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Productivity in Hampshire, Dorset and Southdown flocks of sheep and evaluation of factors affecting performance of lambs

Ben Thomas Powell

To the Graduate Council:

I am submitting herewith a thesis written by Ben Thomas Powell entitled "Productivity in Hampshire, Dorset and Southdown flocks of sheep and evaluation of factors affecting performance of lambs." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

H. J. Smith, Major Professor

We have read this thesis and recommend its acceptance:

E. R. Lidvall, Lewis Dickson

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

December 1, 1966

To the Graduate Council:

I am submitting herewith a thesis written by Ben Thomas Powell entitled "Productivity in Hampshire, Dorset and Southdown Flocks of Sheep and Evaluation of Factors Affecting Performance of Lambs." 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.

Harold J. Smith
Major Professor

We have read this thesis and recommend its acceptance:

E. R. Sidwell

Lewis N. Dickson

Accepted for the Council:

Hilton A. Smith
Dean of the Graduate School

PRODUCTIVITY IN HAMPSHIRE, DORSET AND SOUTHDOWN FLOCKS OF SHEEP AND EVALUATION OF FACTORS AFFECTING PERFORMANCE OF LAMBS

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Ben Thomas Powell

December 1966

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CHAPTER I

INTRODUCTION

Agriculture is entering an age where, to survive, the Tennessee farmer must either purchase more land or improve production on the land he has. Most of the time it is more economical to improve one's production per acre or per animal. One method of accomplishing greater production is through selection of superior producing animals. Selection has been done for centuries through visual observation.

To justify their existence as a group, breeders of registered sheep must produce a type of sheep superior to those in the hands of the commercial producers they serve. This superiority must be expressed in demonstrated ability to increase the quantity and quality of the products the operator has for sale, or in increased efficiency of production.

Purebred sheep flocks have been instrumental in establishing the type of commercial lamb which has been produced for several decades. Successful purebred breeders in the future must not only raise sheep of an acceptable breed-type or character, but they also must produce individuals of an excellent known productive ability. These seed stock producers must gear their breeding and selection programs on performance indexes which include a combination of characters such as the pounds of lamb and wool produced per ewe and the quality of the carcass produced, as well as on an acceptable breed type.

Growth rate and other traits of sheep are controlled by both genetic and environmental factors. Heritability estimates for genetic effects have been established as approximately 25 per cent for weaning weight, 35 per cent for rate of gain, and 40 per cent for yearling body weight. Therefore, under desirable management conditions, relatively rapid progress could be made in selection for improved gaining ability within each flock, among various types within breeds, or in the existing breeds of sheep which are prevalent today.

By utilizing selection indexes for rigid culling and replacement ewe selection over a five-year span, commercial sheep producers in Ohio have increased their 120-day lamb weights by 30 pounds. Performance tested flocks in the state of Wisconsin have shown 16 pounds increase in terms of lamb produced per ewe at four months of age. By eliminating the poor performing ewes in both commercial as well as purebred flocks, the total productivity of the Tennessee sheep industry can be increased. The improvement in lamb production can occur and at the same time, the type of sheep can be produced which will meet the approval of veteran sheep breeders.

Gains through breeding are often slower of achievement and less spectacular than gains through improvements in feeding and management. However, genetic gains are permanent, and since the inherited capacities of animals to produce place a ceiling on the production per individual, genetic improvement must accompany improvements in other phases of production if continued progress is to be made.

Estimating the gains which might be achieved by improving the inherited abilities of sheep to produce is not easy. Among other reasons, it is difficult to estimate the net profit resulting from a given genetic change because the benefits of almost any such change are not obtained without some increase in cost. For example, if producers were suddenly presented with ewes all of which consistently produced twins, they would not realize the advantages of this increased potential unless management improved so that these twins had a good chance of survival, nor could they carry the larger number of lambs to market without some increase in feed. Nevertheless, such a genetic change would undoubtedly lead to an increase in efficiency and in profit in almost all sheep enterprises. Likewise, increased rate of gain to weaning or wool production would not be achieved solely by using genetically superior stock. Some additional feed would be required, but raising the more productive individuals would be expected to increase net income.

The problem of an objective measure for selection among potential breeding animals, where more than one trait or character is to be considered, is always faced by breeders. It has been shown that selection is more effective when based on total score or index, combining and properly weighting the several traits under consideration, than it is for single traits or for several traits with independent culling levels.

The purposes of this study were (1) to compare the performance of ewes and lambs from three different breeds of sheep and (2) to

evaluate the effects of various factors including year, age of dam, type of birth and rearing, sex of lamb, month of birth, and sire on birth weight, weaning weight, average daily gain, condition grade, type score, and 120-day weight of lambs.

CHAPTER II

REVIEW OF LITERATURE

Trail and Sacker (1965) made a study of the factors affecting production records of lambs from a flock of East African Blackheaded sheep. They found that birth weights showed considerable variation between years, sometimes differing by as much as 1.5 pounds in average adjusted weight. The influence of type of birth, sex, and class of dam also varied from year to year.

The sex difference (male-female) for singles from ewes was 0.40 pound, singles from gimmers (first lambers) 0.28 pound, and twins from ewes 0.25 pound. Maximum birth weights of lambs were reported as being achieved between the third and sixth parturitions, with the greatest increase between first and second parturitions. The difference in birth weight between lambs from gimmers and lambs from ewes (second and subsequent lambers) was 0.5 pound and the twin effect was 1.0 pound.

Weaning weights were taken as weights at five months of age. The sex difference (male-female) at weaning was 2.9 pounds for singles from ewes, 0.3 pound for singles from gimmers and 0.7 pound for twins from ewes. The difference in weight between lambs from gimmers and lambs from ewes was 2.6 pounds and the twin effect was 6.0 pounds.

They suggested the following adjustments based on their findings:

	Adjustment
Male single from eye	None
Female single from ewe	Add 2.90 pounds
Male single from gimmer	Add 3.90 pounds
Female single from gimmer	Add 4.20 pounds
Male twin from ewe	Add 7.16 pounds
Female twin from ewe	Add 7.83 pounds

Webb (1963) at the University of Tennessee analyzed the birth weight records of 1,009 purebred Hampshire lambs and average daily gain and 120-day weights for 732 purebred Hampshire lambs to determine the effects of age of dam, season of birth, sex, type of birth, and year of birth on birth weight and the effects of age of dam, season of birth, sex, type of birth, type of birth and rearing, and year of birth on average daily gain and 120-day weight.

He found that season of birth, sex, type of birth, and year effects were significant for birth weight, average daily gain, and 120-day weight. The age of dam influences on birth weight were highly significant. Although differences due to age of dam effects were not significant, there was a tendency for average daily gain of lambs to increase with age of dam up to six years and then decline through ten years of age. Age of dam significantly influenced 120-day weight of lambs.

Fernandes (1964) analyzed the records of 739 lambs born and raised at the Plateau Experiment Station, Crossville, Tennessee. Data on lamb performance were adjusted for the effects of year of birth, breeding of lamb, sex of lamb, type of birth, type of rearing, and age of dam. These adjustments were necessary so that comparisons could be made among various breeding groups of ewes.

He found the effects of year of birth, breeding of the lamb, sex of the lamb, type of birth, and age of dam were highly significant for birth weight, weaning weight, and average daily gain. Year of birth, breeding of lamb, type of birth, and age of dam were highly significant for condition score. Breeding of lamb, sex of lamb, and type of birth significantly influenced type score. Type of rearing was highly significant for weaning weight and average daily gain and was significant for condition score. The age of dam was significant for type score.

Sidwell, Everson, and Terrill (1962) studied birth weight, weaning weight, and gain from birth to weaning in Hampshire, Shropshire, Southdown, and Merino breeds of sheep and their crosses and in the Columbia-Southdale strain of sheep at Beltsville, Maryland. Totals of 4,331 lambs born and 3,423 lambs weaned from 1952 to 1961 were included. Breed, breed cross, year, sex, type of birth and rearing, and age of dam all had significant effects on weight at birth and weaning and gain from birth to weaning.

Bogart et al. (1957) at Oregon State College studied the factors affecting birth weight of 280 crossbred lambs born during 1952 and 1953. Suffolk and Southdown rams were crossed on Hampshire, Border Leicester, Romney, and Cheviot ewes.

They found no consistent differences in birth weights of lambs sired by Southdown or Suffolk rams. Birth type contributed the most consistent of all effects on birth weights. Singles were from 1.92 to 2.40 pounds heavier at birth than twins. Year differences in

birth weights were apparent. Consistent but small differences existed between the birth weights of ram and ewe lambs.

Givens, Carter, and Gaines (1960) developed and compared five selection indexes. These were based on weanling traits including daily gain from birth to weaning or slaughter, 120-day weight, and live market grade. They found that selection on daily gain alone seems most practical because it is easiest to use and should give near maximum genetic progress in economic terms.

Broadbent and Bowman (1964) conducted a study of the effects of Suffolk sires on their progeny. They found that Suffolk rams, when used in fat lamb production, influence their progeny in several ways which can be considered to be of economic importance. High growth rate in the progeny is an obvious economic advantage. The difference between the best and worst ram for growth rate represented a 10 per cent increase in growth rate for the progeny of the best ram over the progeny of the worst ram. There was some evidence of ram X ewe type interaction for this trait.

Butcher, Dunbar, and Welch (1964) at West Virginia studied the heritabilities of and correlations between lamb birth weight and 140-day weight. The pooled data from 665 lambs of four breeds gave a phenotypic correlation between birth and 140-day weights of 0.32. This correlation indicates that some accomplishment might be made in determining at birth which lambs would be the heaviest at 140 days. However, this does not necessarily mean there is a genetic correlation between birth and weaning weights. According to this estimate, about

10 per cent of the variance in 140-day weights may be attributed to variance in birth weight.

At the University of Wisconsin, Felts, Chapman, and Pope (1957) used the records from 32 flocks to obtain constants for age of dam and type of birth and rearing effects on 120-day weight. Pooled type of birth and rearing effects expressed in deviations from the overall mean were: 7.9 pounds for male single; -2.3 pounds for a male twin; 1.98 pounds for a male twin reared as a single; 2.8 pounds for a female single, -7.1 pounds for a female twin; and -3.2 pounds for a female twin reared as a single. The age of dam effects expressed as deviations from the overall mean were: -14.26 pounds for a 1-year-old ewe; 0.06 pound for a 2-year-old ewe; 4.57 pounds for a 4-year-old ewe; 3.73 pounds for a 5-year-old ewe; 2.00 pounds for a 6-year-old ewe; and -.34 pound for a 7-year-old ewe.

Blackwell and Henderson (1955), at Cornell University, analyzed the records of 1,295 lambs from 453 ewes for factors affecting weaning weight and the records of 2,158 lambs from 560 ewes for factors affecting birth weight. The lambs were from the Corriedale, Dorset, Hampshire, and Shropshire breeds. They found that age of dam did not significantly affect weaning weight in Dorset lambs. However, there were statistically significant differences among birth weights of lambs from different ages of dams in the Corriedale, Shropshire, and Hampshire breeds. Males were heavier at birth and weaning than ewe lambs. Single lambs were heavier at birth than twins. Single lambs were heavier at weaning than lambs born as twins but reared as

either singles or twins. In the Dorset lambs, an analysis was made to evaluate the effects of season of birth on birth weight and weaning weight. The results showed that lambs born in the spring were 0.40 pound heavier at birth than lambs born in the fall and were 2.85 pounds heavier at weaning. They also found that differences among years were significant.

Sabin and Brown (1962) analyzed the growth records of 291 inbred Hampshire lambs. They found that wethers were 2.25 pounds heavier at sale time, 3.26 pounds heavier at 120 days, and 0.15 pound heavier at birth than ewe lambs. Single lambs were about 8 pounds heavier at sale time and 120 days than twin lambs. Age of dam effects were statistically significant only when sale weight was being considered. However, the ewes were progressively better producers up to six years of age. The age of the ewe had no effect on birth weight of lambs. Differences were obtained in the growth of lambs among years in which the lambs were born and for season of birth within years. A lamb's sale weight was reduced by about one-half pound for each day later in the season in which it was born. However, lambs born late were heavier at birth and grew at a slightly faster rate than early lambs.

Brown, Baugus, and Sabin (1961) analyzed the records of 132 crossbred lambs and 121 inbred Hampshire lambs with complete preweaning growth records. The difference in birth weight between male and female lambs was not significant. However, there was a significant difference in weight between males and females at 120 days in inbred lambs with males averaging about two pounds heavier. The birth weight of single

lambs was about one pound heavier than twins raised as twins, and about one-half pound heavier than lambs born as twins but reared as singles. The 120-day weight for inbred single lambs was eight pounds heavier than twins reared as twins and crossbred singles were seven pounds heavier than twins reared as twins. The 120-day weight for twins reared as singles was three pounds heavier than singles reared as singles. This may have been due to the fact that there was only a small number of twin lambs reared as singles. Lambs from mature inbred ewes (4, 5, and 6-year-olds) were about one pound heavier at birth than lambs from young ewes (2 and 3-year-olds), and about five pounds heavier at 120 days. The difference in birth weight of inbred lambs from aged ewes (over 7 years old) and mature ewes was not significant. Birth weight was not significantly affected by age of dam in crossbred lambs. Crossbred lambs from young ewes were significantly heavier than lambs from mature ewes at 120 days of age with a difference of about eight pounds. Brown indicated that the reason for the difference in the pattern for age of dam effects in crossbred and inbred lambs was not clear. He further stated that the larger number of lambs from aged inbred ewes gave some indication that they had a longer productive life than crossbred ewes. However, inbred ewes reached a mature production at a later age which may contradict the above statement. Management, nutrition, and selection may provide the clues to the reasons for differences in age of dam affects between inbred and crossbred ewes.

Phillips and Dawson (1937), in a study using Southdown lambs, reported that single lambs were heavier at birth than twins and that, on the average, one could expect an increase of 4.3 pounds in weight at three months of age for each increase of one pound in birth weight of single males. Also, they reported that single male lambs would be expected to weight 0.14 pound less on the average at three months for each day's increase in birth date.

Lambe, Bowman, and Rennie (1964) studied the production traits in sheep as affected by breed and environment at the Ontario Agricultural College. Production records from the Ontario Agricultural College sheep flock collected during the years 1950 to 1960 were analyzed to determine the effects of breed, age of dam, year, and type of birth and rearing on three production traits (birth weight, weaning weight, and first fleece weight).

The effects of years were large but essentially random for all traits except birth weight which progressively declined with time. Single lambs outweighed twins by 0.93 pound at birth and 7.8 pounds at weaning. Lambs from mature ewes (4 years or over) were 0.38 pound heavier at birth and 0.88 pound heavier at weaning than those from 3-year-old ewes, which in turn produced lambs that were 0.34 pound heavier at birth and 3.34 pound heavier at weaning than were those from 2-year-old ewes. The analysis indicated that comparisons among sheep should be made within years. Adjusting birth weights for the effects of age of dam and type of birth will add further accuracy.

They suggested the following adjustment factors:

Class	Adjustment factors Birth wt.	Weaning wt.
2-year-old ewe	+1.0	+4.0
3-year-old ewe	+0.5	+1.0
Mature ewe	0.0	0.0
Single lamb	0.0	0.0
Twin or triplet lamb	+1.0	+8.0

CHAPTER III

EXPERIMENTAL PROCEDURE

Source of Data

The data used in this study were collected from three purebred flocks of sheep located in Middle Tennessee. The Hampshire flock of sheep was located in Wilson County, Tennessee in the Linwood Community which is located nine miles east of Lebanon and six miles north of Watertown. This flock is owned and managed by the author and his father. The Dorset and Southdown flocks were located in Marshall County, Tennessee, in the Farmington Community which is located about fifteen miles west of Shelbyville and eight miles northeast of Lewisburg. The Dorset flock is owned and managed by its owner, Thomas Montgomery; and the Southdown flock is owned and managed by its owner, Paul Woodward. All three flocks are located in the Central Basin of Tennessee with Wilson County being on the north edge and Marshall County being on the south edge. Both of these counties are located in the area where most of the sheep are grown in Tennessee. The top ten counties in sheep numbers in Tennessee have 62 per cent of the state total. Wilson County ranks first and Marshall County ranks eighth in sheep numbers in the state.

Flock Management

The birth weight and birth date of the lambs were collected by the flock owners and the weaning weight, condition score, and type

score for each lamb were collected by the author. The data for the Dorset and Southdown flocks were collected over a 3-year-period, 1962-1964 inclusive. The data for the Hampshire flock were collected over a 5-year period, 1961-1965 inclusive. In the Hampshire flock, 39 to 45 ewes were bred each year; in the Dorset flock, 36 to 43 ewes were bred each year; and in the Southdown flock, 26 to 29 ewes were bred each year. Except for a very limited number of ewe lambs which were bred in some years, replacement ewe lambs were carried over and bred for the first time at about 18 months of age. With a very few exceptions, all replacement ewes in all three flocks were selected from within the flock.

The breeding, feeding, and management practices followed in these three flocks were about the same as those followed in any good sound program of sheep production in Tennessee. Throughout most of each year (spring, summer, and fall) the ewes were grazed on pasture. During the usual grazing season the ewes were grazed on good permanent pastures consisting of either native pastures (Bluegrass, Bermuda grass, and White Dutch clover), orchard grass and Ladino clover, or fescue and Ladino clover. They were maintained on these pastures until winter pastures had adequate growth for grazing. These pastures were used primarily for ewes and their lambs. The winter pastures consisted usually of small grain and crimson clover mixtures. The amount of grazing obtained from winter pastures depended upon the time of seeding, fall and winter temperatures and rainfall. High quality hay was made available to the ewes during periods when pastures were inadequate

or during periods of severe cold weather and snow. Also, the ewes were fed grain (one-half to three-fourths pound per head daily) when needed usually starting about four weeks before lambing. Grain feeding of the ewes was usually discontinued when grazing conditions provided adequate feed, usually in mid-March. The lambs in all three flocks were creep fed from birth until grazing conditions became so good that the lambs refused creep feed. The Hampshire and Southdown lambs on the average did not receive as much creep feed as the Dorsets because of later lambing dates. The Southdowns received the least since their average lambing date was February 28 and pasture was usually adequate shortly after that date. The usual procedure was to put the ewes and lambs on winter pastures and then rotate to permanent pastures in late April and May. Adequate salt and water were always available ad libitum.

The lambs were weighed and identified when born. The birth weight, sex, type of birth, year of birth, and dam number were recorded when each lamb was born. Very little castration was done before weaning since it was the practice to wait until that time to select ram lambs to be saved for breeding rams. The lambs were weaned in all three flocks the day they were weighed which usually was at 100-120 days of age.

The breeding season for the Dorsets was usually May 1 to July 1 and September 1 to November 1. The Dorset lambing season was usually during October and November and March and April. The breeding season for the Hampshire flock was June 1 to December 1 with the lambing

season usually occurring in January, February, and March. The breeding season for the Southdown flock was usually July 1 to December 1 with most of the lambs being born in March.

Methods of Analysis

For ease of study and interpretation, the data for the more important productive traits of ewes and lambs were summarized and are presented in Chapter IV.

The average daily gain of lambs from birth to weaning was calculated using the formula:

$$\text{Average Daily Gain (ADG)} = \frac{\text{Weaning weight - birth weight}}{\text{Weaning age in days}}$$

The 120-day weights of lambs were calculated as:

120-day weight = (ADG x 120) + birth weight.

The data on performance for lambs in the Hampshire flock included in the study for the complete period from 1961 through 1965 were analyzed by least squares methods to determine the effects of year, age of dam, sex of lamb, type of birth, type of birth and rearing, month of birth, and sire on various performance traits including birth weight, weaning weight, average daily gain from birth to weaning, condition score, type score, and 120-day weight. The least squares method of analysis as described by Harvey (1960) for analysis of data with unequal and disproportionate subclass numbers was used.

The least squares analysis for birth weight was based on the

following mathematical model:

$$Y_{ijklmno} = u + y_i + a_j + s_k + t_l + c_m + se_n + e_{ijklmno} .$$

Where:

$Y_{ijklmno}$ is the observed value of a given trait for the ijklmno-th individual,

u is the effect common to all observations and is the mean of the population when equal numbers exist in the subclasses (this effect was absorbed in the analysis),

y_i is the effect of the i-th year,

a_j is the effect of the a-th age of dam,

s_k is the effect of the k-th sex of lamb,

t_l is the effect of the l-th type of birth,

c_m is the effect of the m-th month of birth,

se_n is the effect of the n-th sire,

$e_{ijklmno}$ is the random error associated with the ijklmno-th individuals.

For the least squares analysis involving all traits other than birth weight, the mathematical model was altered to delete type of birth and include two other independent variables, type of birth and rearing and weaning age, as follows:

$$Y_{ijklmno} = u + y_i + a_j + s_k + r_l + c_m + se_n + b\ (X-\bar{x}) + e_{ijklmno}.$$

Where:

r_l is the effect of the l-th type of birth and rearing,

$b\ (X-\bar{x})$ is the regression of the dependent variable (Y) on weaning age.

In the analysis it was assumed that there were no interactions among effects.

Duncan's Multiple Range Test (1955) as modified by Kramer (1957) was used for mean separation when significant differences were detected by analysis of variance.

CHAPTER IV

RESULTS AND DISCUSSION

The results and discussion of this study will be divided into two parts: (1) performance of the Hampshire, Dorset, and Southdown flocks in terms of ewe fertility, ewe productivity, and condition and type scores of the lambs and (2) a statistical analysis of lamb performance data from the Hampshire flock in terms of the effects of year, age of dam, sex of lamb, type of birth and rearing, month of birth and sire on birth weight, weaning weight, average daily gain, condition grade, type score, and 120-day weight. Data on the performance of the Hampshire, Dorset, and Southdown flocks are given in Tables I through III. The Hampshire data cover a period of five years and the Dorset and Southdown data were collected over a 3-year period.

I. PERFORMANCE OF HAMPSHIRE, DORSET, AND SOUTHDOWN FLOCKS

Fertility of Ewes

During the years of this study, 407 ewes were mated (207 Hampshires, 118 Dorsets, and 82 Southdowns) and 379 ewes lambed for an overall lambing percentage of 93.1 per cent. The Dorsets had a 100 per cent lambing percentage (Table II) each year. It should be pointed out that several of the Dorset ewes had two crops of lambs each year which helped make their percentage higher. Ninety-four per cent of the Southdowns (Table III) lambed and 89.2 per cent of the Hampshires (Table I) had lambs.

TABLE I

PERFORMANCE OF EWES AND LAMBS IN THE HAMPSHIRE FLOCK

	Year					
	1961	1962	1963	1964	1965	Average
No. of ewes bred	39	40	45	42	41	41.4
Av. age of ewes lambing, yr.	4.3	4.1	3.7	3.9	4.2	4.04
No. of ewes lambing	38	36	34	40	36	36.8
Per cent of ewes lambing	97.4	90.0	76.0	95.2	87.8	89.3
Av. lambing date of ewes	2-7	2-27	3-5	2-11	2-10	2-18
Per cent lamb crop (to ewes bred)	143.5	145.0	100.0	119.0	136.5	128.8
Lambs raised per ewe bred	1.05	1.05	0.64	0.81	0.98	0.91
No. of lambs born	56	58	45	50	56	53
No. of sets of twins	18	22	11	8	20	15.3
No. of sets of triplets	0	0	0	1	0	0.2
Av. birth wt. of lambs, lb.	9.1	8.7	8.7	8.8	8.6	8.8
Av. weaning age, days	109.6	86.5	102.2	109.1	101.0	101.7
Av. weaning wt., lb.	68.2	60.0	63.4	66.6	68.2	65.3
Av. 120-day wt., lb.	73.3	68.2	73.1	73.4	80.1	73.6
Av. daily gain, lb.	0.54	0.50	0.53	0.54	0.60	0.54
Av. condition grade of lambs	12.8[a]	12.7	12.6	12.8	12.6	12.7
Av. type score of lambs	12.6[a]	12.9	12.3	12.9	12.4	12.6

[a]Low choice = 12; choice = 13; high choice = 14.

TABLE II

PERFORMANCE OF EWES AND LAMBS IN THE DORSET FLOCK

	Year			
	1962	1963	1964	Average
No. of ewes bred	36	39	43	39.3
Av. age of ewes lambing, yr.	3.6	3.0	3.0	3.2
No. of ewes lambing	36	39	43	39.3
Per cent of ewes lambing	100	100	100	100
Av. lambing date of ewes	12-28-61	1-14-63	1-2-64	1-3
Per cent lamb crop (to ewes bred)	138.8	153.8	144.1	145.6
Lambs raised per ewe bred	1.16	1.41	1.28	1.28
No. of lambs born	51	60	62	57.6
No. of sets of twins	15	15	18	16
No. of sets of triplets	0	3	1	1.3
Av. birth wt. of lambs, lb.	8.1	7.0	8.0	7.7
Av. weaning age, days	112.2	107.8	103.7	107.9
Av. weaning wt., lb.	64.2	62.9	57.0	61.4
Av. 120-day wt., lb.	69.4	71.4	65.1	68.6
Av. daily gain, lb.	0.51	0.55	0.48	0.51
Av. condition grade of lambs	12.5[a]	12.9	12.7	12.7
Av. type score of lambs	12.3[a]	12.6	11.3	12.1

[a]Low choice = 12; choice = 13; high choice = 14.

TABLE III

PERFORMANCE OF EWES AND LAMBS IN THE SOUTHDOWN FLOCK

	Year			Average
	1962	1963	1964	
No. of ewes bred	29	26	27	27.3
Av. age of ewes lambing, yr.	5.0	4.9	4.9	4.93
No. of ewes lambing	26	25	26	25.7
Av. lambing date of ewes	3-15	2-22	2-20	2-28
Per cent lamb crop (to ewes bred)	127.5	119.2	125.9	124.2
Lambs raised per ewe bred	1.00	1.12	1.18	1.10
No. of lambs born	37	31	34	34
No. of sets of twins	11	7	8	8.6
No. of sets of triplets	0	0	0	0
Av. birth wt. of lambs, lb.	7.6	7.5	7.6	7.57
Av. weaning age, days	123.1	126.4	134.8	128.1
Av. weaning wt., lb.	55.9	52.3	50.9	53.0
Av. 120-day wt., lb.	55.3	49.1	45.8	50.0
Av. daily gain, lb.	0.40	0.35	0.32	0.36
Av. condition grade of lambs	13.1[a]	12.7	12.8	12.9
Av. type score of lambs	12.3	12.5	12.3	12.4

[a]Low choice = 12; choice = 13; high choice = 14.

The Dorsets had the earliest average lambing date of the three breeds (January 3) (Table II, page 22). The fact that about half of the Dorset ewes lambed in the fall (October and November) made this date average earlier than the date for the other two breeds. The average lambing date for the Hampshire flock was February 18 (Table I, page 21) and the Southdown average lambing date was February 28 (Table III, page 23). The average age of all the ewes when bred was 4.05 years.

The percentage of ewes lambing is important in the development of a productive flock of sheep. This indicates the proportion of ewes in the flock that are contributing to the owner's income through lamb production. The ultimate objective would be that every ewe give birth to a lamb or lambs every year and thus contribute her share to the flock income. There are intensive systems of lamb production where three crops of lambs are produced every two years. In such a system the percentage of ewes lambing would need to be 150 per cent each year.

During the years of this study, 540 lambs were born for an average lamb crop of 132 per cent for all breeds. The Dorsets had an average of 145.6 per cent (Table II, page 22), the Hampshires, 128.8 per cent (Table I, page 21) and the Southdowns, 124.2 per cent lamb crop (Table III, page 23). The average lamb crop percentage differs from the percentage of ewes lambing because of the incidence of multiple births.

Another measure of ewe fertility is the percentage of ewes having multiple births. Forty-four per cent of the Dorset ewes each year had multiple births, 43 per cent of the Hampshires and 33 per cent of the Southdowns.

Productivity of Ewes

During the years of this study, there were 540 lambs born and 418 lambs raised for an average of 77 per cent of lambs raised to lambs born. Eight-eight per cent of the Southdown lambs (Table III, page 23) and 87 per cent of the Dorset lambs (Table II, page 22) born were raised to weaning time. Only 69.8 per cent of the Hampshire lambs (Table I, page 21) survived until weaning time. One of the best single criterion or index of the productivity of ewes in a flock is the average number of lambs raised per ewe bred or exposed. This figure takes into consideration the percentage of ewes lambing, the number of lambs produced, and the survival rate of the lambs. The number of lambs raised per ewe bred was highest for the Dorsets (1.28) (Table II, page 22), next were the Southdowns (1.1) (Table III, page 23), and the Hampshires were third (0.91) (Table I, page 21). The figure of 1.28 lambs raised per Dorset ewe bred was due primarily to the fact that a high percentage of ewes lambed (100 per cent), had a 44 per cent multiple birth rate and raised a high percentage of their lambs (87.5 per cent).

Another measure of the productivity of a ewe flock is the pounds of lamb they produce per ewe in 120 days. The Dorsets averaged 68 pounds of lamb per ewe bred, the Hampshires averaged 66 pounds and the Southdowns averaged 48 pounds per ewe bred.

The average daily gain of all Dorset lambs weaned was 0.51 pound per day (Table III, page 23); Hampshires averaged 0.54 pound per day (Table I, page 21); and Southdowns averaged 0.36 pound per day (Table III, page 23).

Condition and Type Scores of Lambs

The condition score or degree of finish of the lamb at weaning is a reflection of the milking and mothering ability of the ewe as well as the growth rate and health of the lamb. There was very little difference in the condition score of the lambs from the three breeds. The Southdowns held a very slight advantage with a score of 12.9 (Table III, page 23) followed closely by the Hampshires with 12.8 (Table I, page 21) and the Dorsets with 12.7 (Table II, page 22).

There was more variation in type scores among the breeds than in condition scores. Average type scores were: Hampshires, 12.6 (Table I, page 21); Southdowns, 12.4 (Table III, page 23); and Dorsets, 12.1 (Table II, page 22).

II. STATISTICAL ANALYSIS OF LAMB PERFORMANCE DATA FROM THE HAMPSHIRE FLOCK

Complete records on 174 purebred Hampshire lambs, born during the period, 1961-1965, were usable in least squares analyses to determine the effects of various factors including year of birth, age of dam, sex of lamb, type of birth and rearing, month of birth, and sire on birth weight, weaning weight, average daily gain, condition grade, type score, and 120-day weight.

Birth Weight

The analysis of variance for birth weight is shown in Table IV. Least squares constants for the effects of various factors on birth weight are given in Table V.

There were highly significant differences between birth weights among years (Table IV). Lambs with the highest birth weights were born in 1965 and those with the lowest in 1962 (Table V). Difference in climatic conditions from one year to another along with variations in feed supply are possible explanations for the differences due to years. The results of Bogart et al. (1957) also indicate significant differences in birth weights due to year effects.

The differences in birth weights of lambs due to type of birth were highly significant (Table IV). Lambs born as singles were 1.2 pounds heavier than lambs born as twins (Table V). The mean birth weight for all lambs was 8.76 pounds (Table VI). These results are similar to those reported by Phillips and Dawson (1937), Blackwell and Henderson (1955), Bogart et al. (1957), and Brown, Baugus, and Sabin (1961).

The effect of sex of lamb on birth weight was highly significant (Table IV). Males averaged 0.7 pound heavier at birth than females (Table V). The effect due to sex obtained in this study agrees with that of Blackwell and Henderson (1955) who reported a significant difference in birth weight between males and females with males being heavier at birth than females. Bogart et al. (1957) also reported that male lambs were slightly heavier at birth than ewe lambs.

TABLE IV

ANALYSIS OF VARIANCE FOR BIRTH WEIGHT

Source of variation	Degrees of freedom	Sum of squares	Mean square
Total	173	378.314	-
Reduction	24	169.863	-
Year	4	33.093	8.273**
Age of dam	6	11.382	1.897
Type of birth	1	51.378	51.378**
Sex of lamb	1	17.230	17.230**
Month of birth	4	16.175	4.044*
Sire	8	31.745	3.986**
Residual	149	208.451	1.399

*P < .05.

**P < .01.

TABLE V

LEAST SQUARES CONSTANTS FOR THE EFFECTS OF VARIOUS FACTORS ON BIRTH WEIGHT

	No. of lambs	Least squares constant
Year		
1961	39	0.1206[b]
1962	39	-1.7284[c]
1963	26	0.2966[a,b]
1964	32	0.5773[a,b]
1965	38	0.7339[a]
Age of dam		
2 years	30	-0.4287[a]
3 years	38	-0.0038[a]
4 years	44	-0.2818[a]
5 years	21	-0.0584[a]
6 years	23	-0.2233[a]
7 years	12	0.6790[a]
8 years	6	0.3170[a]
Type of birth		
Single	70	0.6044[a]
Twin	104	-0.6044[b]
Sex of lamb		
Male	89	0.3515[a]
Female	85	-0.3515[b]
Month of birth		
December	21	-0.2979[b,c]
January	45	0.5253[a]
February	33	-0.3971[c]
March	55	0.1839[a,b]
April	20	-0.0142[a,b,c]
Sire		
47	19	-1.4448[f]
98	30	-1.1151[e,f]
134	17	-.1007[c,d]
163	11	-.8590[d,e,f]
248	28	-.6173[d,e]
345	27	0.3825[c]
748	18	0.5030[b,c]
749	12	1.7564[a]
945	12	1.4950[a,b]

[a,b,c,d,e,f]Least squares constants within classes of effects followed by the same letter are not significantly different. All others are significantly different ($P < .05$).

TABLE VI

OVERALL MEANS AND STANDARD ERRORS OF LAMB TRAITS
FOR THE YEARS 1961 THROUGH 1965

Trait	Mean	Standard error
Birth weight, lb.	8.76	0.112
Weaning weight, lb.	63.78	1.190
Total gain, lb.	54.89	1.161
Average daily gain, lb.	0.55	0.009
Condition score	12.95	0.174
Type grade	12.72	0.131
120-day weight, lb.	74.24	1.113
Weaning age, days	100.67	1.555

Webb (1963) reported that ram lambs were 0.41 pound heavier than females at birth. Brown, Baugus, and Sabin (1961) found no significant difference in birth weight between male and female lambs.

The effect of sire on birth weight was also found to be highly significant (Table IV, page 28). There was a birth weight difference of 3.2 pounds between the lambs sired by the highest ranking sire and the lowest ranking sire (Table V, page 29).

The effect of month of birth on birth weight was significant (Table IV, page 28). Lambs with the heaviest birth weights were born in January and the lightest birth weights were recorded in February (Table V, page 29).

The effect of age of dam on birth weight was not significant in this study (Table IV, page 28).

Weaning Weight

The effect of sex of lamb on weaning weight was highly significant (Table VII). Male lambs were 3.28 pounds heavier than females at weaning (Table VIII). Fernandes (1964) reported male lambs were 3.98 pounds heavier than females at weaning. The results obtained in this study of the effect of sex on weaning weights of lambs are also in agreement with the results of work by Givens, Carter and Gains (1960), Brown, Baugus, and Sabin (1961), Sabin and Brown (1962), and Trail and Sacker (1965).

The effect of type of birth and rearing on weaning weight was highly significant (Table VII). Lambs born and raised as singles were

TABLE VII

ANALYSIS OF VARIANCE

Source of variation	Degrees of freedom	Mean squares				
		Weaning weight	Average daily gain	Condition grade	Type score	120 day weight
Total	173					
Reduction	26					
Year	4	166.323	0.0126	1.618	2.6982	268.4488
Age of dam	6	49.462	0.0032	0.7933	0.3889	37.4270
Sex of lamb	1	374.069**	0.0122	71.2802**	7.9339	352.1581
Type of birth and rearing	2	2,152,698**	0.1888**	77.6095**	48.6546**	3,268.7127**
Month of birth	4	117.883	0.0135	17.1185**	1.5764	213.8527
Sire	8	208.862**	0.0201*	4.3862	6.6624**	331.4913**
Regression	1	2,834.408**	0.0718**	0.0215	1.8524	967.0982**
Residual	147	76.584	0.0078	1.2827	2.1346	117.578

*P < .05.

**P < .01.

TABLE VIII

LEAST SQUARES CONSTANTS FOR THE EFFECTS OF VARIOUS FACTORS ON WEANING WEIGHT, AVERAGE DAILY GAIN, CONDITION GRADE, TYPE SCORE, AND 120-DAY WEIGHT OF LAMBS

	No. of lambs	Weaning weight	Average daily gain	Condition grade	Type score	120-day weight
Year						
1961	39	-.4399	-.0132	-.7909	0.1357	-3.3725
1962	39	-3.1905	-.0406	-.4983	0.5749	-7.5719
1963	26	1.2947	0.0105	-.0589	-.1933	2.5710
1964	32	-3.9564	-.0230	0.4791	0.3668	-1.7529
1965	38	6.2921	0.0663	0.0869	-.8841	10.1263
Age of dam						
2 years	30	-2.7064	-.0225	-.1617	-.0954	-2.2703
3 years	38	-1.0094	-.0053	-.0384	0.1638	-.9092
4 years	44	0.4836	0.0143	-.0874	0.1638	-.9092
5 years	21	-.6482	-.0001	0.4682	0.1513	0.1717
6 years	23	-.6359	0.0008	-.0708	0.5454	-.7550
7 years	12	3.1982	0.0146	0.0032	-.0854	2.1490
8 years	6	1.3181	-.0094	-.1077	-.8294	0.4422
Sex of lamb						
Male	89	1.6452^{a}	0.0094^{a}	$-.7182^{a}$	$-.2396^{a}$	1.5962^{a}
Female	85	-1.6452^{b}	$-.0094^{a}$	0.7182^{b}	0.2396^{a}	-1.5962^{a}
Type of birth and rearing[e]						
S-S	70	5.5581^{a}	0.0476^{a}	0.9487^{a}	0.9172^{a}	6.6181^{a}
T-S	35	1.4042^{a}	0.0208^{a}	0.4475^{a}	0.0516^{b}	2.1389^{b}
T-T	69	-6.9623^{b}	$-.0684^{b}$	-1.3962^{b}	-.9688	-8.7570^{c}

TABLE VIII (continued)

	No. of lambs	Weaning weight	Average daily gain	Condition grade	Type score	120-day weight
Month of birth						
December	21	4.5716	0.0550	1.6748^{a}	0.5622	6.2142
January	45	3.0614	0.0248	0.5049^{b}	0.3374	3.9501
February	33	0.2960	0.0094	$-.1869^{c}$	-.0768	0.6555
March	55	-1.4502	-.0165	-1.2170^{d}	-.2454	-2.5873
April	20	-6.4788	-.0727	$-.7758^{c,d}$	-.5774	-8.2325
Sire						
47	19	$-3.2459^{b,c}$	$-.0272^{b,c}$	-.8629	$-.6416^{d}$	$-6.2462^{b,c,d}$
98	30	$-.7328^{a,b,c}$	$-.0021^{a,b,c}$	-.6374	1.6566^{a}	$-3.3687^{c,d}$
134	17	$2.2136^{a,b}$	$0.0370^{a,b}$	1.0648	$-.2504^{c,d}$	5.7623^{a}
163	11	6.8713^{a}	0.0538^{a}	-.6348	$-.8549^{d}$	$6.1167^{a,b}$
248	28	-4.8826^{c}	$-.0470^{c}$	-1.2668	$-.2378^{c,d}$	-7.7356^{d}
345	27	4.9506^{a}	0.0470^{a}	0.9798	$0.5373^{b,c}$	7.6150^{a}
748	18	$-.9727^{a,b,c}$	$-.0029^{a,b,c}$	1.1590	$0.8647^{a,b}$	$1.5429^{a,b,c}$
749	12	$-4.7000^{b,c}$	$-.0722^{b,c}$	-.5075	$-.8643^{d}$	-5.2183^{d}
945	12	$0.4985^{a,b,c}$	$0.0136^{a,b,c}$	0.7058	$-.2096^{b,c,d}$	$2.5319^{a,b,c}$
Regression[f]	174	0.3888	-.0020	0.0011	-.0010	-.2271

[a,b,c,d]Least squares constants within classes of effects followed by the same letter are not significantly different. All others are significantly different ($P<.05$).

[e]S-S, born single and reared as single; T-S, born as twin but reared as a single; T-T, born as twin and reared as twin.

[f]Regression of dependent variable on weaning age.

12.52 pounds heavier than twins raised as twins and were 4.15 pounds heavier than twins raised as singles. Twins raised as singles were 8.87 pounds heavier at weaning time than twins raised as twins (Table VIII, page 33). This agrees with results obtained by Sidwell, Everson, and Terrill (1962), Blackwell and Henderson (1955), Sabin and Brown (1964), Fernandes (1964), and Webb (1963).

The effect of sire on weaning weight was also highly significant (Table VII, page 32). Lambs sired by the highest ranking ram for weaning weight were 11.75 pounds heavier at weaning than the lambs sired by the lowest ranking ram (Table VIII, page 33). Broadbent and Bowman (1964) reported that the difference between the best and worst Suffolk ram for growth rate represented a 10 per cent increase in growth rate for the progeny of the best ram over the progeny of the worst ram.

Average Daily Gain

The differences in average daily gains due to type of birth and rearing were highly significant (Table VII, page 32). Lambs born and raised as singles gained 0.116 pound per day faster than twins raised as twins (Table VIII, page 33). This difference in average gain may be attributed largely to the heavier birth weights of single lambs and to the fact that single lambs have a greater milk supply as compared to twin lambs. Givens, Carter, and Gaines (1960) observed similar differences. In their study they found that the singles gained 0.08 pound per day faster than the twins. Fernandes (1964) reported

type of rearing significantly influenced average daily gains. He found that lambs raised as singles gained 0.041 pound per day faster than twins raised as twins.

The effect of sire on average daily gain was significant (Table VII, page 32). The lambs sired by the top ram gained 0.126 pound per day faster than the lambs sired by the bottom ram (Table VIII, page 33).

Condition Grade

Sex of lamb, month of birth, and type of birth and rearing had significant effects on the condition scores of the lambs (Table VII, page 32). Female lambs graded 1.43 units higher than male lambs (Table VIII, page 33). Fernandes (1964), however, found the difference due to sex of lamb was not significant.

Month of birth effects were highly significant on condition grade (Table VII, page 32). Lambs born in December and January graded significantly higher than lambs born in February, March and April.

Single lambs raised as singles graded 2.34 units higher than twins raised as twins and 0.50 unit higher than twins raised as singles (Table VIII, page 33). Twins raised as singles graded 1.84 units higher than twins raised as twins. Fernandes (1964) reported the difference in condition scores between singles and twins was 0.997 in favor of the single lambs.

Type Score

Of the factors studied, only type of birth and rearing and sire were significant (Table VII, page 32). Single lambs raised as singles graded 1.89 units higher than twins raised as twins and 0.97 unit higher than twins raised as singles. The effect of sire on the type scores of lambs was also highly significant (Table VII, page 32). The highest ranking ram's lambs graded 2.52 units higher than the lowest ranking ram's lambs. The differences in the top three rams and the lowest three rams were highly significant (Table VIII, page 33).

120-Day Weight

The effect of type of birth and rearing was highly significant on 120-day weight (Table VII, page 32). Singles raised as singles weighed 15.37 pounds heavier at 120 days than twins raised as twins and 8.76 pounds heavier than twins raised as singles. Twins raised as singles were 10.9 pounds heavier than twins raised as twins (Table VIII, page 33). This agrees with work by Brown, Baugus, and Sabin (1961), Sabin and Brown (1962), and Webb (1963).

The effect of sire on 120-day weight was also highly significant (Table VII, page 32). The top ranking ram's lambs weighed 15.35 pounds more at 120 days than the bottom ranking ram's lambs (Table VIII, page 33).

Correlations

The correlations between lamb performance traits were significant in all cases except for the correlation of birth weight, average daily

gain, type score and 120-day weight with weaning age (Table IX). There was a 0.327 correlation between birth weight and weaning weight. Butcher, Dunbar, and Welch (1965) found the correlation between birth and 140-day weight to be 0.32. This correlation indicates that some accomplishment might be made in determining at birth which lambs would be the heaviest at weaning.

Condition score was closely correlated with weaning weight and total gain (0.587) and average daily gain (0.551). The trait with the highest correlation with type score was condition score (0.642).

As might be expected, there was a high correlation between 120-day weight and average daily gain, total gain, and weaning weight. Givens, Carter, and Gaines (1960) concluded that selection on daily gain alone seemed most practical because it is easiest to use and should give near maximum genetic progress in economic terms.

Applications of Results

This study shows that much could be gained by combining the good traits of Dorset and Hampshire sheep. If the fertility of the Dorset and the productivity (gaining ability) of the Hampshire could be combined into one animal we would have a superb sheep. Perhaps commercial sheepmen should consider using ewes that carry Dorset blood and cross them with Hampshire rams. Dorsets could be used to an advantage in an intensive lamb production operation where three crops of lambs would be raised every two years. This study also points up the fact that too many lambs are lost between birth and weaning, even

TABLE IX

CORRELATIONS AMONG LAMB PERFORMANCE TRAITS

	Birth weight	Weaning weight	Total gain	Average daily gain	Condition score	Type score	120-day weight	Weaning age
Birth weight	1.000	0.327**	0.258**	0.242**	0.155**	0.159*	0.317**	0.109
Weaning weight		1.000	0.996**	0.674**	0.587**	0.412**	0.678**	0.666**
Total gain			1.000	0.666**	0.587**	0.406**	0.662**	0.676**
Average daily gain				1.000	0.551**	0.469**	0.985**	-.071
Condition score					1.000	0.642**	0.543**	0.268**
Type score						1.000	0.463**	0.073
120-day weight							1.000	-.063
Weaning age								1.000

*P < .05.

**P < .01.

in these purebred flocks. More attention should be given this part of the sheep operation.

The statistical analysis to determine the effects of various factors on lamb performance traits shows that selection could be made more effective through adjustment of performance records for environmental effects.

This study showed that lambs born in December and January had the highest condition scores. Condition score declined each succeeding month. This fact should be important to the commercial sheepman who is selling market lambs. The month of birth could possibly be changed by flushing ewes, keeping the rams cool, and by using hormones to synchronize estrus cycles.

Another factor over which breeders have control is sire selection. In this study, lambs sired by one sire weighed 11.75 pounds more at weaning than the lambs sired by another sire. Breeders must start performance testing programs to help identify the sires that will produce these extra gains. The effect due to the sire was significant for birth weight, weaning weight, average daily gain, type score and 120-day weight. Surely sheep breeders and commercial sheepmen must demand performance records on sires that they purchase in the future.

CHAPTER V

SUMMARY AND CONCLUSIONS

The data from 407 purebred Hampshire, Dorset, and Southdown ewes bred and 379 ewes lambing along with the records of 540 lambs born and 418 raised were studied. Data by breeds on ewe fertility and productivity were analyzed to determine the percentage of ewes lambing, percentage of lambs born to ewes bred, number of multiple births, and average lambing date and livability, birth weight, weaning weight, 120-day weight, daily gain, condition score and type score of the lambs.

Data on Hampshire lamb performance including birth weight, weaning weight, average daily gain, condition grade, type score, and 120-day weight were analyzed by least squares methods to evaluate the effects of year of birth, age of dam, sex of lamb, type of birth and rearing, month of birth, and sire.

During the period included in this study, 407 ewes were mated and 379 ewes lambed for an overall lambing percentage of 93.1 per cent. Dorsets, Southdowns and Hampshires had lambing percentages of 100, 94 and 89 per cent, respectively. The average age of all the ewes when bred was 4.05 years. The average lambing date for the Dorset ewes was January 3, February 18 for the Hampshire ewes and February 28 for the Southdown ewes. Several of the Dorset ewes lambed early in the fall and again in late spring each year. This helped improve the

lambing percentage for the Dorsets. It seems that some Dorset breeding in a flock of commercial ewes would be valuable if the owner was considering an intensive system of lamb production where three crops of lambs would be produced every two years. The Dorsets had an average of 145.6 per cent, the Hampshires, 128.8 per cent, and the Southdowns, 124.2 per cent lamb crop (to ewes bred). These figures also show the desirability of some Dorset blood in a commercial flock.

There was little difference in the percentage of multiple births between the Dorsets (44 per cent) and the Hampshires (43 per cent). The Southdowns had about 10 per cent fewer multiple births than the Dorsets and Hampshires. There was also little difference in the percentage of lambs raised to lambs born for the Southdowns (88 per cent) and Dorsets (87 per cent). However, the Hampshires raised only 69.8 per cent of their lambs to weaning age. The average weaning weight for all Hampshire lambs was 65.3 pounds; Dorsets, 61.4 pounds; and Southdowns, 53.0 pounds. There was little difference in average daily gain between the Dorsets (0.51 pound per day) and the Hampshires (0.54 pound per day). The Southdowns gained 0.36 pound per day.

There was little difference between the breeds for condition and type scores of the lambs.

A comparison of the performance of the three breeds indicates the Dorsets were superior in per cent ewes lambing, per cent lamb crop, and lambs raised per ewe bred. The Hampshires had the highest average birth weight, average 120-day weight, average daily gain, and average type score. The Southdowns had the highest percentage of lambs raised

to lambs born and the highest average condition grade.

There were highly significant differences among birth weights, weaning weights, average daily gains, type scores, and 120-day weights due to sires. The birth weights of lambs sired by the two top rams were 1.75 and 1.49 pounds above the adjusted mean birth weight while the lambs sired by the bottom two rams were 1.44 and 1.42 pounds below the mean birth weight. The weaning weights of lambs sired by the highest ranking sire were 6.87 pounds greater than the mean while lambs sired by the lowest ranking sire were 4.88 pounds less than the mean weaning weight, making a difference of 11.75 pounds at weaning due to the sire. Average daily gain differences due to sires were significant. The average type score of lambs by sire 98 was 2.5 units higher than the score of lambs by sire 749. There was a difference of 15.35 pounds in the 120-day weights of lambs sired by the best ram and the poorest ram.

The differences due to type of birth and rearing were highly significant for all traits studied. The lambs born as singles were 0.6 pound heavier than twins. Singles raised as singles were heavier at weaning, gained faster, had a higher condition and type score and weighed more at 120 days than twins raised as singles or twins. Twins raised as singles were 8.36 pounds heavier at weaning, gained 0.088 pound per day more, graded 1.83 units higher on condition scored 1.12 units higher on type and weighed 10.98 pounds more at 120 days than twins raised as twins.

Sex of lamb significantly influenced birth weight, weaning weight, and condition grade. Male lambs were 0.35 pound heavier at birth and weighed 1.64 pounds more at weaning than female lambs. Female lambs graded 0.72 unit higher in condition score than males.

The differences due to month of birth were significant for birth weight and condition grade. The differences in birth weight were random with the heaviest lambs being born in January and March and the lightest being born in December and February. There was a definite trend in condition grade. The highest grading lambs were born in December with the grade declining each succeeding month through April.

LITERATURE CITED

LITERATURE CITED

Blackwell, R. L. and C. R. Henderson. 1955. Variation in Fleece Weight and Birth Weight of Sheep Under Farm Conditions. J. Animal Sci. 14:831.

Bogart, Ralph, R. C. deBaca, Lyle D. Calvin, and O. M. Nelson. 1957. Factors Affecting Birth Weights of Crossbred Lambs. J. Animal Sci. 16:130.

Broadbent, J. S., and J. C. Bowman. 1964. Progeny Testing of Suffolk Rams on Three Maternal Breeds. Animal Production. 6:215-25.

Brown, C. J., C. A. Baugus, and Samuel Sabin. 1961. Evaluation of Factors Affecting the Growth of Spring Lambs. Ark. Agr. Exp. Stat. Bul. 646.

Butcher, R. L., R. S. Dunbar, Jr., and J. A. Welch. 1964. Heritabilities of and Correlations Between Lamb Birth Weight and 140 Day Weight. J. Animal Sci. 23:12.

Duncan, D. B. 1955. Multiple Range and Multiple F Test. Biometrics 11:1.

Felts, V. L., A. B. Chapman, and A. L. Pope. 1957. Estimates of Genetic and Phenotypic Parameters for Use in a Farm Flock Ewe Selection Index. J. Animal Sci. 16:1048.

Fernandes, Antony E. 1964. Performance of Grade and Crossbred Ewes. M.S. Thesis, University of Tennessee Library.

Givens, C. S., Jr., R. C. Carter, and J. A. Gaines. 1960. Selection Indexes for Weanling Traits in Spring Lambs. J. Animal Sci. 19:134.

Harvey, W. R. 1960. Least Squares Analysis of Data with Unequal Sub-class Numbers. U.S.D.A. Agr. Res. Service Bul. ARS-20-8.

Kramer, C. Y. 1957. Extension of Multiple Range Tests to Group Correlated Adjusted Means. Biometrics 13:13-18.

Lambe, J. W., Jr., G. H. Bowman, and J. C. Rennie. 1964. Production Traits in Sheep as Affected by Breeds and Environment. Canadian J. Animal Sci. 45:1-7.

Phillips, Ralph W. and W. M. Dawson. 1937. The Relation of Type and Time of Birth and Birth Weight of Lambs to Their Survival, Growth, and Suitability for Breeding. Proc. Amer. Soc. Animal Prod. 296.

Sabin, S. W. and C. J. Brown. 1962. Analysis of Sale Weights and Growth Rates of Arkansas Milk Fat Spring Lambs. Ark. Exp. Stat. Report Series 104.

Sidwell, George M., Dale O. Everson, and Clair E. Terrill. 1962. Lamb Weights in Some Pure Breeds and Crosses. J. Animal Sci. 21:875.

Trail, J. C. M. and G. D. Sacker. 1965. Factors Affecting Production Records of Lambs from a Flock of East African Blackheaded Sheep. J. Agricultural Sci. 66:87-91.

Webb, Carlos. 1963. Factors and Their Effects on Birth Weight, Average Daily Gain and 120-Day Weight of Purebred Hampshire Lambs. M.S. Thesis, University of Tennessee Library.