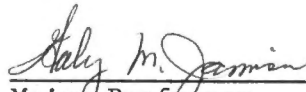


February 20, 1970

To the Graduate Council:

I am submitting herewith a thesis written by James Wayne McKee entitled "Factors Affecting Variation in the Production of Beef Cattle at Ames Plantation." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.


Major Professor

We have read this thesis and
recommend its acceptance:




Accepted for the Council:


Vice Chancellor for Graduate
Studies and Research

FACTORS AFFECTING VARIATION IN THE PRODUCTION OF BEEF

CATTLE AT AMES PLANTATION

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

James Wayne McKee

March 1970

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ABSTRACT

The performance records of 1,534 non-creep fed, purebred Angus heifer and bull calves born during the months of January, February, March and April at Ames Plantation were utilized in this study. These data were collected over a 12-year period (1957-68). Two of the traits of economic importance in Tennessee, average daily gain from birth to weaning and type score at weaning, along with condition grade were studied in these analyses. The objective of this study was to evaluate the influence of sex of calf, age of dam, and month of birth on these traits and to propose adjustment factors to remove from the variables as much as possible of the influence of certain of these environmental effects. Analyses were conducted on all of the data and on data from the first half and last half of the 12-year period.

In all analyses, sex of calf had a significant effect ($P < .01$) on average daily gain from birth to weaning. Male calves gained an average of 0.18 pounds per day more than female calves.

The effects of sex of calf on type score were non-significant in some analyses, but in two analyses male calves graded 0.52 and 1.10 points, respectively, higher than female calves.

The data indicated also that heifer calves, on the average, had condition grades that were one-third of a grade higher than male calves.

Month of birth had no significant effect on average daily gain to weaning. However, the month the calf was born did have a significant effect ($P < .05$) on type score in one analysis. The effect of month of

birth on condition grade was significant ($P < .05$) in only one analysis.

In all but one analysis age of dam was found to have a highly significant effect on average daily gain from birth to weaning. These data show that a cow's individual performance was lowest at 2, 3, 4 and 12 years of age. In all but one analysis age of dam had a highly significant effect on type score. These data indicate that the maximum type score of a cow's calves was attained when she was within the age range of 3 to 9 years and decreased as she became older. The effects of age of dam on condition grade were significant. Calves of 5- and 6-year-old cows had a higher condition grade than calves of cows of other age groups.

While weaning age had a significant ($P < .01$) effect on average daily gain to weaning, it did not have a significant effect on type score. The relationship between weaning age and type score was negative in three analyses, indicating that as calves became older, the type scores were lower. Weaning age had a significant ($P < .01$) effect on condition grade in only one analysis. Since the linear relationships in all analyses were positive, one would conclude that as the calf became older than the mean age the condition grade would be higher.

The effects of condition grade on type score was significant in only two analyses. The correlation between condition grade and type score was 0.52. This was the highest correlation of any combination of traits studied. In all analyses, condition grade as a continuous variable had a significant ($P < .01$) positive effect on average daily gain from birth to weaning.

On the basis of the amount of variation accounted for and the time of collection of the data used in each analysis, the analyses of the last six years' data were chosen as the appropriate ones on which to base the calculation of additive least-squares adjustments for the effects of sex, month-of-birth and age of dam.

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CHAPTER I

INTRODUCTION

Beef cattle producers who expect to realize a profit from their cattle enterprises need to be concerned with selecting animals of superior performance and type. This is especially true if they are to meet the challenge of competition from other livestock and food producers. In the past, visual observation of external appearance was the sole criterion of selection in most herds. However, in recent years the use of performance records as an aid to selection has been introduced. Performance records permit beef cattle producers to reliably compare the producing ability of cattle raised on one farm under the same environmental conditions.

Progress in improving beef cattle herds by such selection is relatively slower than with swine or sheep because of the longer generation interval and lower reproductive rate of beef cattle.

Most beef producers are using selection in efforts to improve type and rate of gain. However, these producers need to be aware of various factors that may influence the effectiveness of their selection in order to conduct a program of selection which will produce the most progress in improving their herds. They especially need to be aware of the fact that heritability of the traits and the accuracy and intensity of selection practiced determine the progress that is made. The accuracy of selection can be improved by adjusting individual animal's values to remove as much as possible of the environmental

variation before comparisons between animals are made for selection purposes.

The objective of this study was to evaluate the influence of sex of calf, age of dam and month of birth on average daily gain from birth to weaning, type score at weaning and to propose adjustment factors to remove from the variables as much as possible of the influence of certain of these environmental effects.

CHAPTER II

REVIEW OF LITERATURE

Many of the permanent environmental factors which affect average daily gain from birth to weaning and type score at weaning have been investigated and reported.

The large amount of variation among estimates from different investigations points out the extreme difficulty in being able to establish biological parameters. Therefore, variations in the magnitude and intensity of these influences on average daily gain and type score are not surprising.

The following review contains studies thought to be comparable to the present investigation.

I. EFFECTS OF CERTAIN PERMANENT ENVIRONMENTAL SOURCE OF VARIATION

Sex. Most investigators have found sex to significantly influence average daily gain from birth to weaning. A review article by Petty and Cartwright (1966) summarizes these effects. These average estimates indicate that bull calves can be expected to gain approximately 0.15 pounds per day more than heifer calves and 0.06 pounds per day faster than steer calves.

Marlowe, Mast and Schalles (1965) reported estimates of some non-genetic influences on calf performance based on 17,294 Angus records and 11,663 Hereford records. The genetic and environmental bases of these

data are believed to be quite similar to those found in Tennessee. Non-creep-fed Angus bull calves gained 0.22 pound per day more from birth to weaning than heifer calves and 0.11 pound per day more than steer calves. Creep-fed Angus bull calves gained 0.26 and 0.14 pound per day more than heifers and steers, respectively. Comparable estimates for Hereford calves were 0.21 and 0.10 pound per day for calves receiving no creep and 0.28 and 0.09 pound for creep-fed calves.

A limited number of studies on the influence of sex and type score at weaning are reported in the literature. Koch and Clark (1955), in a study involving 5,962 Hereford calves, concluded that sex influences on type score at weaning were negligible. Sex differences observed in weaning type score by Marlowe and Gaines (1958), Taylor et al. (1960), Lehmann et al. (1961) and Marlowe (1962) were 0.5, 0.3, 0.9 and 0.5 units, respectively, in favor of heifer calves. Loganathan (1962) reported that among purebred calves, males scored 12.0 and females 11.8. The difference, however, was not significant. The corresponding figures for grade calves produced in the same herd were 12.1 and 12.0, respectively.

Jamison (1966) found that male calves were given type scores slightly higher than those given heifers.

Month of birth. Marlowe and Gaines (1958) studied the effects of calving season on beef cattle production in Virginia. They reported that season of birth had a significant effect on growth of non-creep fed calves but did not affect the growth of creep-fed calves. Type score was not significantly influenced by season of birth in either creep- or non-creep-fed groups.

Lehmann et al. (1961) reported that season of birth significantly affected average daily gain of both creep-fed and non-creep-fed calves.

Barker (1964) observed average daily gain of calves born in January, February and March to be significantly higher ($P < .01$) than those born in other months. He reported also that calves born in August, September, October and November had a lower type score at weaning than calves born during other months.

Age of dam. Many estimates for the effects of age of dam on average daily gain from birth to weaning and weaning type score have been reported. A summary of recent estimates of these effects, as reported by Petty and Cartwright (1966), are shown in Tables I and II.

Jamison (1966), studying factors affecting intra-cow variation, found that calves from 2-, 3-, and 4-year-old dams gained 0.10, 0.05, and 0.03 pound per day, respectively, less to weaning than did calves from 6-year-old dams. In Jamison's study, calves from dams 2 years old and those from dams 9 years of age and older were scored lower for weaning type than were calves out of dams between the ages of 3 and 8 years. In general, calves from 2-, 3-, and 4-year-old dams weighed less at birth, gained less to weaning, and scored lower for weaning type than did calves from mature cows.

In general, the estimates of these effects indicate that cows wean their heaviest calves when 6 to 8 years of age. Most reports indicate that calves out of 2-, 3-, and 4-year-old cows have average daily gains at weaning of about 0.23, 0.14 and 0.08 pound, respectively, less than calves out of 5-year-old dams.

TABLE I

SUMMARY OF ESTIMATED EFFECTS OF AGE OF DAM ON AVERAGE DAILY GAIN FROM BIRTH TO WEANING
EXPRESSED AS DEVIATIONS FROM BASES SELECTED BY THE RESPECTIVE AUTHORS

Author	Breed	Age of Dam, Years								
		2	3	4	5	6	7	8	9	10
Marlowe and Gaines (1958)	Mixed	-.30	-.17	-.11	-.08	-.04	0.00	-.06	-.01	-.07
Lehmann et al. (1961)	Mixed	-.13	0.00	0.10	0.14	0.20	0.13	0.14	0.10	0.10
Loganathan (1962)	Hereford	-.23	-.14	-.08	0.00	0.01	0.06	0.05	0.03	0.09
	Hereford	-.24	-.16	-.05	-.02	0.03	0.07	0.30	0.04	0.02
Swiger et al. (1962)	Angus	-.10	-.08	0.04	0.02	0.04	0.06	0.00	0.04	-.01 ^a
	Hereford	-.22	-.12	-.02	0.03	0.07	0.06	0.09	0.07	-.01 ^a
Brinks et al. (1962)	Hereford		-.14	-.08	-.02	0.00	0.01	0.03	0.02	-.01 ^a
Cunningham and Henderson (1965)	Angus	-.26	-.16	-.07	-.04	-.03	0.00	0.00	0.00	0.00
	Hereford	-.26	-.19	-.08	-.03	-.01	0.00	0.00	0.00	0.00
Marlowe, Mast, and Schalles (1965)	Angus	-.18	-.10	-.06	-.03	-.02	0.00	0.00	-.01	-.01
	Hereford	-.23	-.11	-.07	-.03	0.00	0.00	0.00	-.01	-.01
Petty (1966)	Hereford	-.28	-.16	-.08	0.01	0.05	0.10	0.07	0.04	0.12
Average ^b		-.25	-.16	-.07	-.03	0.00	0.02	0.03	0.00	

^aIncludes that age and older.

^bAverages calculated using constants adjusted to a base of 6 years of age from those reports where cows calved at 2 years of age.

TABLE II

SUMMARY OF ESTIMATED EFFECTS OF AGE OF DAM ON WEANING TYPE SCORE EXPRESSED AS
DEVIATIONS FROM BASES SELECTED BY THE RESPECTIVE AUTHORS

Author	Breed	Age of Dam, Years								
		2	3	4	5	6	7	8	9	10
Marlowe and Gaines (1958)	Mixed	-.9	-.4	-.3	-.1	0.1	0.0	-.1	-.3	-.3
	Mixed	-.7	0.0	0.2	0.5	0.6	0.3	0.4	0.2	-.3
Loganathan (1962)	Hereford	-.9	0.1	-.1	0.3	0.4	0.4	0.3	0.3	0.5
	Hereford	-.5	-.6	-.1	-.2	0.7	1.5	0.0	-.8	0.0
	Hereford ^a	-1.0	-.5	0.0	0.2	0.3	0.5	0.1	0.1	0.4
	Hereford ^a	-.4	-.6	-.5	-.3	0.0	1.6	0.7	-.4	0.0
Brinks et al. (1962)	Hereford ^b		-2.6	-1.3	-.3	0.0	-.3	1.7	1.3	-.9 ^c
Shelby et al. (1963)	Hereford ^b		-2.0	-.2	1.3	1.3	1.3	1.3	1.3	0.5 ^c
Cunningham and Henderson (1965)	Angus	-.5	-.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
	Hereford	-.5	-.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0
Harlowe, Mast and Schalles (1965)	Hereford	-.2	-.1	-.1	0.0	0.0	0.0	0.0	0.0	0.0
	Angus	-.1	0.0	0.0	0.1	0.0	0.0	-.1	-.2	-.2

TABLE II (continued)

Author	Breed	Age of Dam, Years								
		2	3	4	5	6	7	8	9	10
Petty (1966)	Hereford ^d Hereford	-.3 -.2	-.2 -.2	-.1 0.0	0.2 0.1	0.2 0.0	0.4 0.2	0.1 0.1	0.0 0.1	0.1 0.0
Average ^e		-.8	-.5	-.3	-.1	0.0	0.1	-.2	-.3	

^aCondition score constants.

^b5 points = 1 score as comparable to the other reports.

^cIncludes that age and older.

^d9 possible scores as compared to 15 in other reports.

^eAverages calculated using constants adjusted to a base of 6 years of age from those reports where cows calved at 2 years of age. Averages exclude constants for condition score.

Condition grade. Little information concerning sources of variation in weaning condition grades was found in the literature. Pahnish et al. (1964), in a study involving approximately 700 Hereford calves in Arizona, reported average weaning condition grades of 10.9 and 10.5, respectively, for heifer and bull calves. Standard deviation of 1.06 for heifers and 0.82 for bull calves were found. Pahnish reported corroborative results by Synar (1958) in other Arizona work.

Age at weaning. Under most management regimes, age of calf at weaning is usually confounded with month of birth. Therefore, this effect may vary from location to location depending upon the average calving date in a given herd.

However, it is a possible source of environmental variation the magnitude of which has been estimated. Jamison (1966) found it to be a negligible source of variation in average daily gain to weaning. On the other hand, Barker (1964) found calves 120 to 177 days of age at weaning to have a higher average daily gain than those weaned from 180 to 300 days of age.

Marlowe, Mast, and Schalles (1965) reported a small positive relationship between type and age at weaning. This is in agreement with the findings of Koch and Clark (1955), Barker (1964), and Jamison (1966). In view of this, it appears that age at weaning is an effect which may not drastically affect the variation in performance to weaning but, depending on the situation, may have a consistent influence.

CHAPTER III

EXPERIMENTAL PROCEDURE

I. SOURCE OF DATA

The data used in this study were collected over a 12-year period (1957-1968) from the purebred Angus herd of Ames Plantation, a Field Station of the University of Tennessee. The station is located just north of Grand Junction in West Tennessee. It is about 60 miles east of Memphis and 10 miles north of the Mississippi state line. The climate is humid and temperate. The normal growing season averages 209 days. The mean seasonal temperature varies from approximately 42 degrees Fahrenheit in winter to 78 degrees in summer.

The herd was established in 1912 by Mr. Hobart Ames. When the University of Tennessee and the Trustees of the plantation entered into an agreement in 1955, it was decided that the Angus breeding program be expanded and an intensive progeny testing program initiated. During the early period, dwarfism occurred. To eliminate dwarfism, a program was started whereby all animals producing dwarfs or their relatives were gradually eliminated and replaced by animals that by pedigree analysis were believed to be free of dwarfism. The animals purchased were predominantly General and Bardolier breeding. This rebuilding program extended into the early 1960's.

Very little selection pressure was exerted on females prior to 1965. During the last 4 years considered, sufficient numbers were

available to allow some selection among both replacement heifers and older breeding females. Selection among replacement heifers was on type score and average daily gain, with a preliminary selection made at weaning and final selection made the following spring. It was estimated that about 80 percent of the heifer calves weaned were added to the herd during the period under study. Selection among cows was on the basis of both reproductive and progeny performance. Cows which were designated open as of a pregnancy check in the fall following a failure to calve the previous spring were usually culled. The progeny record considered was the average performance of all calves from a cow.

Sire selection was similar to that practiced among heifers. All sires used in the herd were evaluated for gain and type at weaning and at the end of a postweaning performance test. Prospective bulls from outside sources were selected on the basis of their weaning records. These bulls were usually purchased at weaning and placed on postweaning test with the calves selected from the Ames herd.

The cow herd had access to pasture the year around and were fed hay, silage and protein supplement as required during the winter months.

For breeding purposes the cows were classified on the basis of age and past performance records then randomly assigned to sire groups. Cows were bred in single-sire groups and were reassembled into larger groups following the breeding season.

The records of 1534 purebred Angus calves were found suitable for this study. They were sired by purebred bulls. Only records of non-creep fed heifer and bull calves, born during the months of January through April, inclusive, were used in this study. The distribution of

calves by year and sex along with the means and standard deviations of birth weight, age of dam, weaning age, average daily gain from birth to weaning, type score and condition grade at weaning are shown in Tables XX through XXV inclusive, of the Appendix, pages 47 through 52, respectively.

II. CLASSIFICATION OF DATA

Data recorded for each calf at birth included birth date, birth weight, sex, sire and dam. Weaning data included weaning weight, weaning type score and weaning condition grade. Weaning data were usually recorded in September; however, it was usually October when the calves were actually weaned. This allowed time for an index based on rate of gain and type score to be computed in order that selection of bull calves to be performance tested could be made at weaning.

All calves were graded by two or more staff members of the Animal Husbandry-Veterinary Science Department of The University of Tennessee. Each grader worked independently. However, since these men worked together in grading a large number of calves each year, the means and variances of their grades were similar. The coded scores of the two graders were averaged to obtain the type score and condition grade for the individual calves.

The grades were coded by giving Good a numerical value of 10 and adding or subtracting one (1) for each one-third of a grade above or below Good.

The coded scores of the two graders were averaged to the nearest 0.1 grade point (1/30th of a grade). The numerical codes were: fancy plus (17), fancy (16), fancy minus (15), choice plus (14), choice (13),

choice minus (12), good plus (11), good (10), good minus (9), medium plus (8), medium (7), and medium minus (6).

The effective range of type scores in these data was 10 through 15. Very few animals were given scores outside this range. The numerical codes for condition grade were the same as those for type score, with the feeder grade replaced by the appropriate slaughter grade. The effective range of these scores was 7 through 12.

Age of dam at calving was arbitrarily divided into discreet classes on the one-half year; therefore, the age of dam 3 would be that for an animal whose dam was between 2-1/2 and 3-1/2 years of age. All animals 11-1/2 years old or older were classified as age of dam 12.

The average daily gain for each individual calf was calculated by subtracting an actual birth weight from the recorded weaning weight and dividing this weight by age in days.

III. METHOD OF ANALYSIS

In order to remove year differences which were certain to exist within and between the classification factor groups under analyses, it was necessary to absorb year effects in all analyses. In using this procedure one assumes that interactions of this factor with other sources of variation included in these analyses were negligible.

The age of calves at weaning ranged from 120 to 275 days. The mean weaning age for the 12-year study was 230.3 days. The condition grade, a subjective attempt to evaluate differences in condition which exist among calves, had a mean value of 9.2.

Sire effects were so distributed that considerations of such effects in these analyses seemed unnecessary. A study of the unadjusted means indicated there were no significant interactions between the various classes of sire effects.

Least-squares estimates of the effects of sex of calf, month of calving, age of dam and continuous variables for weaning age and condition grade upon average daily gain from birth to weaning and type score at weaning were obtained by the method of fitting constants as described by Harvey (1960).

In three of the analyses condition score was included as a dependent variable. The model on which the analyses were based was:

$$Y_{ijkl} = \mu + s_i + m_j + d_k + b_1 W_{ijkl} + b_2 C_{ijkl} + e_{ijkl}$$

Where:

Y_{ijkl} = is the observed value of a given trait, $ijkl$ th individual

$\hat{\mu}$ = the population mean with equal subclass numbers, i.e., an effect common to all individuals in the population sampled.

s_i = effect of i -th sex, $i = 1, 2$

m_j = effect of j -th month of birth, $j = 1, 2, 3, 4$

d_k = effect of k -th age of dam, $k = 2, \dots, 12$

b_1 = partial regression of Y on weaning age

b_2 = partial regression of Y on condition grade

C = Condition grade

W = Weaning in days

e_{ijkl} = random error associated with an individual record.

The data were subjected to six different analyses in order to assess estimates of the effects of the independent variables on the performance traits. Data representing 12 years (1957-68) of the study, the first 6 years (1957-62) and the last 6 years (1963-68) comprised the first three analyses. The last three analyses, with the same year divisions, included condition grade as an independent variable rather than as a dependent variable.

CHAPTER IV

RESULTS AND DISCUSSION

For ease of discussion the analyses of the three dependent variables, namely, average daily gain type score and condition grade, with weaning age as a continuous independent variable utilizing data collected over the twelve-year period (1957-68), the first six years (1957-62) and the last six years (1963-68) will henceforth be referred to as Analyses I, II and III, respectively. The analyses of two dependent variables, average daily gain and type score, with weaning age and condition grade as continuous independent variables and the same periods specified for Analyses I, II and III, will henceforth be referred to as Analyses IV, V and VI, respectively. No attempt was made to separate means within a subclass when three or more effects were included.

The least-squares estimates of the environmental effects on average daily gain from birth to weaning, type score and condition grade from Analyses I, II and III are presented in Tables III, IV and V, respectively. The least squares estimates of the environmental effects on average daily gain from birth to weaning and type score at weaning from Analyses IV, V and VI are presented in Tables VI, VII and VIII, respectively. The corresponding analyses of variance for Analyses I, II and III are presented in Tables IX, X and XI, respectively, while the corresponding analyses of variance for Analyses IV, V and VI are presented in Tables XII, XIII and XIV, respectively. Means and standard errors are presented in Table XV.

TABLE III
LEAST-SQUARES ESTIMATES FOR TRAITS STUDIED EXPRESSED
AS DEVIATIONS FROM THE MEAN (1957-68) ANALYSIS I

Source	No. of animals	Dependent Variables		
		Type score	Condition grade	A.D.G.
Mean	1,534	12.3	9.2	1.65
Sex				
Males	757	0.058	-.605	0.092
Females	777	-.058	0.605	-.092
Month of birth				
January	382	0.217	0.032	0.045
February	537	0.060	0.009	0.026
March	413	-.107	0.064	-.021
April	202	-.170	-.105	-.050
Age of dam				
2	185	-.574	-.695	-.194
3	250	-.034	0.010	-.069
4	198	0.096	0.062	-.017
5	161	0.370	0.314	0.066
6	145	0.166	0.109	0.047
7	114	0.157	0.048	0.070
8	111	0.264	0.111	0.056
9	109	0.213	0.165	0.039
10	91	-.052	0.079	0.043
11	58	-.183	0.101	0.013
12	113	-.423	-.304	-.054
Regression of dependent variable on:				
Weaning age		0.0001	0.0066	-.0023

TABLE IV
LEAST-SQUARES ESTIMATES FOR TRAITS STUDIED EXPRESSED AS
DEVIATIONS FROM THE MEAN (1957-62) ANALYSIS II

Source	No. of animals	Dependent Variables		
		Type score	Condition grade	A.D.G.
Mean	654	12.0	9.1	1.60
Sex				
Males	329	-.059	-.390	0.092
Females	325	0.059	0.390	-.092
Month of birth				
January	132	0.555	-.449	0.045
February	305	0.227	-.443	0.020
March	152	-.235	0.311	-.022
April	65	-.547	-.581	-.043
Age of dam				
2	83	-.375	-.616	-.123
3	133	0.203	0.263	-.048
4	103	0.263	0.191	0.002
5	75	0.513	0.479	0.066
6	63	0.082	-.168	-.021
7	41	0.282	0.132	0.055
8	34	0.146	-.129	0.051
9	31	0.136	0.388	0.032
10	29	-.312	-.059	0.035
11	18	-.186	0.197	0.045
12	44	-.752	-.796	-.094
Regression of dependent variable on:				
Weaning age		-.0116	0.0202	-.0028

TABLE V
LEAST-SQUARES ESTIMATES FOR TRAITS STUDIED EXPRESSED AS
DEVIATIONS FROM THE MEAN (1963-68) ANALYSIS III

Source	No. of animals	Dependent Variables		
		Type score	Condition grade	A.D.G.
Mean	880	12.4	9.3	1.69
Sex				
Males	428	0.132	-.761	0.090
Females	452	-.132	0.761	-.090
Month of birth				
January	250	0.019	0.160	0.034
February	232	-.027	0.241	0.026
March	261	-.059	-.063	-.021
April	137	0.067	-.338	-.039
Age of dam				
2	102	-.715	-.746	-.250
3	117	-.222	-.241	-.084
4	95	-.050	0.110	-.033
5	86	0.298	0.150	0.067
6	82	0.264	0.285	0.097
7	73	0.085	0.031	0.078
8	77	0.316	0.247	0.057
9	77	0.260	0.099	0.044
10	62	0.105	0.102	0.047
11	40	-.150	0.090	0.003
12	69	-.191	-.127	-.026
Regression of dependent variables on:				
Weaning age		0.0056	0.0023	-.0019

TABLE VI

LEAST-SQUARES ESTIMATES FOR TRAITS STUDIED EXPRESSED AS
DEVIATIONS FROM THE MEAN (1957-68) ANALYSIS IV

Source	No. of animals	Dependent Variables	
		Type score	A.D.G.
Mean	1,534	12.3	1.65
Sex			
Males	757	0.263	0.108
Females	777	-.263	-.108
Month of birth			
January	382	0.206	0.044
February	537	0.057	0.026
March	413	-.129	-.023
April	202	-.134	-.047
Age of dam			
2	185	-.339	-.175
3	250	-.038	-.069
4	198	0.075	-.018
5	161	0.263	0.057
6	145	0.129	0.044
7	114	0.141	0.069
8	111	0.226	0.053
9	109	0.157	0.034
10	91	-.079	0.041
11	58	-.217	0.010
12	113	-.318	-.046
Regression of dependent variable on:			
Condition grade		0.3387	0.0266
Weaning age		-.0023	-.0025

TABLE VII

LEAST-SQUARES ESTIMATES FOR TRAITS STUDIED EXPRESSED AS
DEVIATIONS FROM THE MEAN (1957-62) ANALYSIS V

Source	No. of animals	Dependent Variables	
		Type score	A.D.G.
Mean	654	12.0	1.60
Sex			
Males	329	0.047	0.097
Females	325	-.047	-.097
Month of birth			
January	132	0.677	0.051
February	305	0.347	0.025
March	152	-.319	-.026
April	65	-.705	-.050
Age of dam			
2	83	-.208	-.116
3	133	0.131	-.051
4	103	0.239	0.001
5	75	0.383	0.060
6	63	0.127	-.019
7	41	0.246	0.053
8	34	0.181	0.053
9	31	0.131	0.027
10	29	-.296	0.036
11	18	-.240	0.043
12	44	-.694	-.087
Regression of dependent variable on:			
Condition grade		0.2717	0.0126
Weaning age		-.0171	-.0031

TABLE VIII

LEAST-SQUARES ESTIMATES FOR TRAITS STUDIED EXPRESSED AS
DEVIATIONS FROM THE MEAN (1963-68) ANALYSIS VI

Source	No. of animals	Dependent Variables	
		Type score	A.D.G.
Mean	880	12.4	1.69
Sex			
Males	428	0.550	0.134
Females	452	-.550	-.134
Month of birth			
January	250	-.068	0.025
February	232	-.159	0.121
March	261	-.024	-.017
April	137	0.251	-.129
Age of dam			
2	102	-.306	-.207
3	117	-.090	-.070
4	95	-.110	-.040
5	86	0.216	0.058
6	82	0.108	0.080
7	73	0.068	0.076
8	77	0.181	0.043
9	77	0.205	0.038
10	62	0.049	0.041
11	40	-.199	-.002
12	69	-.122	-.017
Regression of dependent variable on:			
Condition grade		0.5477	0.0043
Weaning age		0.0580	-.0020

TABLE IX
ANALYSIS OF VARIANCE OF PERFORMANCE TRAITS STUDIED
(1957-68) ANALYSIS I

Source of variation	d.f.	Mean Squares		A.D.G.
		Type score	Condition grade	
Sex	1	5.065	555.088**	12.652**
Month of birth	3	1.317	1.065	0.560
Age of dam	10	12.386**	12.066**	1.011**
Regression of the dependent variable on:				
Weaning age	1	0.001	1.549	0.679**
Residual	1507	1.458	2.180	0.036
R ²		0.068	0.186	0.317

**P < .01.

TABLE X
ANALYSIS OF VARIANCE OF PERFORMANCE TRAITS STUDIED
(1957-62) ANALYSIS II

Source of variation	d.f.	Mean Squares		
		Type score	Condition grade	A.D.G.
Sex	1	2.191	96.009**	5.380**
Month of birth	3	2.988	7.098	0.022
Age of dam	10	7.321**	8.026*	0.241**
Regression of the dependent variable on:				
Weaning age	1	6.126	18.607*	0.361**
Residual	633	1.690	3.542	0.387
R ²		0.072	0.090	0.284

*P < .05.

**P < .01.

TABLE XI
ANALYSIS OF VARIANCE OF PERFORMANCE TRAITS STUDIED
(1963-68) ANALYSIS III

Source of variation	d.f.	Mean Squares		A.D.G.
		Type score	Condition grade	
Sex	1	15.077	498.273**	6.925**
Month of birth	3	0.539	3.520*	0.040
Age of dam	10	8.500	7.771**	0.902**
Regression of the dependent variable on:				
Weaning age	1	2.355	0.385	0.273**
Residual	859	1.243	1.077	0.033
R ²		0.113	0.411	0.380

*P < .05.

**P < .01.

TABLE XII
ANALYSIS OF VARIANCE OF PERFORMANCE TRAITS STUDIED
(1957-68) ANALYSIS IV

Source of variation	d.f.	Mean Squares	
		Type score	A.D.G.
Sex	1	89.104**	14.976**
Month of birth	3	1.698	0.068
Age of dam	10	5.858**	0.829**
Regression of the dependent variable on:			
Condition grade	1	376.880**	2.328**
Weaning age	1	0.667	0.784**
Residual	1506	1.209	0.035
R ²		0.228	0.346

**P < .01.

TABLE XIII
ANALYSIS OF VARIANCE OF PERFORMANCE TRAITS STUDIED
(1957-62) ANALYSIS V

Source of variation	d.f.	Mean Squares	
		Type score	A.D.G.
Sex	1	1.340	5.724**
Month of birth	3	5.042*	0.030
Age of dam	10	4.240**	0.213**
Regression of the dependent variable on:			
Condition grade	1	165.554**	0.358**
Weaning age	1	13.193**	0.426**
Residual	632	1.431	0.038
R ²		0.216	0.294

*P < .05.

**P < .01.

TABLE XIV
ANALYSIS OF VARIANCE OF PERFORMANCE TRAITS STUDIED
(1963-68) ANALYSIS VI

Source of variation	d.f.	Mean Squares	
		Type score	A.D.G.
Sex	1	168.681**	10.017**
Month of birth	3	2.386	0.018
Age of dam	10	2.313	0.595**
Regression of the dependent variable on:			
Condition grade	1	277.627**	3.110**
Weaning age	1	1.427	0.311**
Residual	858	0.922	0.029
R ²		0.344	0.448

**P < .01.

TABLE XV
 MEANS AND STANDARD DEVIATIONS OF CERTAIN DEPENDENT AND
 INDEPENDENT VARIABLES (12 YEARS, 1,534 CALVES)

Variable	Mean	Standard deviation ^a
Birth weight	57.1	.18
Age of dam	5.9	.08
Weaning age	230.3	.73
Weaning		
ADG	1.65	.01
Type	12.3	.03
Condition	9.2	.03

^aStandard deviations are calculated on a within-year-and-sex basis.

I. SEX EFFECTS

Sex of calf in all analyses had a significant effect ($P < .01$) on average daily gain from birth to weaning. Male calves in Analyses I, II and III had an average daily gain from birth to weaning of 0.18 pounds greater than females. In Analyses IV, V and VI, male calves had an average daily gain from birth to weaning of 0.22, 0.20 and 0.26 pounds greater than females, respectively. These estimates are well within the range of the findings of other workers: 0.22 pound by Marlowe, Mast and Schalles (1965), and 0.15 pound by Petty and Cartwright (1966), and other published estimates of sex-of-calf effects are either larger or smaller than those calculated from these data. These discrepancies between estimates of the sex effects may be attributed, at least in part, to the wide range in weaning age (180-240 days) in various studies.

When weaning age and condition grade were included in the model, the estimates of sex effects became larger; and heifer calves, on the average, had a higher condition grade at weaning than did male calves.

The values of 0.12, 0.11 and 0.26 for the sex-of-calf effects on type score at weaning in Analyses I, II and III, respectively, were non-significant. However, in Analyses IV and VI, with values of 0.52 and 1.10, respectively, these differences were significant ($P < .01$). Sex differences as reported by Marlowe and Gaines (1958), Taylor et al. (1960), Lehmann et al. (1961) and Marlowe (1962) were 0.5, 0.3, 0.9 and 0.5 units, respectively, in favor of heifer calves.

The fact that male calves graded higher than females undoubtedly results from the earlier sexual development of bulls.

The sex effects on condition grade at weaning estimated in Analyses I, II and III were highly significant. Heifer calves, on the average, were scored one-third of a grade higher than male calves. Little information concerning sources of variation in weaning condition grades was found in the literature.

II. MONTH OF BIRTH

Month of birth did not have a significant influence on average daily gain from birth to weaning in any of the analyses, even though calves born in January grew faster from birth to weaning than did calves born in April. In contrast to the non-significant effect in the present study, Barker (1964) reported that average daily gain of calves born in January, February and March was significantly higher than that of calves born in other months.

Month of birth had a significant effect ($P < .05$) on type score at weaning only in Analysis V. In all analyses except Analysis VI, calves born in January were scored higher than calves born in other months, whereas, in Analysis VI April calves were scored highest.

Month of birth in Analysis III had a significant effect ($P < .05$) on condition grade at weaning. Calves born in April scored less than calves born in January, February and March. Corresponding differences existed in both Analyses I and II but were non-significant.

III. AGE OF DAM

Age of dam was considered a discrete variable in all of the analyses since it was thought (Swiger, 1961) that neither a straight

line nor a quadratic curve would accurately describe the biology of the aging process. The effects of age of dam on gain from birth to weaning were highly significant in Analysis I, II, III, IV and V. These data show that a cow's individual performance was lowest at 2, 3, 4 and 12 years of age. These estimates were in general agreement with those reported by Petty and Cartwright (1966).

The estimates of age-of-dam effects on type score indicate that the maximum type score of a cow's calves was attained when she was within the age range of 3 to 9 years, and decreasing as she became older. In general, the largest improvement in a cow's performance as measured by type score of her calves occurred between the ages of 2 and 3 years. These findings are in general agreement with the summary of work reported by Petty and Cartwright (1966).

The effect of age of dam on condition grade was significant. These data indicate that calves of 5- and 6-year-old cows scored higher than calves of cows of other age groups. Since condition grades are subjective estimates, it is probable that the criteria on which the scores are based differ among graders.

IV. WEANING AGE

Difference in weaning ages is undoubtedly one of the many factors concealing the outward expression of differences in genotype and one that should be taken into account when selection is based on performance at weaning.

Previous work has indicated that growth from birth to about 150 days of age is essentially linear after which age average daily gain

tends to decrease. Under most management regimes, age of calf at weaning is usually confounded with month of birth.

The effect of weaning age on gain from birth to weaning in all analyses was significant ($P < .01$). Within the range of weaning age represented in these data, as weaning age increased beyond the mean, that daily rate of gain would decrease between .0020 and .0031 pounds with each additional day of age. These findings are in agreement with those of Barker (1964) who reported that calves between 120 and 177 days of age at weaning had higher average daily gain than those weaned 180 to 300 days of age.

Weaning age did not have a significant effect on type score in Analysis I, II, III, IV and VI, but the effect was highly significant ($P < .01$) in Analysis V. The relationship between weaning age and type score was negative in Analyses II, IV and V, indicating that as calves became older, their type score decreased. This does not agree with the findings of Marlowe, Mast and Schalles (1965) who reported a small positive relationship between type score and age of weaning.

Weaning age had a significant ($P < .01$) effect on condition grade only in Analysis II, and the linear relationships in all analyses were positive. These data certainly indicate that condition grade increases as weaning age increases beyond the mean.

V. CONDITION GRADE

The effect of condition grade on type score was not significant in Analysis IV, but it did have a significant effect on Analyses V and VI. The relationship in each analysis was positive. The correlation

between condition grade and type score in a within-year-and-sex basis was 0.52.

Condition grade as a continuous variable had a significant ($P < .01$) positive effect on average daily gain in all analyses. As average daily gain increases, so does condition grade.

VI. CORRELATIONS

Correlations, calculated on a within-year-and-sex basis are shown in Table XVI. The relationships studied were all positive except that between weaning age and average daily gain from birth to weaning which was negative ($r = -.14$).

The positive relationship of type score at weaning with condition grade at weaning (0.52) indicates the inability of the grader to separate these two traits. Another relationship of interest was type score at weaning with average daily gain from birth to weaning ($r = 0.41$).

VII. ADJUSTMENT FACTORS

The adjustment factors appropriate for adjusting for the environmental effects included in this study are presented in Tables XVII, XVIII and XIX.

The model used in Analysis VI accounted for 67 per cent of the variation in average daily gain from birth to weaning, whereas, in the overall analysis, with weaning age as a continuous variable (Analysis I), only 56 per cent of the variation in average daily gain was accounted for and 59 per cent in Analysis IV.

TABLE XVI
CORRELATIONS AMONG CERTAIN VARIABLES STUDIED^{a,b}

	2	3	4	5	6
1. Birth weight	.15	.06	.01	.25	.30
2. Type score at weaning		.52	.11	.41	.02
3. Condition grade at weaning			.16	.29	.04
4. Weaning age				-.14	.05
5. A.D.G. birth to weaning					.21
6. Age of dam					

^aCorrelations calculated on a within-year-and-sex basis.

^bCorrelations of 0.05 and 0.07 required for significance (P < .05) and (P < .01), respectively.

TABLE XVII
FACTORS APPROPRIATE FOR ADJUSTING AVERAGE DAILY GAIN
OF FEMALE CALVES TO A MALE, JANUARY BIRTH MONTH,
6-YEAR-OLD AGE OF DAM BASIS

	Analysis I	Analysis II	Analysis III	Analysis IV	Analysis V	Analysis VI
Sex ^a	0.184	0.184	0.180	0.216	0.194	0.268
Month of birth						
January	0.000	0.000	0.000	0.000	0.000	0.000
February	0.019	0.025	0.008	0.018	0.026	-.096
March	0.066	0.067	0.055	0.067	0.077	0.042
April	0.095	0.088	0.073	0.091	0.101	0.154
Age of dam						
2	0.241	-.102	0.347	0.219	-.097	0.287
3	0.116	-.027	0.181	0.113	-.032	0.150
4	0.064	0.023	0.130	0.062	0.020	0.120
5	-.019	0.087	0.030	-.013	0.079	0.022
6	0.000	0.000	0.000	0.000	0.000	0.000
7	-.023	0.076	0.019	-.025	0.072	0.004
8	-.009	0.072	0.040	-.009	0.072	0.037
9	0.008	0.053	0.053	0.010	0.046	0.042
10	0.004	0.056	0.058	0.003	0.055	0.039
11	0.034	0.066	0.094	0.034	0.062	0.082
12	0.101	-.073	0.123	0.090	-.068	0.097

^aIn order to adjust the record of a male calf, no adjustment is necessary for sex.

TABLE XVIII
FACTORS APPROPRIATE FOR ADJUSTING TYPE SCORE OF
FEMALE CALVES TO A MALE, JANUARY BIRTH MONTH,
6-YEAR-OLD AGE OF DAM BASIS

	Analysis I	Analysis II	Analysis III	Analysis IV	Analysis V	Analysis VI
Sex ^a	0.116	0.118	0.264	0.526	0.094	1.100
Month of birth						
January	0.000	0.000	0.000	0.000	0.000	0.000
February	0.157	0.328	0.046	0.149	0.330	-.091
March	0.324	0.790	0.078	0.435	0.996	-.044
April	0.387	1.102	-.048	0.340	1.382	0.319
Age of dam						
2	0.740	0.457	0.979	0.468	0.335	0.414
3	0.200	-.121	0.486	0.167	-.004	0.198
4	0.070	-.181	0.214	0.054	-.112	0.218
5	-.204	-.431	0.034	-.134	-.256	-.108
6	0.000	0.000	0.000	0.000	0.000	0.000
7	0.009	-.200	0.179	-.012	-.119	0.040
8	-.098	-.064	-.052	-.097	-.054	-.073
9	-.047	-.054	0.004	-.028	-.004	-.097
10	0.218	0.394	0.159	0.208	0.423	0.059
11	0.349	0.268	0.414	0.346	0.367	0.307
12	0.589	0.834	0.455	0.447	0.821	0.230

^aIn order to adjust the record of a male calf, no adjustment is necessary for sex.

TABLE XIX

FACTORS APPROPRIATE FOR ADJUSTING CONDITION GRADE OF
FEMALE CALVES TO A MALE, JANUARY BIRTH MONTH,
6-YEAR-OLD AGE OF DAM BASIS

	Analysis I	Analysis II	Analysis III
Sex ^a	1.210	0.780	1.522
Month of birth			
January	0.000	0.000	0.000
February	0.023	0.006	-.081
March	-.032	0.760	0.223
April	0.137	-.132	0.498
Age of dam			
2	0.804	-.448	1.031
3	0.099	0.431	0.526
4	0.047	0.359	0.175
5	-.205	0.647	0.135
6	0.000	0.000	0.000
7	0.061	0.300	0.254
8	-.002	0.039	0.038
9	-.056	0.556	0.186
10	0.030	0.109	0.183
11	0.008	0.365	0.195
12	0.413	-.628	0.412

^aIn order to adjust the record of a male calf, no adjustment is necessary for sex.

If all the data were to be subjected to statistical analysis to estimate genetic parameters with respect to average daily gain from birth to weaning, Analysis IV would be most appropriate, having explained 59 per cent of the variation in this trait.

However, the adjustment factors most appropriate for adjusting future data should come from Analysis VI since the data used in Analysis VI were the most recent and 67 per cent of the variation in average daily gain from birth to weaning was accounted for; whereas, Analysis IV accounted for only 59 per cent of the variation in this trait, the economically most important one studied here.

The model used in Analysis IV accounted for 48 per cent of the variation in type score at weaning. In the overall analysis (Analysis IV) the model used accounted for 48 per cent of the variation in type score as compared to 26 per cent in Analysis I. The model used in Analysis VI with weaning age and condition grade as a continuous variable accounted for 59 per cent of the variation in type score; whereas, Analysis III accounted for only 34 per cent of the variation in this trait. The adjustment factors from Analysis VI would be most appropriate to use in adjusting future type score data because this analysis was based on the most recent data and accounted for more variation than did the other analyses.

The adjustment factors that should be used for adjusting future condition data should come from Analysis III because 64 per cent of the variation was accounted for by this analysis and also because data used in this analysis were from the last six years of the study.

The data from Analysis I, which was an overall analysis, accounted for only 43 per cent of the variation in condition grade.

CHAPTER V

SUMMARY

The performance records of 1,534 non-creep fed, purebred Angus heifer and bull calves born during the months of January, February, March and April at Ames Plantation were utilized in this study. These data were collected over a 12-year period (1957-68). Two of the traits of economic importance in Tennessee, average daily gain from birth to weaning and type score at weaning, along with condition grade were studied in these analyses. The objective of this study was to evaluate the influence of sex of calf, age of dam, and month of birth on these traits and to propose adjustment factors to remove from the variables as much as possible of the influence of certain of these environmental effects. Analyses were conducted on all of the data and on data from the first half and last half of the 12-year period.

In all analyses, sex of calf had a significant effect ($P < .01$) on average daily gain from birth to weaning. Male calves gained an average of 0.18 pounds per day more than female calves.

The effects of sex of calf on type score were non-significant in some analyses, but in two analyses male calves graded 0.52 and 1.10 points, respectively, higher than female calves.

The data indicated also that heifer calves, on the average, had condition grades that were one-third of a grade higher than male calves.

Month of birth had no significant effect on average daily gain to weaning. However, the month the calf was born did have a significant

effect ($P < .05$) on type score in one analysis. The effect of month of birth on condition grade was significant ($P < .05$) in only one analysis.

In all but one analysis age of dam was found to have a highly significant effect on average daily gain from birth to weaning. These data show that a cow's individual performance was lowest at 2, 3, 4 and 12 years of age. In all but one analysis age of dam had a highly significant effect on type score. These data indicate that the maximum type score of a cow's calves was attained when she was within the age range of 3 to 9 years and decreased as she became older. The effects of age of dam on condition grade was significant. Calves of 5- and 6-year-old cows had a higher condition grade than calves of cows of other age groups.

While weaning age had a significant ($P < .01$) effect on average daily gain to weaning, it did not have a significant effect on type score. The relationship between weaning age and type score was negative in three analyses, indicating, that as calves became older, the type scores were lower. Weaning age had a significant ($P < .01$) effect on condition grade in only one analysis. Since the linear relationships in all analyses were positive, one would conclude that as the calf became older than the mean age the condition grade would be higher.

The effects of condition grade on type score was significant in only two analyses. The correlation between condition grade and type score was 0.52. This was the highest correlation of any combination of traits studied. In all analyses, condition grade as a continuous variable had a significant ($P < .01$) positive effect on average daily gain from birth to weaning.

Additive least-squares adjustment factors were calculated from all of the analyses. Because a larger fraction of the variation in the traits of interest was accounted for in the analyses based on the last six years' data, the factors calculated from these analyses would be most appropriate for use in adjusting current data from calves born in the Ames Plantation herd if adjustment factors are not calculated from each current year's data.

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LITERATURE CITED

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APPENDIX

TABLE XX

MEANS AND STANDARD DEVIATIONS OF CERTAIN DEPENDENT AND INDEPENDENT VARIABLES, 1957-1958

	1957				1958			
	Male		Female		Male		Female	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
No. of calves		33		32		55		52
Birth weight	58.5	1.47	50.2	1.61	60.8	.75	56.0	1.02
Age of dam	6.3	.63	4.9	.49	4.9	.40	5.1	.44
Weaning age	232.4	4.76	231.5	4.85	237.9	3.01	235.8	4.01
Weaning								
ADG	1.68	.04	1.56	.04	1.66	.04	1.59	.03
Type	12.2	.22	12.1	.22	11.7	.23	12.6	.19
Condition	9.5	.19	8.5	.20	8.8	.15	10.3	.15

TABLE XXI

MEANS AND STANDARD DEVIATIONS OF CERTAIN DEPENDENT AND INDEPENDENT VARIABLES, 1959-1960

	1959				1960			
	Male		Female		Male		Female	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
No. of calves		69		56		61		67
Birth weight	57.5	.95	53.9	1.19	58.5	.91	54.4	.80
Age of dam	5.4	.36	4.8	.39	5.6	.38	5.7	.40
Weaning age	254.4	3.23	260.0	3.59	238.2	2.79	238.5	2.38
Weaning								
ADG	1.51	.02	1.45	.03	1.68	.03	1.37	.02
Type	11.5	.14	11.5	.18	12.0	.19	11.6	.15
Condition	8.0	.12	9.6	.38	9.1	.14	10.5	.12

TABLE XXII

MEANS AND STANDARD DEVIATIONS OF CERTAIN DEPENDENT AND INDEPENDENT VARIABLES, 1961-1962

	1961				1962			
	Male		Female		Male		Female	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
No. of calves		72		56		39		62
Birth weight	62.0	.85	58.5	1.03	57.9	1.49	53.6	.96
Age of dam	5.6	.36	5.7	.32	5.4	.39	6.1	.37
Weaning age	277.1	2.83	283.3	2.81	230.8	4.07	232.0	3.38
Weaning ADG	1.80	.02	1.54	.02	1.89	.03	1.58	.02
Type	12.3	.14	12.5	.14	12.2	.20	12.3	.18
Condition	8.1	.12	10.0	.12	9.0	.14	10.3	.13

TABLE XXIII

MEANS AND STANDARD DEVIATIONS OF CERTAIN DEPENDENT AND INDEPENDENT VARIABLES, 1963-1964

	1963				1964			
	Male		Female		Male		Female	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
No. of calves		80		64		67		74
Birth weight	57.8	.91	53.0	.76	55.0	.81	52.2	.68
Age of dam	6.1	.33	5.5	.36	6.7	.35	6.1	.33
Weaning age	247.9	3.48	241.2	4.23	237.2	3.45	226.9	4.51
Weaning								
ADG	1.61	.03	1.54	.03	1.70	.02	1.51	.02
Type	12.4	.14	12.2	.19	12.5	.13	11.9	.16
Condition	7.4	.11	9.4	.15	7.5	.20	8.1	.11

TABLE XXIV

MEANS AND STANDARD DEVIATIONS OF CERTAIN DEPENDENT AND INDEPENDENT VARIABLES, 1965-1966

	1965				1966			
	Male		Female		Male		Female	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
No. of calves		63		81		76		72
Birth weight	53.9	.69	52.2	.60	62.4	.77	59.4	.83
Age of dam	7.4	.37	6.3	.37	6.2	.39	6.2	.38
Weaning Age	205.4	3.57	207.3	3.72	227.2	3.38	232.4	3.53
Weaning								
ADG	1.68	.03	1.50	.03	1.79	.03	1.61	.02
Type	12.3	.12	11.9	.15	11.9	.10	11.5	.13
Condition	8.2	.10	9.7	.10	8.7	.10	10.2	.18

TABLE XXV

MEANS AND STANDARD DEVIATIONS OF CERTAIN DEPENDENT AND INDEPENDENT VARIABLES, 1967-1968

	1967				1968			
	Male		Female		Male		Female	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
No. of calves		74		78		68		83
Birth weight	62.9	.77	57.3	.72	59.9	.81	58.4	.76
Age of dam	6.6	.38	6.5	.35	6.1	.39	6.4	.36
Weaning age	201.6	3.59	206.0	3.21	228.9	3.46	230.3	3.30
Weaning								
ADG	2.05	.03	1.81	.02	1.90	.02	1.64	.02
Type	13.2	.12	13.3	.11	13.2	.11	12.9	.14
Condition	10.5	.11	12.3	.10	8.9	.09	10.6	.14

VITA

James W. McKee was born in Covington, Tennessee on November 14, 1937, and received his elementary and secondary education in the Tipton County school system. He was raised on a cotton and livestock farm and was graduated from the University of Tennessee, Knoxville in 1959 with a B.S. degree in Agriculture with a major in Agricultural Education.

He worked for the United States Department of Agriculture as a Processed Fruits and Vegetables inspector for four years. In 1963 he was employed by the Agricultural Extension Service as an Assistant County Agent in Haywood County.

Mr. McKee is a charter member of the Farm House Fraternity at the University of Tennessee. He is also a member of Alpha Zeta.

Mr. McKee enrolled in the University of Tennessee Graduate School to work toward a Master of Science degree with a major in Animal Husbandry. He expects to receive his degree in the graduation exercises in March 1970.

In 1960, Mr. McKee was married to the former Beverly Blalack of Brighton, Tennessee. They are the parents of two daughters, ages eight and two.