of 58, 66, and 69 percent respectively. Estimates of heritability of nineteen body measurements, including height at withers, width between the eyes, width of muzzle and depth of chest ranged from 40.1 to 65.5 percent. Heritability estimates for height at chest floor, height at flank, circumference at foreflank, circumference of shin bone, and all the width measurements except width at shoulder ranged from 4.5 to 33.5

percent.

Rollins and Wagner (1956) studying two separate experimental range herds, found the average heritability of weaning grade to be 36 percent.

Kidwell and McCormick (1956) stated that at a given weight or age, animals of larger mature size will gain more rapidly on less feed than animals of smaller mature size. Further, carcasses of larger animals will contain a higher proportion of bone and muscle, and lower proportion of fat.

Kidwell et al. (1957) concluded that there is no real relation between feeder grade and rate or economy of gain. There is a positive relation of both feeder and slaughter grade with dressing percent and percent fat in the 9-10-11 rib. There is a negative relation between these two grades and percent bone and muscle in the 9-10-11 rib. Feeder grade is only slightly related to the percent of various wholesale cuts. There is no significant relation between slaughter score and rate of gain. Slaughter score is related to carcass score, dressing percent and percent bone, muscle, and fat in the 9-10-11 rib. There is a low but real relation between slaughter score and percent of wholesale cuts. These results tend to support and extend those of previous investigators according to Kidwell et al. (1957).

Shelby et al. (1954) using data collected during 10 years (1941-1952), consisting of records of 635 steers from grade beef cows mated to 88 sires from nine lines, resulted in the following estimates of heritability: birth weight, 71.6 percent; weaning weight, 22.8 percent; gain in the feedlot, 60.4 percent; final weight at the end of the feedlot period, 84.0 percent; efficiency of feed utilization, 21.8 percent; slaughter grade, 42.1 percent, shrink, 91.4 percent; dressing percentage, 72.7 percent; carcass grade, 16.4 percent; color of eye muscle, 31.2 percent; area of eye muscle, 71.5

percent; and thickness of fat, 37.7 percent.

Koch and Clark (1955), using data from 4553 calves stated that heritability and repeatability (measured as permanent characteristics of the cow) estimates were (heritability first and repeatability second) .35 and .26 for birth weight, .24 and .34 for weaning weight, .21 and .34 for gain from birth to weaning, .18 and .22 for weaning score, .47 and .20 for yearling weight, .39 and .09 for gain from weaning to yearling age, and .27 and .02 for yearling score.

Koch and Clark (1955) analyzed records on 4234 dam-offspring pairs in 85 sire-offspring groups, and concluded that heritability estimates calculated from the regression of offspring on dam and progeny average on sire were .44 and .35 for birth weight, .11 and .25 for weaning weight, .07 and .17 for gain from birth to weaning, .16 and .15 for weaning score, .43 (offspring-dam) for fall yearling weight, .18 for gain from weaning to fall yearling age, and .14 for fall yearling score.

Kieffer et al. (1958) using data on 60 Angus steers and heifers produced by 7 different sires with 6 to 14 animals per sire group, stated the heritability of rib eye area was 0.56. The correlation between rib eye area and carcass weight was 0.52. Significant sire differences were found for carcass grade, slaughter grade, marbling score, and percent bone of the 9-10-11 ribs.

Krehbiel et al. (1958) using annual records of evaluation of type by scorecard in a small purebred Aberdeen-Angus herd consisting of 9 sires, 40 foundation females, and 175 female offspring, produced between 1941 and 1957, stated that selecting for type on the basis of a scorecard was effective in improving the type of a herd. In this experiment, estimates of heritability of type were 0.33 from regression of offspring on midparent, 0.77 for intra-sire regression of offspring on dam and 0.24 for regression of offspring on sire.

Gaines et al. (1958) found that heritability estimates for TDN/cwt. of gain in beef cattle that were full fed were 0.17 in steers and 0.63 in bulls. The data were from 276 bulls and 152 steers individually fed; the bull records covered a ten-year and steer records a six-year period.

Orme et al. (1958) found that relationships between subjective live animal scores and comparable live animal measurements were quite low in most cases; whereas, such items as rib eye area, fat thickness at 12th rib and dressing percentage were highly significant. Such live animal measurements as circumference of fore and hind flank, circumference of middle, circumference of round above the hock; width of rump, and live weight were all significantly related to ribeye area. When live weight was held constant, standard partial regression coefficients of .89, .57, .58 and -.57 were obtained for circumference of fore and hind flank, circumference of middle and circumference of the leg above the hock, respectively. Thirty-one steers were included in this study.

Follis et al. (1959) stated that the ratio of weight to height and the ratio of weight to length were correlated with dressing percentage, area of rib eye and edible portion. In both steer and heifer data, the two ratios were positively correlated with rib eye area (steers, .52 for the ratio of weight to height and .51 for weight to length and for heifers the correlations were .39 for the ratio of weight to height and .45 for the ratio of weight to length), and negatively correlated with edible portion (for steers the correlations were -.45 for the ratio of weight to height and -.43 for the ratio of weight to length and for heifers these correlations were -.52 and -.48 respectively). These ratios were significantly correlated, .37 and .37 respectively, with dressing percentage in steers but not in heifers.

Carter and Kincaid (1959) estimated heritability of important economic traits in beef cattle by using records on 424 calves, the progeny of 38 sires raised over a six-year period at the Virginia Station. The following estimates were obtained from paternal half-sib correlations, involving the steers: weight at 6 months, 0.08; feeder grade, 0.41; daily gain in feedlot, 0.38; feed efficiency, 0.99; slaughter grade, 0.45; and carcass grade, 0.16. For the heifers these were: weight at 6 months, 0.60; feeder grade, 0.51; daily gain on pasture, 0.54; and, yearling feeder grade, 0.17. Heritability estimates calculated from regression of progeny averages on the sire's records were, for the steers: feeder grade, 0.16; daily gain in feed lot, 0.21; feed efficiency, 0.22; slaughter grade, 0.07; and, for the heifers the estimates were: feeder grade, 0.63; daily gain on pasture, 0.20. Estimates calculated from intra-sire regression of offspring on dam were, for the steers: feeder grade, 0.07; daily gain, 0.40; and, for the heifers they were: feeder grade, zero; daily gain on pasture, 0.57; and, yearling feeder grade, 0.32.

Kieffer _et al._ (1959) concluded that intra-herd, intra-sire regression of the records of contemporary daughters on the records of contemporary dams when pooled over all herds yielded heritability estimates of 0.40, 0.32, and zero for maternal effects on birth weight, weaning weight, and weaning score, respectively. Estimates of heritability from paternal half-sib correlations were 0.60, 0.39, and 0.04 for maternal effects on birth weight, weaning weight, and condition score, respectively.

Orts and King (1959) stated that muscle and bone had a definite relationship. Sixty-six Hereford steers were divided into age groups and simple and partial correlation coefficients were calculated between length, weight, area and weight-length ratio of the metacarpus and metatarsus bones. Bone weight and weight-length ratio were found to be more highly correlated to wholesale cut weights (0.87 and 0.88), ribeye area (0.80 and 0.80) and chilled carcass weight (0.950 and 0.867) than length and area. However, length and area had a positive significant relationship to all wholesale cut weights (0.70 and 0.67), ribeye area (0.63 and 0.70) and chilled carcass weight (0.70 and 0.69).

Shelby et al. (1960) using records for 542 bull calves tested in record-of-performance tests at the U. S. Range Livestock Experiment Station, Miles City, Montana, from 1940-1954, stated that heritability estimates by paternal half-sib correlations were: gain in the feed lot 0.46; final weight (13 months), 0.77; adjusted final weight, 0.55; and efficiency of feed utilization, 0.32. Weight at 13 months appeared to be the most valuable criterion for selection, concludes Shelby et al. (1960).

Taylor et al. (1960) stated that the repeatability of cow performance was 0.18 for birth weight, 0.30 for gain from birth to weaning, and 0.27 for weaning grade for cows used at the Virginia Station. At the Front Royal (Virginia) Station repeatability estimates were 0.30 for birth weight, 0.41 for gain from birth to midsummer, 0.32 for midsummer grade, 0.42 for gain from birth to weaning, and 0.23 for grade at weaning.

Magee et al. (1960) concluded that the correlation between loin eye area and percent round and loin on a carcass basis was: -.53 for steers, -.86 for bulls born in 1959 and 0.17 for bulls born in 1960. Carcass weight had a consistent effect on percent round and loin. The correlations between these two traits were -.37, -.50, and -.59 for the three groups, respectively. In the 1960 group of bulls the correlations between loin eye and percent round and percent loin, independent of the effect of carcass weight, were .50 and -.14, respectively. The correlation between percent round and percent loin was -.23. The correlations between left and right side for percent loin, round and hind quarter were 0.47, 0.77, and 0.78, respectively. Five bulls were tested in 1959 and 12 bulls were tested in 1960. The steers were slaughtered at an average weight of about 900 pounds.

Minyard and Dinkel (1960) using records of 2351 calves representing 120 sires collected from 1951 through 1957 in 20 purebred Hereford and Angus herds, stated that heritability of weaning weight, estimated within ranch-year subclasses by the paternal half-sib correlation method was 0.32 with fiducial limits of 0.21 and 0.47.

Backus et al. (1960) using data for 293 steers concluded that average ribeye width was highly significantly correlated with ribeye area; and the correlations ranged from 0.54 to 0.88. The lower and upper values for correlations between the average ribeye width and the circumference of the round were 0.25 to 0.44. Thickness of fat over the 12th rib was significantly correlated with carcass grade, but the relationship approached zero when correlated with all other measurements. Rate of gain during the feeding test was highly correlated with carcass length (0.45). Length of carcass and length of leg were highly significantly correlated with length of loin, circumference of the round, width of chest, depth of chest at both the fifth and seventh rib, average ribeye width, ribeye length, ribeye area, and width of round. Correlations of length of loin with circumference of round, width of chest, average ribeye width, and ribeye area were low, whereas higher correlations were found between depth of chest at the fifth and seventh rib and width of round. Circumference of round was highly significantly correlated with width and depth of chest, average ribeye width, ribeye length, ribeye area and width of round. Depth of chest at fifth and seventh rib was highly significantly correlated with ribeye area.

Wythe et al. (1961) stated that there is a definite relationship between bone and muscle. Using 28 yearling Hereford steers, fed for 215 days, with an average weight of 919 pounds at slaughter, Wythe et al. (1961) found that the sum of the weights of the loin, rib, round, and rump had a simple correlation coefficient to the trimmed weight of the metacarpus and tibia of .63 and .74, respectively. The sum of the weights of the "retail trimmed" chuck, rib, and loin had a simple correlation coefficient to the trimmed weight of the metacarpus and tibia of .69 and .78, respectively. The area of the ribeye had a simple correlation coefficient to the trimmed weight of the metacarpus and tibia of .65 and .69, respectively.

Wheat and Holland (1960) working with 688 cattle, found a correlation of 0.22 between live grade and carcass grade after ribbing and 0.89 between marbling and carcass grade. They found a high correlation (0.56) between live grade and carcass conformation.

Good et al. (1961) studied live animal and carcass traits of steers at the International Livestock Exposition in 1956-1957-1958. The following live animal traits were significantly negatively correlated with fat cover at the 12th rib: width between the eyes (pooled, -.11), width of muzzle (pooled, -.23), circumference of round (pooled, -.19) and circumference of cannon (pooled, -.34). According to Good et al. (1961) this indicates that broad-headed, heavy boned cattle with large rounds are desirable as such animals tend to have less fat and more lean.

The following measurements were significantly correlated with the area of loin eye: muscling score (pooled, 0.11), circumference of round (pooled, 0.16), and circumference of cannon (pooled, 0.13), according to Good _et al._ (1961).

Gregory and Stewart (1962) stated that 154-day postweaning feedlot gains of bulls gave a higher predictive value of the performance of the progeny than 182-day weights. Twenty-nine bulls were compared, in a six-year period ending in 1956, with the 182-day weights and grades and 18 months weights and grades of their progeny. Gregory and Stewart (1962) further concluded that ten progeny are needed to adequately test a bull. Five progeny gave about the same information as the 154-day post-weaning feedlot performance of a bull himself based on the heritability estimate of 0.14 on 18 months weight of the progeny. Other heritability estimates obtained were 182-day weights 0.54, 182-day grades 0.23, and 18-months grades 0.0. These heritability estimates were obtained from 425 cows representing 29 sire-offspring groups.

Christian _et al._ (1962) using 176 Angus calves by 24 sires during a three-year period, stated that heritability based on paternal half-sib correlations for slaughter weight, average daily gain, dressing percent and slaughter grade were 100, 88, 74, and 49 percent respectively. Carcass heritability estimates for weight, grade, conformation, fat thickness, and loin eye area were 96, 78, 29, 38, and 76 percent, respectively. Heritability estimates of percent of round, chuck, loin, and rib on a live weight basis were 46, 60, 46 and 30 percent, respectively. In the rib section the percent of lean, fat, and bone yielded heritability estimates of 30, 31, and

41 percent, respectively.

MATERIALS AND METHODS

Data from 137 cows, 4 bulls, and 133 calves from the Jim Houghton and Son Hereford Ranch near Tipton, Kansas, were used in this study. The cows were good commercial Hereford cows of medium size and beefiness.

Two of the bulls used in this study were registered Hereford bulls from the Nebraska Breeders Service at Fremont, Nebraska. They were N. U. Jupitors Esquire, H. H. 73, and E. L. Bocaldo, H. H. 74. Their weights were 2090 and 1900 pounds, respectively and each bull's overall type score was 83. The Angus Association's herd classification report form was used in scoring the bulls. An example of the classification report is found in Table 8 in the Appendix.

The cows were artifically inseminated to the two bulls from the Nebraska Breeders Service. This was accomplished with the cooperation of the Kansas Artificial Breeders Service Unit and the Mitchell County Extension Service. The artificial breeding period included 27 days, after which, two "clean-up" bulls were turned with the cows. No scores were obtained on the "clean-up" bulls, as they were sold and not available for scoring.

Eight steers and ten heifers that were used in this study were sired by H. H. 73; twenty-four steers and nineteen heifers were sired by H. H. 74;; and thirty-eight steers and thirty-four heifers were sired by the "clean-up" bulls. Since the two "clean-up" bulls were with the cows at the same time it was impossible to identify each bull's progeny. The progeny of the two bulls make up the third sire group.

The calves were scored at weaning, September 13, 1961, by Mr. V. E.

McAdams and Dr. Don Good. The scoring procedure is found in Table 9 in the Appendix.

All scoring was done on the ranch, using the Houghton facilities and under ordinary ranch conditions.

The weaning weights of the calves were adjusted to 210 day weights. The adjusted weight schedule was compiled by Professor Walter Smith of Kansas State University. A copy of the schedule can be found in Table 10 in the Appendix.

The steer calves were wintered on a ration containing 1 pound of 41 percent protein, approximately 6 pounds of sorghum grain, and all the sorghum silage they would eat. The heifers were wintered on a ration with less energy. The heifers ration consisted of 4 pounds of alfalfa hay and all the sorghum silage they would eat.

The cows were scored on pasture June 18, 1962 by using the scoring system followed in the Herd Classification Program of the American Angus Association shown in Table 8 in the Appendix.

The same scoring system was used for the animals during the weaning and wintering phases. It is shown in the Appendix. A numerical score was used to represent the grades, i.e., fancy +,16; fancy,15; fancy -,14: choice +,13; choice, 12; choice -11; good +, 10; good -,9: and good -,8. None of the calves graded below good -. The muscling, bone, gaining ability, and condition scores were graduated from 0 to 6, the higher value indicating the more desirable condition.

On April 24, 1962, the calves had completed the wintering phase and were scored by Dr. Don Good and the writer.

At the completion of the wintering phase, April 24, 1962, 66 steers were put on a self-feeder containing a high energy ration. The steers were self-fed grain sorghum, 20 per cent cottonseed hulls, and approximately 1.5 pounds of 41 percent protein per head per day. The heifers not kept as replacements were sold. On August 16, the end of the full feeding period, the steers were individually graded and classified. The scoring system used was a combination of the weaning-wintering phase scoring system and the one used for the cows and bulls, shown in the Appendix in Table 11. In addition, live yield grade and slaughter grade were estimated for the finished cattle. The scoring was done by Dr. Don Good and the writer.

A slaughter price was placed on each steer by Mr. Kennth Jakeman (cattle buyer) for Maurer-Neuer Packing Company at Kansas City, Missouri. Individual weights were taken on the cattle at the ranch. The steers were then shipped approximately 227 miles to the Kansas City market on August 16. At 7:00 a.m. the following morning in Kansas City the steers were individually weighed, and were slaughtered at 9:30 a.m. Circumference of the cannon and forearm was measured and hide and hot carcass weights were taken.

On August 18 the carcasses were ribbed, and then graded and scored for various carcass traits by a federal grader. Five wholesale cuts, namely, rib, loin, chuck, round, and shank were tagged from 32 randomly selected carcasses, 8 from sire group 1, 13 from sire group 2, and 11 from sire group 3 (the steers by the two "clean-up" bulls).

After a 24 hour chill cold carcass weights were obtained and tracings of the cross-sectional area of the longissimus dorsi and fat cover at the 12th rib were made on acetate paper. Area of the loin eye muscle was determined from the tracings with a compensating polar planimeter. Fat depth over the 12th rib was measured at three sites, averaged and recorded to the nearest tenth of an inch. These measurements were obtained as described by

Naumann (1952) at the Fifth Annual Reciprocal Meat Conference.

Traits scored by the federal grader included distribution of finish, percent kidney fat, degree of marbling, degree of firmness, conformation, lean color, degree of maturity, quality grade and yield grade. Four circumference measurements were taken on the round; at 40, 50, 60, and 70 percent of the distance between the base of the aitch bone and the base of the hock.

On August 20 after a 72-hour chill, all 66 carcasses were regraded by the federal grader and scored for the previously listed carcass quality traits. Weights were obtained on the 32 randomly selected carcasses which were then broken down into the wholesale cuts and weights were obtained for the untrimmed and trimmed round, rib, loin, and chuck. In addition, weights were also taken on the amount of fat trimmed from the round, rib, loin, and chuck.

CORRELATION ANALYSIS

An overall comparison of the records of offspring within the three sire groups is possible by studying the means and range for each sire group (Table 1). The maximum scores for various traits were also recorded where applicable.

Weaning weights for the calves, grouped by sires, varied from 416 to 502 pounds in favor of the first sire group. There were no large differences among sire groups in weaning muscling scores. The largest and most significant difference among the progeny groups at weaning was that among weaning grades. The average weaning grades varied from 11.2 to 10.6 with the sire groups ranking 2, 1, and 3, respectively (a score of 11 means a grade of

Table 1. The mean of certain live and slaughter characteristics studied.

	Maximum Score	Sire Group 1 (H.H. 73)		Sire Group 2 (H.H. 74)		Sire Group 3 ("clean-up" bulls)	
		Mean	Range	Mean	Range	Mean	Range
Weaning Characteristics							
Age at weaning (days)		229	215-249	227	210-246	197	157-218
Weaning weight		502	400-585	482	390-595	416	285-530
Adjusted weaning weight		506	417-608	484	390-561	470	337-564
Weaning grade	16	10.7	9-13	11.2	8-13	10.6	8-13
Forearm muscling	6	3.4	3-5	3.5	2-5	3.6	2-5
Muscling over top	6	3.8	3-5	3.8	2-5	3.5	2-5
Muscling in round	6	3.4	2-5	3.4	2-6	3.8	2-5
Bone	6	3.1	2-5	3.0	2-5	2.8	1-5
Chest capacity	6	3.6	2-5	3.9	2-5	3.7	2-6
Middle capacity	6	4.6	4-6	4.6	3-6	4.3	3-6
Head and bone	6	3.4	2-5	4.0	2-6	3.7	1-6
Condition	6	4.3	3-5	4.5	3-6	4.0	2-5
Post-winter Characteristics							
Feeder grade	16	11.1	9-13	11.6	9-13	10.9	8-13
Post-winter weight		764	600-980	707	515-950	631	475-890
Winter gain		251	140-450	245	70-350	227	75-415
Forearm muscling	6	3.4	2-4	3.4	2-4	3.1	2-4
Muscling over top	6	3.5	2-4	3.9	2-5	3.4	2-4
Muscling in round	6	3.1	2-5	3.5	2-5	3.0	2-5
Bone	6	3.2	2-4	3.1	2-5	2.8	2-4
Chest capacity	6	3.7	3-5	2.9	3-5	3.4	2-4
Middle capacity	6	4.2	3-5	4.2	3-5	3.8	2-5
Head and bone	6	3.5	2-5	3.8	2-5	3.7	2-6
Condition	6	3.6	2-5	3.6	2-6	2.8	2-5

Table 1 (concl.)

	Maximum Score	Sire Group 1 (H.H. 73)		Sire Group 2 (H.H. 74)		Sire Group 3 ("clean-up bulls")	
		Mean	Range	Mean	Range	Mean	Range
Live Slaughter Characteristics							
Yield grade	6	2.6	2-3	2.4	2-4	2.5	2-4
Slaughter grade	16	11.9	9-13	11.6	10-13	10.9	9-13
Forearm muscling	6	4.3	3-5	3.8	3-5	3.7	3-5
Muscling on top	6	3.9	2-6	4.4	3-5	3.7	3-5
Muscling in round	6	4.5	3-5	4.4	3-6	3.7	2-5
Bone	6	3.4	3-4	3.0	2-4	3.2	2-4
Condition	6	5.6	4-6	5.2	4-6	4.6	3-6
Type	14	10.9	9-13	11.0	9-13	10.4	9-13
Size	10	10.0	9-10	9.3	8-10	8.9	8-10
Quality	6	4.5	4-5	4.9	4-6	4.7	4-6
Shoulder and chest	8	6.0	5-7	6.5	5-7	6.0	5-7
Head and neck	8	6.2	6-7	6.4	5-7	6.1	5-7
Weight at the ranch		1140#	990-1285#	1052#	905-1195#	1022#	930-1155#
Shrink		57.5#	45-65#	50.9#	35-65#	47#	25-70#
Price		$27.09	$25-$28	$27.28	$26.25-$28	$26.85	$25.75-$27.75
Hide weight		95.1#	84-109#	89.9#	73-98#	87.8#	71.5-112#
Full feed gain		264#	210-325#	242#	165-305#	264#	190-345#
Average daily gain		2.3#	1.84-2.85#	2.1	1.45-2.68	2.3#	1.67-3.03
Carcass Characteristics							
Marbling score(24 hr.chill)	36	10.3	8-13	11.8	9-15	11.3	9-15
Area of ribeye (sq.in.)		11.5	9.1-13.3	10.6	9.1-12.5	10.2	8.1-12.3
Circumference of cannon		16.3	15.7-17.1	15.7	14.9-16.7	15.7	14.4-16.6
Circumference of forearm		33.5	32.1-34.7	32.4	30.4-34.5	31.6	30.2-33.9
Circumference of round (sum of 4 measurements)		128	120.1-130.1	124	114.7-132.7	119	109.8-127.3
Conformation	24	195	18-21	19.3	18-21	19.1	18-20
Yield grade	6	2.6	2-3	2.8	2-3	2.7	2-3
Quality grade(24 hr.chill)	24	15.9	15-17	16.8	16-18	16.7	16-18
Chilled carcass wt.(72 hr.)		627#	545-749#	620#	589-716#	596#	498-679#

choice minus).

The variation in some of the scores incresed in the post-wintering phase. This was especially true for muscling over the top, forearm muscling, and muscling in the round. The means of the forearm scores, in the post-wintering phase were 3.4, 3.4, and 3.1 for sire groups 1, 2, and 3, respectively. The means of the muscling over the top scores in the post-wintering phase were 3.5, 3.9, and 3.4 for sire groups 1, 2, and 3 respectively. The means of the muscling in the round scores were 3.1, 3.5, and 3.0 for sire groups 1, 2, and 3 respectively.

Sire group 3 did not rate as high in other traits as the other two sire groups. The means of the post-wintering bone scores were 3.2, 3.1, and 2.8 for sire groups 1, 2, and 3, respectively. The mean scores for middle capacity were 4.2, 4.2, and 3.8 of sire group 1, 2, and 3, respectively. The mean scores for chest capacity were 3.7, 3.9, and 3.4 for sire groups 1, 2, and 3, respectively.

The mean scores for slaughter grade were 11.9, 11.6, and 10.9 for sire groups 1, 2, and 3, respectively. For slaughter grade, sire groups 1 and 2 reversed their order from that for weaning score; however the type scores at the end of the feeding period were in the same order as weaning grade, since the average type scores were 10.9, 11.0 and 10.4 for sire groups 2, 1, and 3, respectively. This variation in slaughter grade and type score was reflected in the average market price per head in the sire groups. The average price per head was $27.09, $27.28, and $26.85 respectively for sire groups 1, 2, and 3. The mean scores for forearm muscling were 4.3, 3.8, and 3.7 respectively for sire groups 1, 2, and 3. The mean scores for muscling over the top were 3.9, 4.4, and 3.7 respectively for sire groups 1, 2, and 3.

The mean scores for muscling in the round were 4.5, 4.4, and 3.7 for sire groups 1, 2, and 3 respectively. The average weights at the ranch were 1140, 1052, and 1022 pounds per sire groups 1, 2, and 3 but the average daily gains during the full-feeding period were 2.3, 2.1, and 2.3 pounds per head per day respectively for the sire groups. The mean scores for the live yield grade were 2.6, 2.4, and 2.5, respectively.

The simple correlation coefficients involving average daily gain, weaning scores, and post-wintering scores and certain live animal scores with certain slaughter scores are found in Table 2. Slaughter grade was highly significantly correlated with weaning grade (.48**, **P < .01, *P < .05) and slaughter price (.85**). Slaughter grade was also significantly correlated with bone score at weaning (.37**), post winter weight (.34**), post winter bone score (.32**), post winter condition (.39**), yield grade (.32**), and average daily gain (.32**). Slaughter grade was also significantly correlated with feeder grade (.29*), slaughter weight (.25*), and percentage shrink (.26*).

Slaughter forearm score was highly significantly correlated with post winter weight (.49**), post winter gain (.41**) and post winter bone score (.52**). Slaughter forearm score was also significantly correlated with bone score at weaning (.32**), feeder grade (.36**), winter condition score (.30*), slaughter weight (.25*), and percentage shrink (.30*). Round score was significantly correlated with weaning bone score (.40**), post winter bone score (.35**), and condition score at weaning (.29*). Bone score at slaughter was significantly correlated with weaning grade (.40**), feeder grade (.35**), post winter condition (.33**), and was highly correlated with slaughter price (.55**).

Table 2. Simple correlation coefficients of average daily gain, weaning, post-wintering and certain live animal scores with certain slaughter scores.

Live	Slaughter Grade	Forearm	Round	Bone	Type	Size	Thighs & Rounds	Feet & Legs	Condition	Head & Neck	Price, (Slaughter)	Over Top Muscling
Adj. weaning wt.	-.01	.18	-.10	-.27	-.10	.06	-.04	-.06	.11	.25+	-.11	.10
Weaning grade	.48++	.12	.02	.40++	.40++	.42++	.31+	.10	.43++	.39++	.50++	.32++
Bone (weaning)	.37++	.32++	.40++	.25+	.28+	.41	.26+	.03	.31+	.18	.35++	.19
Condition (weaning)	.21	.13	.29+	.18	.29+	.07	.22	.13	.24	.07	.20	.16
Feeder grade	.29+	.36++	.23	.35++	.45++	.36++	.31+	.27+	.38++	.44++	.50++	.42++
Post-winter wt.	.34++	.49++	.21	.09	.06	.70	.29+	-.24	.47++	.07	.21	.25+
Post-winter gain	.23	.41++	.18	-.04	-.00	.36	.17	-.14	.25+	-.05	.01	.09
Post-winter bone	.32++	.52++	.35++	.18	.08	.55	.15	.06	.32++	.19	.25+	.23
Post-winter condition	.39++	.30+	.15	.33++	.28	.48	.44++	.07	.54++	.12	.49++	.57++
Yield grade	.32++	.16	.06	-.10	.07	.29+	.21	-.10	.39++	-.01	.23	.10
Av. daily gain	.32++	.07	.09	-.24	-.13	.17	-.13	.01	.08	-.30+	.05	-.11
Slaughter wt.*	.25+	.25+	.19	-.01	-.03	.65	.18	-.24	.44++	-.06	.18	.19
Percentage shrink	.26+	.30+	.11	-.18	-.12	.70++	-.10	-.28+	.23	-.13	.11	.01
Slaughter price	.85++	.32++	.22	.55++	.74++	.37++	.72++	.51++	.73++	.32++		.62++

*Weight taken at ranch.

+Significant at the .05 level.

++Significant at the .01 level.

Bone score at slaughter was also correlated with bone score at weaning (.25*).

Type score at slaughter was highly correlated with weaning grade (.40**), feeder grade (.45**) and slaughter price (.74**). Type score at weaning was also correlated with bone score at weaning (.28*) and condition at weaning (.29*).

Size score at slaughter was significantly correlated with weaning grade (.42**), feeder grade (.36**), slaughter price (.37**) and percentage shrink (.70**). The size score at slaughter was also correlated with yield grade (.29*).

Thighs and round score at slaughter was positively associated with post winter condition ($r = .44^{**}$) and slaughter price ($r = .72^{**}$). The thighs and round score was also positively correlated with weaning bone score (.26*), weaning grade (.31*), feeder grade (.31*), and post winter weight (.29*). Feet and leg score at slaughter was highly correlated with slaughter price (.51**) and was correlated with feeder grade (.27*).

Feet and leg score at weaning was also negatively correlated (-.28*) with percentage shrink. Condition score at slaughter was highly correlated with weaning grade (.43**), post winter weight (.47**), post winter condition (.54**), slaughter weight (.44**), and price (.73**). Slaughter condition score was also significantly correlated with feeder grade (.38**), weaning bone score (.31*), post winter gain (.25*), post winter bone (.32**), and live yield grade (.39**). The head and neck score at slaughter was highly correlated with feeder grade (.44**) and was also significantly correlated with weaning grade (.39**), slaughter price (.32**) and adjusted weaning weight (.25*).

Head and neck score was negatively correlated with average daily gain (-.30*).

Slaughter price was highly correlated with weaning grade (.50**), feeder grade (.50**) and post winter condition (.49**). Slaughter price was also significantly correlated with weaning bone score (.35**) and post winter bone score (.25*). The score for muscling over the top at slaughter was highly correlated with feeder grade (.42**), post winter condition score (.57**) and slaughter price (.62**). Muscling score over the top at slaughter, was also significantly correlated with weaning grade (.32**) and post winter weight (.25*).

Simple correlation coefficients between some live animal traits scored and measured just prior to slaughter and certain carcass characteristics are presented in Table 3. Weight of the untrimmed primal cuts was significantly correlated with forearm score (.52**), size score (.67**), weight at the ranch (.95**), percentage shrink (.56**), slaughter grade (.35*), and condition score (.43*). Weight of the trimmed primal cuts was significantly correlated with forearm score (.53**), size (.65**), weight at the ranch (.95**), percentage shrink (.56**), condition score (.41*), and live yield grade (.34*). Area of the ribeye was significantly correlated with weight at the ranch (.47**) and percentage shrink (.41*).

Carcass yield grade was significantly correlated with slaughter grade (.47**), size (.38**), weight at the ranch (.36**), price (.36**), bone score (.29*), shoulder and chest (.27*), rib and back (.31*), loin (.30*), rump (.28*), and thighs and round score (.34*). The 72 hour chilled carcass weight was positively correlated with live yield grade (.39**), slaughter grade (.43**), forearm (.52**), condition score (.48**), size score (.65**),

Table 3. Simple correlation coefficients of the slaughter steer traits with their carcass characteristics.

Live scores	Wt. of untrimmed primal cuts**	Wt. of trimmed primal cuts**	Fat thickness (3 measurements)**	Area of Ribeye**	Yield grade*	72 hr. chill wt.*	Conformation*	Circumference of cannon*	Circumference of forearm*	Circumference of round (av. of measurements)**	Quality grade*	Wt. of fat trim from primal cuts*	Degree of marbling 24 hr. chill*
Yield grade	.33	.34+	.08	.20	.12	.39++	.19	.17	.23	.26	-.10	.17	.14
Slaughter grade	.35+	.33	-.02	.22	.47++	.43++	.47++	.16	.41++	.42+	.13	.36+	-.07
Forearm	.52++	.53++	.05	.17	.22	.52++	.28+	.45++	.51++	.45++	-.13	.33	.03
Muscling over top	.25	.24	.04	.29	.11	.23	.50++	.22	.43++	.48++	.14	.15	-.05
Round	.19	.23	-.11	-.01	.14	.16	.10	.48++	.19	.09	.01	-.15	.21
Bone	.08	.08	.24	.14	.29+	.13	.20	-.20	.19	.31	-.01	.09	.01
Condition score	.43+	.41+	.05	.29	.23	.48++	.43++	.25+	.42++	.61++	-.01	.36+	-.21
Type	.00	-.01	.25	.01	.22	.04	.46++	-.06	.08	.31	.00	.13	.04
Size	.67++	.65++	.01	.29	.38++	.65++	.15	.49++	.54++	.49++	.03	.25	-.31+
Quality	-.18	-.19	.08	-.21	.22	-.12	.22	-.27+	.07	.21	.20	-.13	.08
Shoulder & Chest	.02	.01	.17	-.05	.27+	.04	.21	-.07	.06	.22	.03	.70++	-.05
Rib & Back	.14	.11	.29	-.00	.31+	.18	.22	-.03	.17	.35++	.20	.27	-.63
Loin	.28	.26	.07	.26	.30+	.34+	.43++	.05	.48++	.55++	.21	.29	-.01
Rump	.07	.06	.21	-.04	.28+	.07	.50++	-.06	.19	.42++	.18	.13	.12
Thighs & Rounds	.23	.23	.08	.21	.34+	.27+	.60++	.08	.49++	.54++	.10	.11	.05
Feet & Legs	-.14	-.17	-.07	-.11	.07	-.19	.22	-.16	-.04	.05	.31+	.13	.25+
Head & Neck	.03	.03	.03	.06	.11	-.02	.29+	.04	.09	.20	.17	.04	-.07
Wt. at ranch	.95++	.95++	.26	.47++	.36++	.94++	.35++	.65++	.13	.64++	-.04	.54++	-.23
Price	.16	.15	-.10	-.01	.36++	.22	.30+	.05	.25+	.45++	.20	.18	-.07
Percentage shrink	.56++	.56++	.04	.41+	.01	.57++	.03	.60++	.47++	.44++	-.04	.30	-.36++
Av. daily gain	.25	.22	-.06	.17	.22	.28+	.04	.20	.06	-.06	.23	.36+	-.10

*66 head of steers used.

**30 head of randomly selected steers.

+Significant at the .05 level.

++Significant at the .01 level.

weight at the ranch (.94**), percentage shrink (.57**), loin (.34*), thighs and round score (.27*), and average daily gain (.28*). Carcass conformation score was correlated with slaughter grade (.47**), muscling over the top score (.50**), condition score (.43**), type (.46**), loin (.43**), rump (.50**), thighs and round score (.60**), weight at the ranch (.35**), forearm (.28*), head and neck (.29*) and price (.30*). Circumference of cannon as measured in the carcass was correlated with forearm muscling score (.45**), muscling over the top (.48**), size score (.49**), weight at the ranch (.65**), percentage shrink (.60**) and condition score (.25*) and was negatively correlated with quality score (-.27*). Circumference of forearm in the carcass was positively correlated with slaughter grade (.41**), forearm muscling (.51**), muscling over the top (.43**), condition score (.42**), size (.54**), loin (.48**), thighs and rounds (.49**), percentage shrink (.47**), and slaughter price (.25*). Circumference of the round in the carcass was significantly correlated with forearm muscling (.45**), muscling over the top (.48**), condition (.61**), size score (.49**), rib and back (.35**), loin (.55**), rump (.42**), thighs and rounds (.54**), weight at the ranch (.64**), slaughter price (.45**), percentage shrink (.44**), and slaughter grade (.42*). Quality grade was associated only with feet and leg score (r = .31*). The weight of fat trim from the primal cuts was significantly correlated with shoulder and chest (.70**), weight at the ranch (.54**), slaughter grade (.36*), condition score (.36*) and average daily gain (.36*). Degree of marbling was negatively correlated with percentage shrink (-.36**), size (-.31*) and was positively correlated with the score for feet and legs (.25*).

Comparisons of classification scores for the different conformation traits in the sires, the means for the dams with which they were mated and mean scores of their progeny are presented in Figs. 1, 2, and 3. These include only the 66 head of steers. Fig. 1 includes sire H. H. 73, the cows to which he was mated and their offspring. The average scores for type, shoulder and chest, rib and back, and feet and legs were lower for the progeny than either the sire or the dam. The scores for size and quality were equal to or greater than size and quality scores of the sire or the dam. Loin score of the progeny was the same as the dam but lower than the loin score of the sire. Rump, and thighs and round scores were lower for the progeny than those for the sire but higher than those on the dams. Head and neck scores of the progeny were somewhat lower than the dams' head and neck score, but much higher than head and neck score of the sire.

Fig. 2 shows the scores of H. H. 74, the mean scores of the cows to which he was mated, and mean scores of their progeny. Scores on type, and rib and back were lower on the progeny than for either the sire or the dams. Score on quality, rump, thighs and rounds, and head and neck averaged higher on the progeny than either the sire or dams. Shoulder and chest scores on the progeny were somewhat lower than the dams' average scores, but higher than those for the sire. Progeny mean score for loin was the same as mean loin score on the dams, but was much lower than that for the sire. Mean score for feet and legs on the progeny was lower than for the sire but was higher than for the dams.

The mean scores for dams mated to the "clean-up" bulls and the mean scores of their progeny are presented in Fig. 3. Scores on the "clean-up" bulls were not obtained as they were sold before they could be scored. Mean scores on type, shoulder and chest, rib and back, loin, rump, and feet and legs for the "clean-up" bulls' progeny were lower than those for the dams.

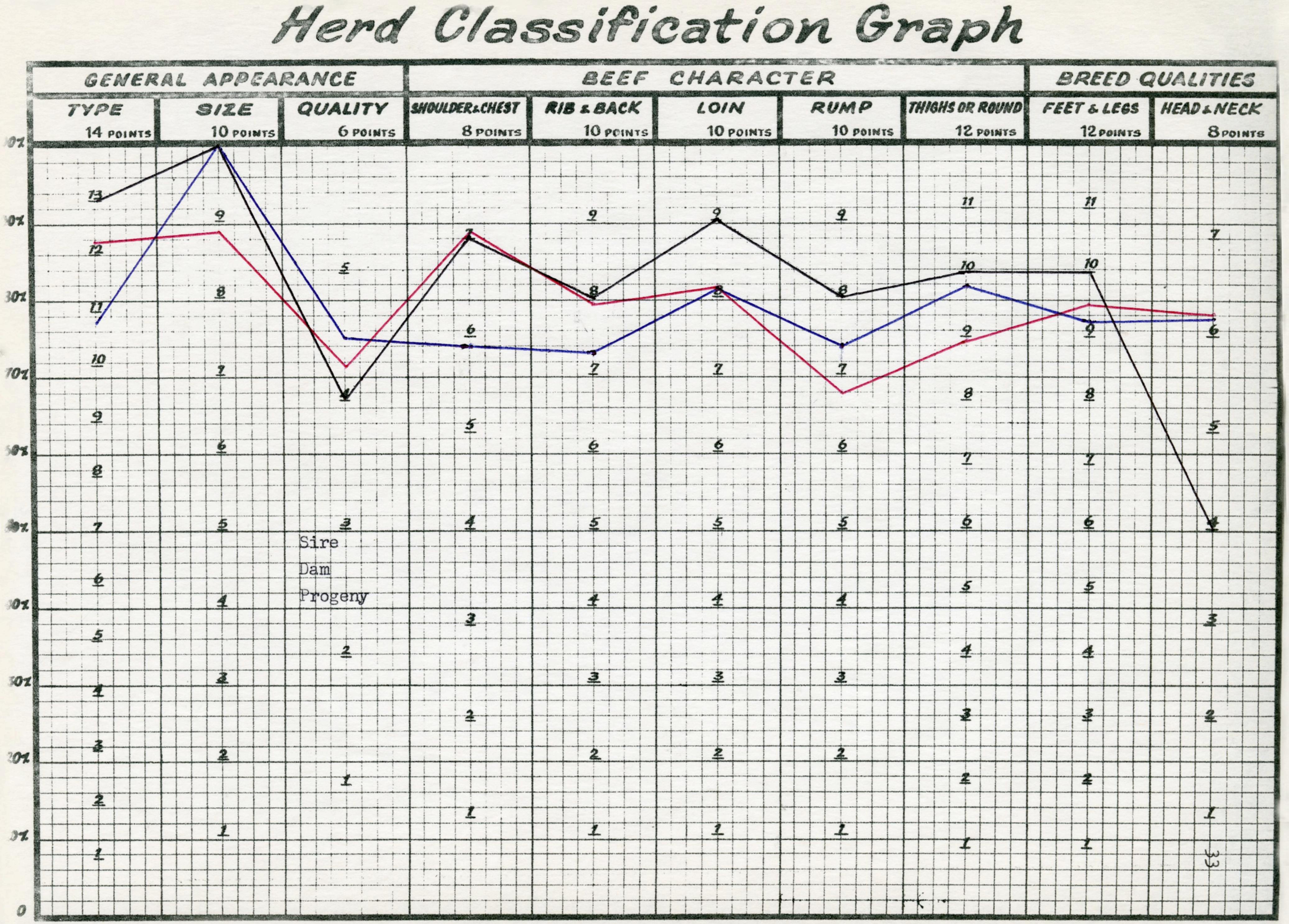

Fig. 1 Herd Classification Graph (H.H. 73)

Herd Classification Graph

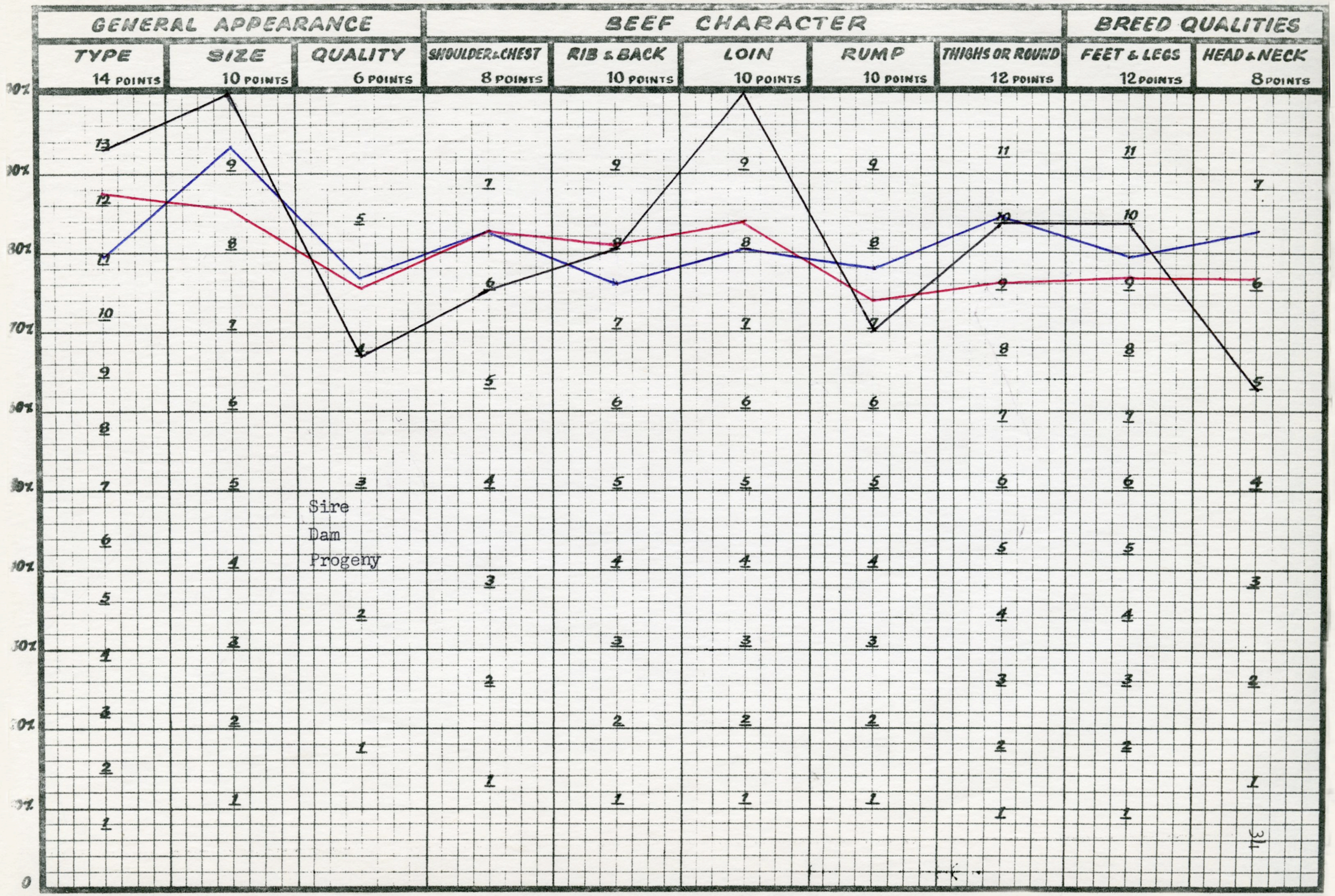

Fig. 2. Herd Classification Graph. H.H. 74)

Herd Classification Graph

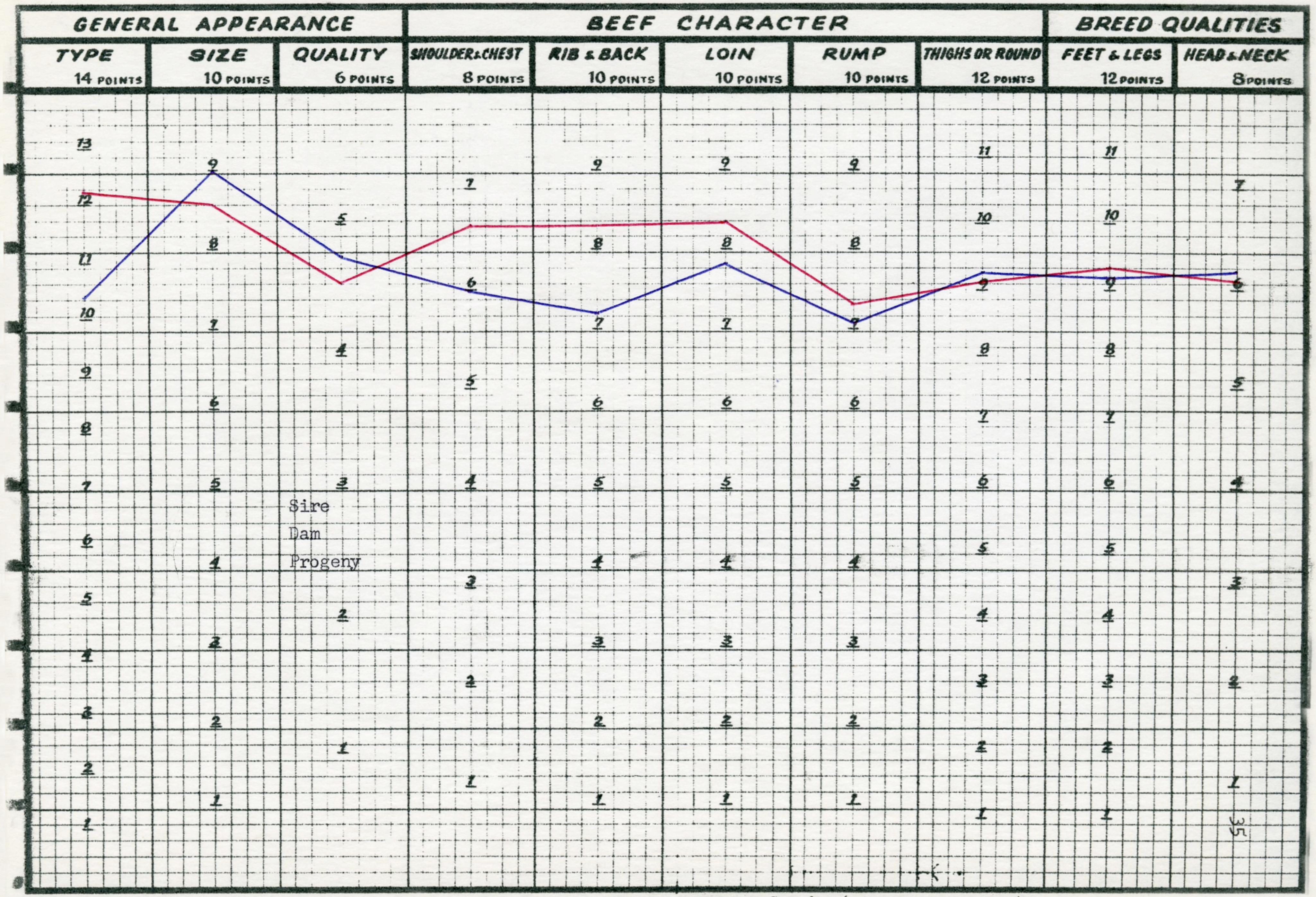

Fig. 3. Herd Classification Graph. ("Clean-up bulls")

Mean scores on size, quality, thighs and round, and head and neck were higher in the case of the progeny than the dams.

Tables 4, 5, 6, and 7 show analyses of variance in sire groups used in this study for certain live animal and carcass traits. There was no significant difference among the sire groups on weaning grade or feeder grade. There was no significant difference in type, size, or bone. However, there was a significant variation among sire groups at the .01 level, in slaughter grade, muscling in round scores, muscling over the top scores, forearm muscling scores, average daily gain, market price, and slaughter weight. There was no significant difference in marbling score or carcass grade. However, there was a significant difference, at the .05 level, in area of ribeye.

Table 4. Analyses of variance in weaning grade and feeder grade in Hereford cattle.

Source of Variation	D.F.	Mean Squares	
		Weaning Grade	Feeder Grade
Total	132		
Sire group	2	6.74	6.61
Sex within sire group	3	1.09	.99
Within sex within sire group	127	1.45	.85

Table 5. Analyses of variance in certain live animal slaughter traits in Hereford steers.

Source of Variation	D.F.	Mean Squares: Slaughter Grade	Type	Size	Muscling in Round	Muscling Over Top
Total	64					
Sire groups	2	4.45**	3.0	1.37	4.87**	8.4**
Within sire groups	62	.90	1.2	4.3	.64	.51

*P .05

**P .01

Table 6. Analyses of variance in certain live animal slaughter traits in Hereford steers.

Source of Variation	D.F.	Mean Squares: Forearm Muscling	Bone	Av. Daily Gain	Market Price	Slaughter Weight
Total	64					
Sire groups	2	8.2**	.07	.28**	1.52**	38348**
Within sire groups	62	.04	.47	.09	.30	5148

*P .05

**P .01

Table 7. Analyses of variation in certain carcass characteristics of Hereford steers.

Source of Variation	D.F.	Mean Squares: Marbling Score	Mean Squares: Area of Ribeye	Mean Squares: Carcass Grade
Total	64			
Sire groups	2	7.33	5.85*	2.67
Within sire groups	3	2.74	1.19	.45

*P .05

DISCUSSION

Krehbiel *et al.* (1958) concluded that selecting for type on the basis of a scorecard was effective in improving the type of a herd. Gifford et al. (1951), essentially agreed when they reported that judges were in general agreement on the points of conformation using a classification system. Ray and Gifford (1949) found score card scoring was very valuable in placing life-time classification scores on animals.

Lush (1922) stated that no score card or standard based on conformation could ever be so accurate that the future performance of individual steers could be predicted from it with but few mistakes. Knapp *et al.* (1939) concluded that scoring as a technique of evaluation of differences between animals is subject to considerable error and is probably of doubtful value when differences between animals are very small.

In a discussion of the findings of this study, consideration should be given to the types of animals and to the scoring system used. In the conformation classification numerical values recommended by the American Angus

Association in its classification program was used. Also, it should be recalled that the overall type score of 2 of the sires was the same and that the third sire group of progeny was actually sired by two bulls on which no overall type scores could be obtained.

Table 4 showed no significant variation in the sire groups in weaning grade. However, the mean of the weaning grades was 10.7, 11.2, and 10.6 respectively, for sire groups 1, 2, and 3. There was no significant difference in the adjusted weaning weight (not shown in table) of the sire group. The mean of the adjusted weaning weights were 506, 484, and 470 pounds respectively for sire groups 1, 2, and 3. Despite the fact that the overall score of the two bulls that sired groups 1 and 2 were the same, there was a 20-pound difference in the means of the weaning weights, an average of 57 pounds in the post winter weights, and an 88-pound difference in the slaughter weights. There was a 20-pound difference between the two sire progeny groups in the average gains while on full feed. This difference in average weights could be very important to the producer when he selects sires.

The average age of weaning and weaning weights for all three sire groups should be considered. The average age of the calves at weaning for the third sire group was younger because the cows were artificially bred for a period of 27 days, after which time the "clean-up" bulls (the third sire group) was turned with the cows. This explains, in part, why the animals in the third sire group were younger, and this group had the lowest average weaning weight. However, the average weaning weight of the third sire group was still lower than those for the other two sire groups even when the weights were adjusted to a constant age of 210 days.

The mean of the feeder grade scores were not statistically different, but there was a slight advantage in favor of the second sire group (Table 4). The average feeder grades were 11.6 for the second sire group, whereas, the mean of sire groups 1 and 3 was 11.1 and 10.9 respectively.

There was a significant difference in slaughter grade as far as the sire groups were concerned (Table 5). The offspring in the first sire group had the highest average grade of 11.9, whereas, groups 2 and 3 averaged 11.6 and 10.9 respectively. The slaughter grade is an overall evaluation of the animal and this significant difference is especially important since it was highly correlated with market price (.85**) and is the most commonly accepted evaluation used by producer and buyer. There was a significant difference in the muscling traits of the slaughter animals in the three sire groups (Tables 5 and 6). The muscling score means were slightly lower in the third sire group for all three muscling traits than in the other sire groups. Forearm muscling scores averaged 4.3, 3.8, and 3.7 respectively for sire groups 1, 2, and 3; whereas muscling over top scores averaged 3.9, 4.4, and 3.7 respectively for sire groups 1, 2, and 3. Scores for muscling in the round averaged 4.5, 4.4, and 3.7, respectively for sire groups 1, 2, and 3. The three sire groups also differed significantly as far as market price (determined by the packer buyer) was concerned. Sire group 3 had a mean price of $26.85, the lowest; whereas, sire group 2 had a mean price of $27.28, and group 1 averaged $27.09 cwt. The variation in price was consistent with the type scores of the sire groups. The mean type scores were 10.9, 11.0, and 10.4 respectively for sire groups 1, 2, and 3.

Table 7 shows no significant variation in marbling score among sire groups. And since marbling score is a very important consideration in carcass quality grade, there was not, as expected, a significant variation in carcass grade among sire groups. The significant difference in sire groups for area of ribeye was in favor of sire group 1. The average area of ribeye was 11.5, 10.6, and 10.2 square inches respectively for sire groups, 1, 2, and 3. Size of the steers at the time of slaughter possibly influenced area of ribeye.

The correlation of live yield grades to the carcass yield grade was positive (.12) but not significant. However, the mean of live yield grades were 2.6, 2.36, and 2.5 for the sire groups 1, 2, and 3 respectively, while the means of the carcass yield scores were 2.6, 2.8, and 2.7. Therefore, average carcass yield grades can be predicted with reasonable accuracy from live animal evaluations. It is also important to note that the market price, placed on the cattle individually at the ranch, was positively correlated with carcass yield grade (.36**), and circumference of round (.45**). Furthermore, market price was positively correlated with slaughter grade (.85**), forearm (.32**), type (.74**), bone (.55**), size (.37**), thighs and rounds (.72**), and muscling over the top (.62**). The carcass yield grade was also positively correlated with slaughter grade (.47**), slaughter size score (.38**), shoulders and chest (.27*), loin (.30*), bone (.29*) rib and back (.31*), rump (.28*), and thighs and rounds (.34*). The carcass conformation score was positively correlated with slaughter grade (.47**), forearm (.28*), muscling over the top (.50**), type score (.46**), and thighs and rounds (.60**). The weight of the trimmed primal cuts was positively correlated with live yield grade (.34*) and forearm (.53**). All this suggests that certain carcass characteristics can be fairly accurately predicted by careful observation of live traits. Slaughter grade was highly correlated with carcass conformation (.47**). Wheat and Holland (1960) also found this correlation to be very high (.56). It is also important to note the high correlation between market price and slaughter grade (.85**) and type (.74**) which indicates the packer buyer was placing the same emphasis on the live traits that received high scores in this study. This also indicates that large emphasis should be placed on bone and muscling. This agrees with the findings of Good et al. (1960) who stated that heavy boned cattle with larger rounds are desirable as such animals tend to have less fat and more lean.

On the other hand, there are some carcass traits which cannot be predicted by an analysis of live traits. Slaughter grade was positively correlated, but not significantly, with carcass grade (.13) and with area of ribeye (.22). This essentially agrees with Wheat and Holland (1960) who found this correlation to be (.22). Slaughter grade had a slightly negative correlation with degree of marbling (-.07). Type score was essentially independent of the weight of the trimmed primal cuts ($r = -.01$), area of ribeye ($r = .01$), quality grade ($r = .00$) and degree of marbling ($r = .04$).

However, since certain valuable carcass characteristics can be predicted by careful examination of the slaughter animal, it seems necessary to determine if certain slaughter characteristics can be predicted by a study of the weaning and feeder cattle traits. The weaning and feeder grades appeared to be the best traits to study in an attempt to predict slaughter grade and other important traits of the slaughter animal. The weaning grade was significantly correlated with slaughter grade (.48**), bone (.40**), type (.40**), size (.42**), thighs and rounds (.31*), slaughter price (.50**), and muscling over the top (.32**). Feeder grade was positively correlated with slaughter grade (.29*), type (.45**), size (.36**), thighs and round (.31*), slaughter price (.50**), and muscling over the top (.42**). These facts indicate that slaughter traits can be predicted with a reasonable degree of accuracy by a careful analysis of the weaning and feeder grades.

Knapp et al. (1939) stated that the value of the use of score charts in evaluating animals is probably very doubtful when differences between animals are very small. However, plotting results on herd classification graphs as shown on pages 33, 34, and 35 can be very helpful to the breeder. The breeder can, by plotting the results of his herd classification, know for which traits his cows are particularly weak and obtain sires that are extremely strong for these traits. One can also check the influence of sire and dam on individual traits in their progeny. Despite the fact that scores on individual traits of H. H. 73 and H. H. 74 are very similar, their progeny differed considerably, indicating that sires with the same score may or may not exert exactly the same influence on their offspring when the sires were mated to random samples of cows. In addition, plotting can be advantageous when there is variation in the sires because regardless of what the scores were on the "clean-up" bulls, the average scores for most traits within their progeny was below those of the dams. This indicates that the scores of the progeny of the "clean-up" bulls were not improved over those for their dams at all by the sires. This could be a valuable tool to the cattleman in sire selection.

All this suggests that differences occur in progeny of the sire groups despite the fact that sires show similar characteristics in live appraisal. The main emphasis in selection should be placed on those traits of economic importance to the producer and yet, select cattle that yield carcasses which satisfy the consumer demand for beef quality.

SUMMARY

Data from 137 cows, 4 bulls, and 133 of their progeny from the Jim Houghton Hereford Ranch near Tipton, Kansas, was used in this study to determine the influence of certain traits of the sire on certain live and carcass traits of his progeny. In addition, an effort was made to determine the influence of certain live traits on other live and carcass characteristics of the same animal.

Numerical values, using the American Angus Association classification reports, were determined for the bulls and cows. Other numerical values were placed on weaning, feeder, slaughter, and carcass traits. All live animal scoring was done by Dr. Don Good, Mr. V. E. McAdams and the writer. Slaughter market price was evaluated for each of the 66 steers individually by a packer buyer for the Maurer-Neuer Packing Company at Kansas City, Missouri. Carcass evaluations were designated for each carcass by a federal grader.

Two of the four bulls used, H. H. 73 and H. H. 74, were artifically bred randomly to the cows for 27 days. Each of these two bulls had an overall classification score of 83. After the 27 day period, two "clean-up" bulls were turned with the cows. No evaluation scores were obtained on the "clean-up" bulls as they were sold before the project was begun and scores could not be taken.

There was a highly significant difference among sire groups for slaughter grade, muscling in the round, muscling over the top, forearm muscling, average daily gain, market price and slaughter weight. There was

no significant difference among sire groups in type, size, and bone scores. There was a significant difference in area of ribeye among the sire groups, but differences in marbling score and carcass grade were not significant.

The correlation of live yield grades to the carcass yield grade was positive (.12), but not significant. However, the means of the live yield grades were 2.6, 2.36, and 2.5 for sire groups 1, 2, and 3 respectively, and the means of the carcass yield grades were 2.6, 2.8, and 2.7.

Market price was positively correlated with carcass yield grade (.36**), slaughter grade (.85**), and with scores such as those for forearm (.32**), type (.74**), bone (.55**), size (.37**), thighs and rounds (.72**), and muscling over the top (.62**). The carcass yield grade was positively correlated with slaughter grade (.47**), and scores for slaughter size (.38**), loin (.30*), rib and back (.31*), bone (.29*), and thighs and rounds (.34*). Slaughter grade was positively correlated with market price (.85**), type (.74**), carcass conformation (.47**), weaning grade (.48**), and feeder grade (.29*).

However, some carcass traits were not accurately predicted by live evaluation. Slaughter grade was positively, but not significantly, correlated with area of ribeye (.22) and carcass grade (.12). The type score of the slaughter steers was essentially independent of traits such as slaughter grade (r = -.07), weight of the trimmed primal cuts (r = -.01), area of ribeye (r = .01), quality grade (r = .00), and degree of marbling (r = .04).

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APPENDIX

Table 8. Herd Classification Report

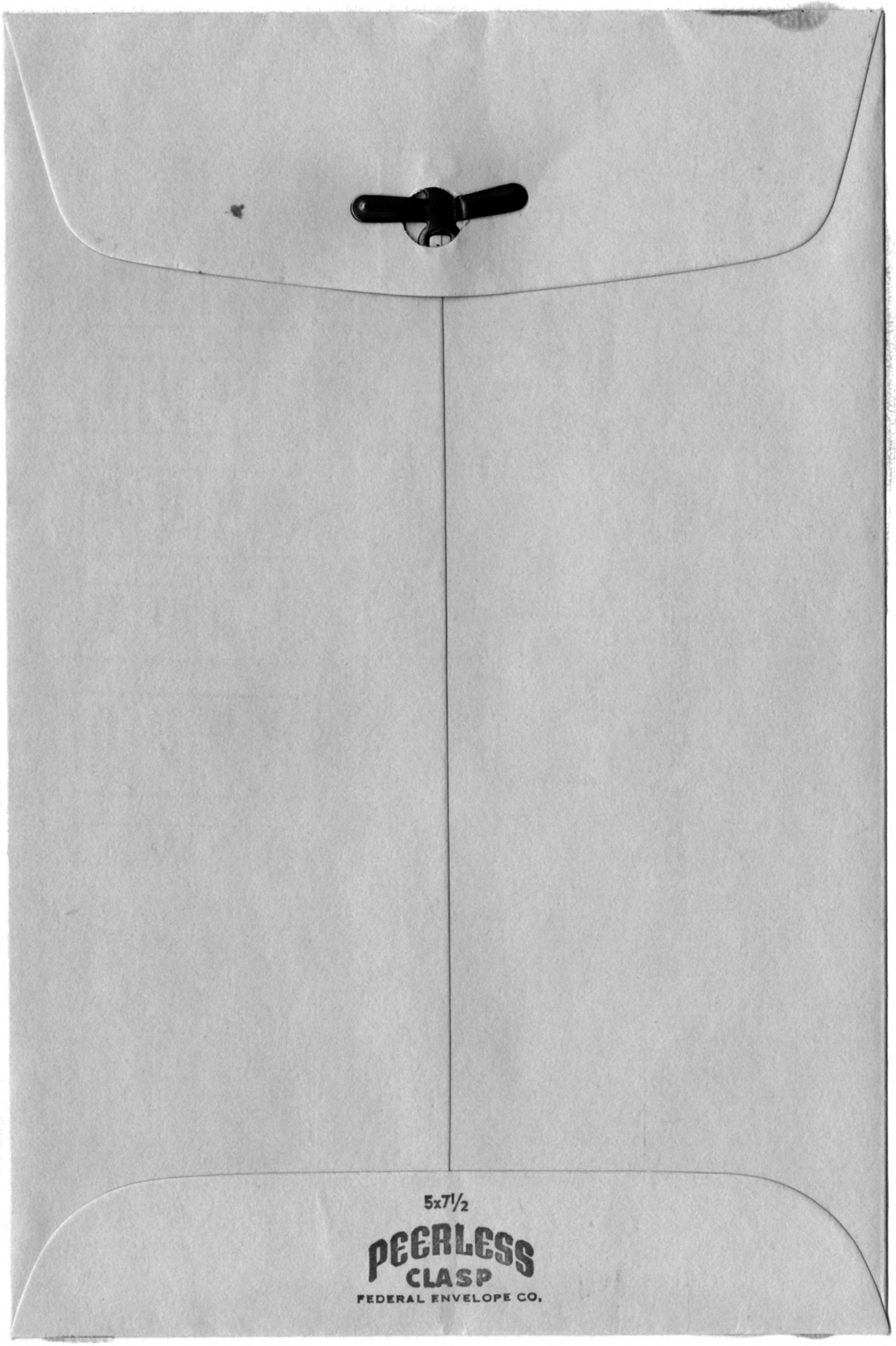

Table 8. Herd Classification Report

AMERICAN ANGUS ASSOCIATION

HERD CLASSIFICATION REPORT

Owner

Chain No. Registration No. Report No.

Score

Sex Tattoo: Left Ear Right Ear

Classifier Date

Date of Birth: Mo. Day Yr. Age: Yrs. Mos. Date of Last Calf: Mo. Day Yr. Sire Dam

REPORT OF DEFECTIVE CHARACTERISTICS

One Tick (√) Slight Degree — Two Ticks (√√) Pronounced Degree

HEAD, NECK AND SHOULDERS	narrow head	coarse head	narrow muzzle	dull eye	heavy shoulder	flat poll		
BODY	narrow crops	weak back	low loin	narrow loin	shallow body	light quarter	lack heart girth	high flank
RUMP	narrow	low pins	high tailhead	rough hooks	too short			
FEET AND LEGS	too straight	sickled hocks	weak pasterns	too fine	spraddle walk	toe out	shallow heel	open toed
UDDER	lack capacity	fleshy	unbal-anced	large teats	scrotal de-ficiencies			

GENERAL APPEARANCE 30		
Type 14	Size 10	Quality 6

BEEF CHARACTER 50				
Shoul-der and Chest 8	Rib and Back 10	Loin 10	Rump 10	Thighs or Round 12

BREED QUALITIES 20	
Feet and Legs 12	Head and Neck 8

REMARKS

HC-1A

Table 9. Clifford Houghton Herd, Tipton, Kansas, Feeder Calf Evaluation. September 13, 1961.

Steer No.	Weight	Feeder Grade	Muscling			Visual Bone	Gaining Ability			Coat Color	Condition	Striking defects of structure
			Fore-arm	Over Top	Round		Chest Capacity	Middle Capacity	Head and Bone			

Table 10. Correction values for adjusting weaning weights to 210 days.

Age of Calf	Steer Calves: Age of Dam 3	4	5	6	7	Heifer Calves: Age of Dam 3	4	5	6	7
150	131	113	105	82	82	155	137	129	106	106
151	129	111	103	80	80	153	135	127	104	104
152	128	110	102	79	79	152	134	126	103	103
153	127	109	101	78	78	151	133	125	102	102
154	125	107	99	76	76	149	131	123	100	100
155	124	106	98	75	75	148	130	122	99	99
156	122	104	96	73	73	146	128	120	97	97
157	121	103	95	72	72	145	127	119	96	96
158	120	102	94	71	71	144	126	118	95	95
159	118	100	92	69	69	142	124	116	93	93
160	117	99	91	68	68	141	123	115	92	92
161	116	98	90	67	67	140	122	114	91	91
162	114	96	88	65	65	138	120	112	89	89
163	113	95	87	64	64	137	119	111	88	88
164	112	94	86	63	63	136	118	110	87	87
165	110	92	84	61	61	134	116	108	85	85
166	109	91	83	60	60	133	115	107	84	84
167	107	89	81	58	58	131	113	105	82	82
168	106	88	80	57	57	130	112	104	81	81
169	105	87	79	56	56	129	111	103	80	80
170	103	85	77	54	54	127	109	101	78	78
171	102	84	76	53	53	126	108	100	77	77
172	101	83	75	52	52	125	107	99	76	76
173	99	81	73	50	50	123	105	97	74	74
174	98	80	72	49	49	122	104	96	73	73
175	97	79	71	48	48	121	103	95	72	72
176	95	77	69	46	46	119	101	93	70	70
177	94	76	68	45	45	118	100	92	69	69
178	93	75	67	44	44	117	99	91	68	68
179	91	73	65	42	42	115	97	89	66	66
180	90	72	64	41	41	114	96	88	65	65
181	88	70	62	39	39	112	94	86	63	63
182	87	69	61	38	38	111	93	85	62	62
183	86	68	60	37	37	110	92	84	61	61
184	84	66	58	35	35	108	90	82	59	59
185	83	65	57	34	34	107	89	81	58	58
186	82	64	56	33	33	106	88	80	57	57
187	80	62	54	31	31	104	86	78	55	55
188	79	61	53	30	30	103	85	77	54	54
189	78	60	52	29	29	102	84	70	53	53
190	76	58	50	27	27	100	82	74	51	51
191	75	57	49	26	26	99	81	73	50	50
192	73	55	47	24	24	97	79	71	48	48
193	72	54	46	23	23	96	78	70	47	47

Table 10 (cont.)

Age of Calf	Steer Calves Age of Dam 3	4	5	6	7	Heifer Calves Age of Dam 3	4	5	6	7
194	71	53	45	22	22	95	77	69	46	46
195	69	51	43	20	20	93	75	67	44	44
196	68	50	42	19	19	92	74	66	43	43
197	67	49	41	18	18	91	73	65	42	42
198	65	47	39	16	16	89	71	63	40	40
199	64	46	38	15	15	88	70	62	39	39
200	63	45	37	14	14	87	69	61	38	38
201	61	43	35	12	12	85	67	59	30	36
202	60	42	34	11	11	84	66	58	35	35
203	59	41	33	10	10	83	65	57	34	34
204	57	39	31	8	8	81	63	55	32	32
205	56	38	30	7	7	80	62	54	31	31
206	54	36	28	5	5	78	60	52	29	29
207	53	35	27	4	4	77	59	51	28	28
208	52	34	26	3	3	76	58	50	27	27
209	50	32	24	1	1	74	56	48	25	25
210	49	31	23	0	0	73	55	47	24	24
211	48	30	22	-1	-1	72	54	46	23	23
212	46	28	20	-3	-3	70	52	44	21	21
213	45	27	19	-4	-4	69	51	43	20	20
214	44	26	18	-5	-5	68	50	42	19	19
215	42	24	16	-7	-7	66	48	40	17	17
216	41	23	15	-8	-8	65	47	39	16	16
217	39	21	13	-10	-10	63	45	37	14	14
218	38	20	12	-11	-11	62	44	36	13	13
219	37	19	11	-12	-12	61	43	35	12	12
220	35	17	9	-14	-14	59	41	33	10	10
221	34	16	8	-15	-15	58	40	32	9	9
222	33	15	7	-16	-16	57	39	31	8	8
223	31	13	5	-18	-18	55	37	29	6	6
224	30	12	4	-19	-19	54	36	28	5	5
225	29	11	3	-20	-20	53	35	27	4	4
226	27	9	1	-22	-22	51	33	25	2	2
227	26	8	0	-23	-23	50	32	24	1	1
228	25	7	-1	-24	-24	49	31	23	0	0
229	23	5	-3	-26	-26	47	29	21	-2	-2
230	22	4	-4	-27	-27	46	28	20	-3	-3
231	20	2	-6	-29	-29	44	26	18	-5	-5
232	19	1	-7	-30	-30	43	25	17	-6	-6
233	18	0	-8	-31	-31	42	24	16	-7	-7
234	16	-2	-10	-33	-33	40	22	14	-9	-9
235	15	-3	-11	-34	-34	39	21	13	-10	-10
236	14	-4	-12	-35	-35	38	20	12	-11	-11

Table 10 (concl.)

Age of Calf	Steer Calves, Age of Dam: 3	4	5	6	7	Heifer Calves, Age of Dam: 3	4	5	6	7
237	12	-6	-14	-37	-37	36	18	10	-13	-13
238	11	-7	-15	-38	-38	35	17	9	-14	-14
239	10	-8	-16	-39	-39	34	16	8	-15	-15
240	8	-10	-18	-41	-41	32	14	6	-17	-17
241	7	-11	-19	-42	-42	31	13	5	-18	-18
242	5	-13	-21	-44	-44	29	11	3	-20	-20
243	4	-14	-22	-45	-45	28	10	2	-21	-21
244	3	-15	-23	-46	-46	27	9	1	-22	-22
245	1	-17	-25	-48	-48	25	7	-1	-24	-24
246	0	-18	-26	-49	-49	24	6	-2	-25	-25
247	-1	-19	-27	-50	-50	23	5	-3	-26	-26
248	-3	-21	-29	-52	-52	21	3	-5	-28	-28
249	-4	-22	-30	-53	-53	20	2	-6	-29	-29
250	-5	-23	-31	-54	-54	19	1	-7	-30	-30

Table 11. Clifford Houghton Herd, Tipton, Kansas. Slaughter Steer Evaluation. August 16, 1962.

Tattoo______________ Weight______________ Price________________

Yield grade____________________________

Slaughter grade________________________ Muscling
Forearm score______________ Over top score__________

Rounds score___________________________ Bone score________________ Coat Color score_________

Condition score____________________

Type	Size	Quality	Shoulder & Chest	Rib & Back	Loin	Rump	Thighs & Rounds	Feet & Legs	Head & Neck	Total
14	10	6	8	10	10	10	12	12	8	

RELATIONSHIP BETWEEN CERTAIN CONFORMATION TRAITS OF A SIRE AND THE CONFORMATION AND CARCASS CHARACTERISTICS OF HIS PROGENY

by

EUGENE ROSS

B. S., Oklahoma State University, 1952

AN ABSTRACT OF A MASTER'S THESIS

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Numerical values were placed on certain traits of 133 calves at weaning and at the end of the winter phase; also certain slaughter and carcass traits were determined for 66 steers, and additional carcass traits were obtained for 32 carcasses randomly selected from the 66. The animals were the progeny of 137 cows and 4 bulls from the Jim Houghton & Son Hereford Ranch near Tipton, Kansas. Two of the bulls, H. H. 73 and H. H. 74 had the same overall classification score. They were randomly bred by artificial insemination to the cows for a 27-day period, after which, two "clean-up" bulls were turned with the cows. No classification scores were obtained from the "clean-up" bulls as they were sold from the ranch before scores could be taken.

The scores of various live traits of two of the sires, the mean of certain traits of the cows to which they were bred, and the mean of certain traits among sire progeny groups were plotted on Herd Classification Graphs used by the American Angus Association. These graphs indicated that despite the fact that scores on individual traits of the bulls were very similar, sires with the same scores may or may not exert exactly the same influence on their offspring. The graphs indicated that evaluation scores of the progeny of the "clean-up" bulls were not improved by the sires since most mean scores were below the mean scores of their dams.

Some important live and carcass traits can be reasonably predicted by live evaluation. Market price was positively correlated with carcass yield grade (.36**), slaughter grade (.85**), and scores for forearm (.32**), type (.74**), bone (.55**), size (.37**), thighs and rounds (.72**), and muscling over the top (.62**). The carcass yield grade was positively correlated with slaughter grade (.47**), slaughter size (.38**), loin (.30*), rib and back (.31*), bone (.29*) and thighs and rounds (.34*). Slaughter grade was positively correlated with market price (.85**), type (.74**), carcass conformation (.47**), weaning grade (.48**), and feeder grade (.29*).

However, some carcass traits were not accurately predicted by live overall evaluation. Slaughter grade was positively, but not significantly, correlated with area of ribeye (.22) and carcass grade (.12). The type score of the slaughter steers was essentially independent of slaughter grade ($r = -.07$), weight of the trimmed primal cuts ($r = -.01$), area of ribeye (.01), quality grade (.00), and degree of marbling (.04).