THE RELATIONSHIP OF RATE OF GROWTH IN LAMBS TO BODY MEASUREMENTS AND CARCASS VALUE

Thesis for the Degree of M. S.
MICHIGAN STATE COLLEGE

Harold A. Henneman

1942

THESIS

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by

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Submitted to the Graduate School of Michigan State College of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Animal Husbandry

1942

THESIS

Acknowledgements

The author is grateful to all who graciously gave time and thought in connection with this problem.

He wishes to express his sincere appreciation to Professor G. A. Brown and Dr. C. L. Cole for their advice and constructive criticism in the preparation of this manuscript, as well as guidance concerning the course of study.

Appreciation is also due Dr. W. D. Baten, Associate in Mathematics, for his helpful advice in the statistical computations.

Table of Contents

THE RELATIONSHIP OF RATE OF GROWTH IN LAMBS TO BODY MEASUREMENTS AND CARCASS VALUE

Introduction

In producing spring lambs for market, a producer is concerned primarily with the return above costs. Black and Knapp (1) in their work with beef cattle ran a multiple correlation showing that average daily gain and slaughter grade account for 87 per cent of the variation in return above feed costs.

Winters (22) concluded that for practical purposes in the selection of efficient animals, daily gains and perfection in body form, as reflected in sale value, are the two most important factors to be considered.

Breeders for years have been selecting animals for type and body conformation, thinking that these animals were more efficient producers. In our meat animals the consumer has affected type to a certain extent by preferring smaller cuts. As yet, it has not been proved that this type is the most efficient.

In this study we have used certain body measurements in trying to predict the performance of the animal. By the use of ratios we have tried to determine whether or not the selected type has any advantage. A part of the study was conducted to determine the percentage of wholesale cuts from body measurements.

We know there are several different breeds of sheep each selected on a somewhat different basis. To conclude our work, we have compared the different breeds for efficient production of the carcass most in demand, by use of the analysis of variance.

Review of Literature

From the literature we find that studies of the relationship of body measurements to average daily gain are limited. Some work has been done with mechanical measurements, but the uses to which they have been put are varied, and the results conflicting. Experiments in this country have been limited primarily to predicting the weight of the animal from some body measurement, or the changes in body shape, due to intensive fattening. Measurements have been taken of draft horses, dairy cattle, and swine, but this review was limited to beef cattle and sheep due to the selection for similar body types.

Lush (13) has studied the relationship of body shape of feeder steers to rate of gain, dressing percentage, and value of dressed carcass in range-bred Hereford steers. His correlations indicated that a long-bodied, tall steer with a big paunch, but narrow loin and small flank girth made the best gains. This is somewhat contrary to belief. He explained this by saying that the long-bodied, paunchy steers had a large frame. A narrow loin would indicate a steer in thin condition, and therefore, ready to make rapid gains. A small flank girth would indicate little if any "fill". Such a steer would be in excellent condition to make large gains, especially since non-carcass increases in liveweight play a considerable part in observed gains. Lush states that large, but thin steers tend to gain rapidly, but there is not much other association between conformation and rate of gain. In conclusion, his data indicated that no score card or standard based on conformation could ever be so accurate that the future performance of individual steers could be predicted from it with but few mistakes. Form and function in these respects were not closely enough correlated.

Hultz (9) did not measure any steers mechanically, but rather fitted them into a type series ranging from low-set to very rangy. His work substantiates that of Lush. Very rangy calves make more rapid gains than do low-set calves. However, he states, that the rangy calves tend to become more typy on fattening and the low-set calves become more rangy. The rangy calves have a lower dressing percentage, and shrink more on their way to market. When he worked with two-year-old steers the low-set, typy cattle made slightly more rapid and more economical gains than either the intermediate or the rangy steers.

Hankins and Burk (7) state that feeder grade was closely related with width and depth of body, thickness of finish and shape of the feeder's head, but none of them were reliable indices of the relative rate of gain of the animals in the feed-lot.

Black, Knapp and Cook (2) found a negative correlation existing between height at withers and average daily gain, but it was not significant. A significant negative correlation was found between height at withers and efficiency of gain. The taller, rangier type of animal has a tendency to put on gains less economically than the shorter, blockier type. Height at withers had a high negative correlation with percentages of fat and edible meat in the carcass. Length of leg had a negative correlation with the production factors considered. Shorter type steers had a significantly higher dressing percentage. These measurements were taken on fifty head of record-of-performance steers. These workers concluded that slaughter grade was a better measure of beef type than any ratios of measurements. Measurements cannot show exactly the symmetry and proportions that should exist in a good beef-type animal.

Propp (16) obtained results indicating that there is a slight correlation between the various body measurements and the performance of the animal in the feed-lot. The animals used in his experiment were of similar type and he states that even though this particular type shows a slight relation to performance, one should not conclude that an improvement in type would result in a corresponding improvement in efficiency. A proportion of measurements was significantly better than any single measurement in predicting feeder grade. Of the single measurements, body length was the most accurate, while foreleg length was second in predicting average daily gain. The average body depth was the least accurate.

Wilford (21) correlated body measurements to dressing percentage. Condition had more influence upon dressing percentage than any other factor. Rangy, leggy, coarse-headed animals had a lower dressing percentage than the short, low-set more compact animals.

In beef cattle the results have been obtained by measuring the performance of feeder steers in the feed-lot. Primarily, the increase in weight studied has been that of fattening. In raising spring lambs, we are interested in a rapid growth rate of the young lamb including increase of muscle, fat and bone. For a spring lamb to yield a high-quality carcass, he must be an early maturing lamb.

Ritzman (17) has divided the first year's growth curve into quarters and gives a percentage of the first year's growth in weight as 60, 20, 15 and 5, for each quarter respectively. He states that early growth rate is an indication of early maturing qualities.

Senequier (18) in his work on body development of the sheep claims that at two months of age a lamb has attained one-third its mature weight; at five months of age, a lamb has grown to one-half its mature weight.

Hirzel (8) has made carcass studies of mutton and beef and he makes the statement that muscle development in an animal within a breed follows the direction of bone development. Bone represents a direct waste to the consumer and the demand is for light-boned carcasses. Although there may be no actual loss in weight of a particular bone, the shortening and thickening brings with it a shortening and thickening of the muscle covering. This produces a more attractive joint, allowing for a deeper slice of mutton and a larger area from which slices may be cut. Thus, the shank is shortened. An attempt might be made to lighten the bone, but too much refinement tends to reduce the thickness of muscle, a factor which has been realized and is being guarded against by suitable breeding. Actually, objection is taken to the long bone rather than the heavy bone.

Palsson's (15) work indicates that short-boned breeds are more early developing in muscles at the last rib than long-boned breeds. The bones increase more in weight with growth, than in length. Lush (13) in his work with steers showed a positive correlation between cannon bone circumference and average daily gain.

Gartner and Sternberg (4) concluded that cannon bone circumference and weight at one year give a reliable indication of constitution and yield; a conclusion arrived at by practical breeders a number of years ago.

Breed differences in lambs have been studied in detail by a few English observers. The only work reported so far in this country is that of crossing different breeds of rams on western ewes.

Hirzel (8) compared the carcasses of different breeds to a standard arrived at by measuring the prize-winning carcasses at the

Smithfield Show. These measurements were based on lambs at nine months of age. He also set up standards for mutton from sheep 21 months of age. He commented on the breeds as follows:

Southdown - Outstanding lamb breed with excellent depth of eye, with the fault of being overfat.

Suffolk - A well-meated carcass but too heavy and long-shanked.

Hampshire - Approaches the Southdown in proportion of depth to width of eye; however, it is too heavy, fat and long in leg.

Dorset - Too heavy and fat with a shallow eye.

Cheviot - Fattens too slowly to be remunerative and has a shallow eye.

In general (8) the breeds lacked little in width of eye muscle, but fell considerably short of the standard in depth. Most carcasses were too fat. Marbling was influenced by fatness, breed and age. Under existing conditions quantity is paying better than quality; but those who produce quality, e.g. New Zealand breeders, obtain an increasing demand for their product instead of a stationary or decreasing one.

Palsson (15) in his work with lambs of the same age concludes that width of eye muscle is an early developing character, while depth of eye muscle is a late maturing character; and this explains the higher correlation of width to total muscle weight in lambs rather than depth. There is a tendency for short-boned animals to have a deep eye muscle relative to their width. The difference between any two breeds in width of eye muscle is in no case significant at the one per cent level; however, there are wide differences between breeds in depth of eye.

Hammond (6) reported on the relative growth and development of various breeds and crosses of sheep nine months of age. According to weight and weekly rate of growth the lambs ranked as follows: Lincoln, Cotswold, Suffolk, Hampshire, Oxford, Cheviot, Dorset Horn, Shropshire and Southdown. In carcass percentage the rank was: Southdown, Hampshire, Suffolk, Shropshire, Oxford and Cheviot. In reporting his work, only breeds common in the United States have been listed. Within a breed, the heaviest animals generally have the highest carcass and fat percentages. By crossbreeding, Hammond noted a tendency to increase early maturity.

Branaman (3) at Illinois reports that Southdown lambs of choice market finish give higher yields of dressed carcass, boneless meat, and separable lean meat than do Hampshire lambs similar in finish; and thus, are worth a higher price as live lambs, in the carcass and in retail trade. Well-fed Hampshire single lambs attain choice market finish approximately six weeks younger than Southdown single lambs. Southdowns compared favorably with Hampshires for economical production of market lambs.

Miller (14) in a crossbreeding investigation in the production of California spring lambs, found that lambs sired by Hampshire and Suffolk rams weighed six to eight pounds more than Shropshire and Southdown sired lambs. These rams were mated to Rambouillet ewes. In slaughter and carcass grade, selling price per hundredweight and dressing percentage they ranked: Southdown, Shropshire, Hampshire and Suffolk. However, in return per carcass they ranked: Hampshire, Suffolk, Shropshire and Southdown. He concluded that the trade did not disciminate sufficiently in weight and quality of carcass to permit the choice Southdown lamb to compete favorably with the larger, coarser Hampshire or Suffolk lambs in terms of gross income.

Hultz and Wheeler (11) substantiate the results of Miller on the same type of lambs. They found that lambs sired by Suffolk, Hampshire and Southdown rams outsold the lambs sired by Lincoln, Corriedale and Rambouillet rams.

Winters (22) in his studies of breeding for increased efficiency states that the two single factors showing the highest correlation with net profit were daily gains and sale price; the correlation coefficients were 0.807 and 0.823 respectively.

Experimental Material

The five Hampshire, four Oxford and six Rambouillet wethers used in this study were purebreds taken from the Michigan State College flock. Two of the Shropshire wethers were also from the College flock, while the other two were taken from the W. K. Kellogg flock which is bred and operated in conjunction with the College. Thirteen crossbred lambs made up the rest of the study. The seven two-breed lambs were sired by a Cotswold ram and out of Rambouillet ewes. The F_1 females (Cotswold X Rambouillet) were mated to a Hampshire ram producing the six three-breed lambs (1/4 Cotswold, 1/4 Rambouillet and 1/2 Hampshire).

The 32 wether lambs were slaughtered when they weighed about 85 pounds. Weight was the only criterion of selection.

The lambs were born between February 8 and March 22. Only nine lambs were dropped in March. The College lambs were started on creep feed at two to three weeks of age, and received grain until the sheep were turned to pasture on May 16. The first lambs were slaughtered before weaning and these were genuine spring lambs. Those not weighing 85 pounds by weaning time were then placed (about July 20) on clover pasture and were fed grain. These lambs would be slaughtered as spring lambs.

The lambs from the Kellogg farm were fed grain only from the first week in October until slaughter time. The first lambs were slaughtered June 24 and the last November 5.

The lambs were taken off feed in the afternoon, being weighed, graded, sheared, and measured that evening, and slaughtered the next morning.

Measurements

The measurements were read in centimeters and were taken with standard equipment (Figure 1) used by the Bureau of Animal Industry, United States Department of Agriculture. To obtain more accurate measurements the lambs were sheared.

To study width, five measurements were taken: width of shoulder, width of rack (narrowest point just back of shoulder), two widths of loin (back of last rib, and front of hooks), and width of thurls (Figure 2). These were averaged and an average width figure was used in the correlations. An average depth was arrived at by averaging the depth of fore flank and depth of rear flank (Figure 3). The two measurements, floor of chest to ground, and rear flank to ground, were used in determining the average length of leg. Three length measurements were used: Length from pinpoints to base of throat, length from pinpoints to front edge of hooks, and length from front edge of hooks to the last rib.

No circumference measurement was taken of the cannon bone. However, in carcass studies of these lambs Ljungdahl (12) had measured the length of the tibia and fibula from the patella to the upper break joint. He also separated this bone from the carcass and weighed it in grams. As a measure of size of bone the grams per centimeter were figured. This gave a figure, similar to a circumference measure, with which to work.

As a measure of muscling, the eye muscle was used. A photograph was made of the surface of the hotel rack between the eleventh and twelfth ribs. A planimeter was used to measure the area of the eye muscle on the photograph. The depth of fat was taken over the eye muscle and these two measurements were corrected as to scale (Figures 4, 5, ... 9).

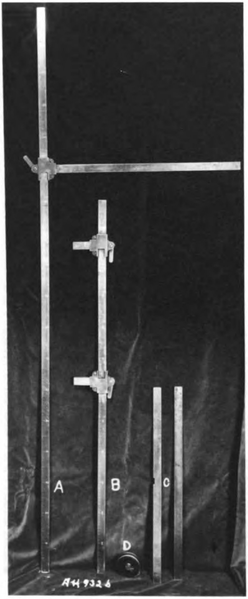

Figure 1. Measuring Instruments, Standard Equipment Obtained from the Bureau of Animal Industry, United States Department of Agriculture. (A) Measuring rule for height of animal, (B) caliper for width measurements, (C) arm used to replace short caliper arms for width measurement of shoulder and thurls, (D) centimeter tape.

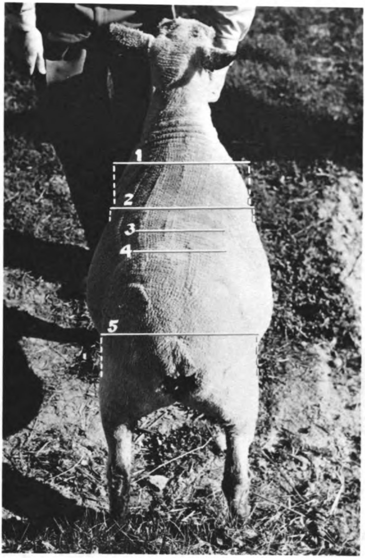

Figure 2. Measurements Taken for Width of Body

(1) Width at shoulders, (2) width at rack (narrowest width just back of shoulders), (3) width at loin just behind the last rib, (4) width at loin just ahead of hooks, (5) width at thurls.

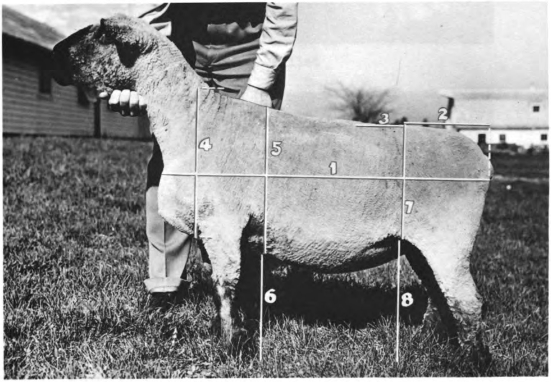

Figure 3. Measurements for Depth of Body, Length of Body, and Length of Leg

(1) Length of body (base of throat to pinpoints), (2) length of rump (hooks to pinpoints), (3) length of loin (hooks to last rib), (4) depth of brisket (top of shoulder to floor of chest between the front legs), (5) depth of fore flank, (6) length of foreleg (floor of chest to the ground), (7) depth of rear flanks, (8) length of rear leg (rear flank to the ground).

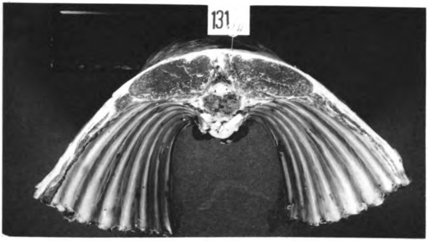

Figure 4. Rambouillet

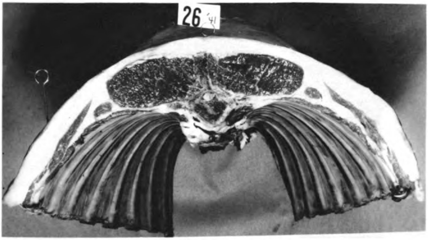

Figure 5. Hampshire

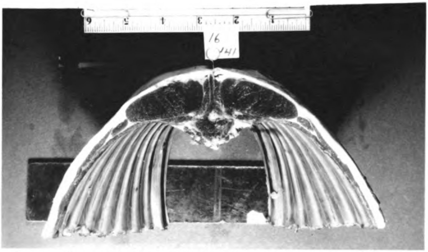

Figure 6. Two-breed (Rambouillet X Cotswold)

Photographs of the hotel rack of each breed were taken between the eleventh and twelfth rib.

Figure 7. Three-breed (Rambouillet, Cotswold X Hampshire)

Figure 8. Shropshire

Figure 9. Oxford

Photographs of the hotel rack of each breed were taken between the eleventh and twelfth rib.

To insure uniform cutting of wholesale cuts a system of measurements of the carcass was used. The amount of the ribs to be left on the hotel rack was first determined. At the last rib, a point was made one-half the distance from the midpoint of the back to the navel. On the fore-rib of the rack, the point was set at two-thirds the distance from the midpoint of the back to the sternum. The ribs were then sawed on a straight line between these two points, and the shank was cut at right angles to the shoulder arm. To divide the leg, loin, hotel rack and shoulder from each other, definite articulations of vertebrae were used. The leg was separated from the loin at the articulation between the last two lumbar vertebrae. The loin was divided from the hotel rack at the articulation between the last two thoracic vertebrae. This left the thirteenth rib on the loin. To get a nine-rib rack, the next division was made at the articulation between the third and fourth thoracic vertebrae. This left a three-rib chuck. These wholesale cuts were very satisfactory.

A chemical analysis was run on the hotel rack to determine the percentage of ether extract in fat and lean. A figure was obtained for average daily gain. The dressing percentage used in comparing the breeds was derived by dividing the forty-eight hour chilled carcass weight by the empty body weight. A figure for empty body weight was arrived at by subtracting the weight of the contents of stomach and intestines from the slaughter weight. This eliminated any error in slaughter weight due to "fill".

In determining slaughter and carcass grade, charts were drawn up (Charts 1 and 2) and used by a committee of three to five animal husbandmen. An average of these decisions was used as the slaughter and carcass

SLAUGHTER LAMB GRADING CHART 1

Lot No. Date Grader

Animal No.	2	4	6	8	10	12	14	16	18
FOREQUARTER									
Width Fore-Rib		Very Full			Moderately Full			Narrow	
Depth Fore-Rib		Very Deep			Moderately Deep			Shallow	
Smoothness		Very Smooth			Moderately Smooth			Rough	
MIDDLE									
Length		Very Compact			Moderately Compact			Rangy	
Width Loin		Very Wide			Moderately Wide			Narrow	
Depth		Very Deep			Moderately Deep			Shallow	
QUARTERS									
Length Rump		Very Long			Moderately Long			Short	
Width Dock		Very Wide			Moderately Wide			Narrow	
Depth Leg		Very Deep			Moderately Deep			Deficient	
QUALITY									
Smoothness		Very Smooth			Moderately Smooth			Rough & Uneven	
Refinement (Head & Bone)		Very Refined			Moderately Refined			Coarse	
FINISH									
Back		Very Thick			Moderately Thick			Thin	
Rib		Very Thick			Moderately Thick			Thin	
Dock		Very Thick			Moderately Thick			Thin	
FINAL GRADE		Prime		Choice		Good		Medium	Common

LAMB CARCASS GRADING CHART 2

Lot No. Animal No.	2	4	6	8	10	12	14	16	18
CONFORMATION									
Compactness		Very Compact			Moderately Compact			Rangy	
Balance and Thickness of Carcass		Very Thick			Moderately Thick			Shelly	
Rack		Very Thick			Moderately Thick			Shelly	
Loin		Very Thick			Moderately Thick			Shelly	
Leg		Very Plump			Moderately Full			Deficient	
FINISH									
Thickness of Fat		Very Thick			Moderately Thick			Thin	
Distribution		Very Uniform			Moderately Uniform			Uneven	
QUALITY									
Color of Fat		White			Creamy			Yellow-Fiery	
Firmness of Fat		Flaky			Slightly Soft			Stringy	
FINAL GRADE		Prime	Choice		Good		Medium		Common

grade. To use these grades in correlations and analyses of variance, values were given for each grade. Prime ranged from two to four; choice from six to eight; good from ten to twelve, etc. In other words, the higher the grade, the lower the score. This means that in running correlations those factors which increase an animal's value by their greatness would have a negative correlation with grade. Those factors detracting from an animal's value would have a positive correlation with grade. This is rather undesirable and in succeeding experiments, it would be best to reverse the scale, so the high grade has the high score.

Objectives

1. To study the relationship between body measurements and average daily gain in spring lambs, to determine whether or not various ratios of these measurements are more accurate in predicting growth rate than single measurements.

2. To study the relationship between body measurements and slaughter grade, using individual measurements and ratios, to determine which individual measurements are of more importance in the eyes of the graders.

3. To determine the importance of certain body measurements in predicting the percentage of wholesale cuts.

4. To study breed differences in growth rate and carcass value by the use of the analysis of variance.

Results of Experiment

From Table I, the measurement giving the highest correlation with average daily gain is average width (r = +0.969). This would suggest that the most accurate measurement in predicting average daily gain would be the average width. The fact that thickness of fat over the eye muscle does not have a significant correlation (+0.012) with average daily gain indicates that the wider lambs and faster gaining lambs are not necessarily the fattest. The muscular and skeletal growth must be the determining factors in predicting average daily gain from average width. This fact is partially substantiated by the correlation of +0.646 between area of the eye muscle and average daily gain. The faster gaining lambs have the largest eye muscles.

Width of rack with a correlation coefficient of +0.603 is more highly correlated with average daily gain than depth of forerib with a coefficient of correlation of +0.450. However, both are significant at the one per cent level. This is somewhat contrary to belief. Ritzman (17) and Swett (19) have indicated that depth is the more important. When these two measurements are added together and the sum correlated to growth rate, the correlation coefficient (+0.674) is higher than either measurement correlated individually. The two measurements give an indication of constitutional development. The grams per centimeter of bone gave a correlation of +0.714 with rate of growth. If width of rack, depth of forerib, and grams per centimeter of bone are added together a correlation of +0.756 is obtained which is higher than any of the three measurements correlated singly. This is in agreement with the breeders' belief that size of bone and constitutional development are indications

Table I

Coefficient of Correlation between Average Daily Gain and:

Heart girth.[1]	+ 0.417*
Depth of forerib	+ 0.450**
Width of rack	+ 0.603**
Depth of forerib plus width of rack	+ 0.674**
Grams per centimeter of bone (tibia)	+ 0.714**
Heart girth plus grams per cm. of bone	+ 0.563**
Depth of forerib plus width of rack plus grams per cm. of bone	+ 0.756**
Average width (W)	+ 0.969**
Average depth (D)	+ 0.254
Average width plus average depth	+ 0.595**
Length of body (L)	+ 0.515**
Average length of leg (C)	+ 0.050
Length of body plus average length of leg	+ 0.323
$\frac{L}{W}$ [2]	- 0.482**
$\frac{L + C}{W}$	- 0.483**
Length, hooks to base of throat	+ 0.257
Length, hooks to base of throat plus average length of leg	+ 0.210
$\frac{P + C}{W + D}$ [3]	- 0.243
$\frac{P + C}{W}$	- 0.401*
Area of eye muscle	+ 0.646**
Thickness of fat over eye muscle	+ 0.012
Carcass grade	- 0.171

(1) Carcass measurement; (2) L = Length of body; C = Average length of leg; (3) P - Length from hooks to base of throat; W - Average width; D - Average depth. *Significant at the 5% level. **Significant at the 1% level.

of rapid growth.

The heart girth measurement with a correlation of + 0.417 is less significant than either depth of forerib or width of rack, being significant at the five per cent level. When heart girth is added to grams per centimeter of bone and the sum correlated to growth rate, the correlation is intermediate, + 0.563. This lower correlation to average daily gain as compared to depth of forerib, plus width of rack, plus bone, may be explained by the fact that in measuring heart girth, the smaller measurement, floor of the chest, is taken into consideration.

Length of body from pinpoints to base of throat leads to a correlation of + 0.515 which is significant at the one per cent level. The long-bodied lambs are large framed and rapid growing. The average length of leg does not have a significant correlation (+ 0.050) and when the average length of leg and length of body are added together the sum does not have a significant correlation with average daily gain (+ 0.323). The average depth of body is not correlated significantly with average daily gain (+.254) and when average width and average depth are added together, the average depth reduces the significance of the correlation of average width (+0.595).

In judging for type, it is felt that lambs should be short from their hooks to the base of the throat. This individual measurement is also correlated singly with average daily gain and the correlation (+0.257) is not significant.

To obtain a measure of type in lambs, a ratio is used. Measures of smallness are called such because the larger they get, the less desirable the lamb from the standpoint of type. The measures of smallness, such as, length from hooks to base of throat and average length of leg, are added together and used as a numerator. The measures of greatness, such as, average width and average depth are added together and used as the denominator. The larger the denominator and the smaller the numerator, the smaller the figure representing type and also the typier the lamb. We would then expect a negative correlation to daily gain if typy lambs are more rapid gainers.

In the ratio $\frac{P + C}{W + D}$ a correlation of -0.243 is obtained which is not significant; when "P" equals length from hooks to base of throat, "C", the average length of leg, "W" the average width, and "D", the average depth. In the correlations using individual measurements, we find that average depth is not significant. If average depth is not used, and the proportion $\frac{P + C}{W}$ is used, we get a correlation of -0.401, which is significant at the five per cent level. The length from hooks to base of throat is not significantly correlated with average daily gain, and the correlation with (L) length of body from pinpoints to base of throat is significant. If we set up a ratio of $\frac{L + C}{W}$ we obtain a correlation with average daily gain of -0.483. In using the proportion $\frac{L}{W}$ we obtain a correlation coefficient of -0.482. These correlations are significant at the one per cent level, and indicate that the typy lambs are more rapid gainers. However, some of the single measurements, and sums of single measurements are more highly correlated with average daily gain than the proportions used.

There is an indication that faster gaining lambs graded higher in the carcass, but the coefficient of correlation is not large enough to be significant (- 0.171).

Thickness of fat over the eye muscle, or finish, is the most important factor in the eyes of the grading committee in determining slaughter grade. The coefficient of correlation is – 0.673 and is significant at the one per cent level (Table II). Three of the correlations are significant at the five per cent level. The proportion $\frac{P + C}{W}$ gives a correlation of + 0.424 with slaughter grade. This indicates that wide lambs in proportion to the length of leg and length from hooks to base of throat, are graded the highest. The sum of length from hooks to base of throat and average length of leg gives a correlation of + 0.442; indicating that long-legged, long-bodied lambs grade lower than short-legged, short-bodied lambs. Average depth of body, which in type is a desirable characteristic, seemed to be the reverse when correlated with slaughter grade. The coefficient of correlation is + 0.441 and is significant at the five per cent level. In other words, the deeper lambs are criticized and graded lower than the shallow-bodied lambs. This is probably

Table II

Coefficient of Correlation between Slaughter Grade and:

Thickness of fat over eye muscle	-0.673**
Average width	-0.229
Average depth	+0.441*
Average width plus average depth	+0.170
Length of body	+0.155
Length, hooks to base of throat	+0.286
Average length of leg	+0.344
Length, hooks to base of throat plus average length of leg	+0.442*
$\frac{P + C}{W}$	+0.424*

due to the Rambouillet and crossbred lambs included in the study. They are deep-ribbed lambs, but tend to be graded lower primarily for their lack of finish. U. S. D. A. workers (20) stated that mutton-type lambs showed slightly closer relationships between measurements and grade than did Rambouillet lambs.

The other individual measurements do not give significant correlations. However, there is a tendency toward selecting against long-legged lambs (+ 0.344) and, also, against long-bodied lambs (+ 0.155). There is an indication that the wider lambs are graded higher than the narrow lambs (− 0.229).

The percentages of wholesale cuts are predicted in Table III, from body measurements and slaughter grade.

Table III

Predicting Percentage of Wholesale Cuts from Body Measurements and Slaughter Grade

Percentage of Leg:	
Slaughter grade	+ 0.584**
Width of thurls	+ 0.119
Length of pinpoints to hooks	− 0.494**
Length from upper breakjoint to twist	+ 0.687**
Length from upper breakjoint to lower breakjoint	+ 0.435*
Percentage of Loin:	
Slaughter grade	− 0.614**
Average width of loin	− 0.051
Length from hooks to last rib	− 0.125
Percentage of Hotel Rack:	
Slaughter grade	− 0.240
Width of rack	− 0.279
Percentage of Shoulder:	
Slaughter grade	+ 0.205
Width of shoulder	+ 0.395*
Depth of shoulder	− 0.011

This study indicates that the best measurement to use in predicting the percentage of leg is the length from upper breakjoint to twist. These two factors have a correlation coefficient of + 0.687 which is significant at the one per cent level. The length from upper breakjoint to lower breakjoint (cannon) gives a correlation of + 0.435 which is significant at the five per cent level. A correlation of - 0.494 is obtained in predicting percentage of leg from the measurement, length from pinpoints to hooks. From Branaman's (3) figures at Illinois, it is shown that from fourteen per cent, in a lighter, shorter-boned breed, to twenty-five per cent, in a longer, coarser-boned breed, of the wholesale leg cut is bone. These figures might explain why a bone measurement gives such a high correlation. Also, a lamb long in cannon and tibia may be long in the femur, thus increasing the length of the meated area if not the plumpness. In this study, the long-legged, long-shanked lambs are also the shortest in the rump, (Rambouillet and Rambouillet X Cotswold). This might explain the negative correlation of the rump measurement.

The width of thurls is not significantly correlated with percentage of leg; however, it is positive (+ 0.119). Slaughter grade and percentage of leg have a correlation coefficient of + 0.584. The higher grading lambs have a lower percentage of leg. However, the lambs grading high have a higher percentage of loin than the lower grading lambs due to the increased fatness. The correlation between slaughter grade and percentage of loin is - 0.614, which is significant at the one per cent level. This indicates that in grading, the percentage of loin is important. The average width of loin and length from hooks to last rib do not give significant correlations (- 0.051) and (- 0.125) respectively.

There were no significant correlations between body measurements and percentage of hotel rack. The correlation coefficient of - 0.240 indicates that high grading lambs have a higher percentage of hotel rack, although not significant. The width of the rack gave a negative correlation to percentage of hotel rack (- 0.279). The wider the rack, the wider the shoulder, and width of shoulder has a significant correlation with percentage of shoulder, thus decreasing the percentage of rack. The coefficient of correlation + 0.395 between width of shoulder and percentage of shoulder is significant at the five per cent level. Depth of shoulder was not significant with percentage of shoulder (- 0.011). The correlation indicates that high grading lambs have a low percentage of shoulder, but it is not significant.

It is felt that more satisfactory correlation coefficients would be obtained if the predictions of percentages of wholesale cuts were made within a breed rather than for a combination of breeds.

To study the differences of the breeds in average daily gain, grade, and carcass value, the analysis of variance is used.

The total average daily gain of five Hampshire lambs is 2.53 pounds per day; four Oxfords, 2.24 pounds; six three-breeds, 2.76 pounds; seven two-breeds, 3.09 pounds; four Shropshires, 1.29 pounds; and, six Rambouillets, 2.44 pounds per day. The mean average daily gain for Hampshire, Oxford, three-breed, two-breed, Shropshire, and Rambouillet lambs is: 0.506, 0.56, 0.46, 0.44, 0.32, and 0.407 pounds per day, respectively. A table of the analysis of variance is included.

Source	Degrees of Freedom	Sum of Squares	Mean Squares	Experi- mental Error
Total	31	6.3159		
Between Breed Means	5	6.1281	1.2256	
Within Breed Means	26	0.1878	0.0072	0.085

The "F" value ($\frac{1.2256}{0.0072} = 170.2$) indicates a significant difference between at least two of the means at the one per cent level. The standard deviation of the means and standard deviation of the difference of the means is figured. The "Student t" table is then used to test for the significant difference between the means.

The analysis shows that Oxford lambs make significantly higher daily gains than Shropshire and Rambouillet lambs at the one per cent point. Oxfords also gain faster than two-breeds at the five per cent point. Hampshire lambs make significantly higher daily gains than Shropshire lambs at the one per cent level. Three-breeds make significantly faster gains than Shropshires at the five per cent level.

An analysis of variance of slaughter grade indicates that Shropshires grade significantly higher at slaughter than two-breeds and Rambouillets at the one per cent level. Three-breed lambs have a significantly higher slaughter grade than two-breed lambs at the one per cent level, and Rambouillets at the five per cent level. Oxford and Hampshire lambs have a significantly higher slaughter grade than two-breeds at the one per cent point.

In analyzing the differences between breeds in dressing percentage, the 48-hour chilled carcass weight and the empty body weight are used. The results show that Hampshire, Oxford, three-breed, and Shropshire lambs have a significantly higher dressing percentage than two-breeds and

Rambouillets at the one per cent level.

The breed differences in carcass grade are analyzed and the "t" values indicate that three-breed, Shropshire, Hampshire, and Oxford lambs grade significantly higher at the one per cent level than Rambouillet or two-breed lambs.

"The "F" value in the analysis of variance of area of eye muscle indicates there is no significant difference between breed means. Palsson (15), Hammond (6), and Hirzel (8) have found a significant difference in the size of the eye muscle. Their work was based on older lambs than the majority of lambs used in this study. Palsson (15) has stated that width of eye muscle is an early developing character, while depth of eye muscle is a late maturing character. The eye muscle of lambs in this study probably had not matured in depth of eye muscle, because the majority of the lambs were slaughtered before six months of age.

The results of the analysis of variance of thickness of fat over the eye muscle show that three-breed and Hampshire lambs were significantly fatter over the eye muscle than two-breed and Rambouillet lambs at the one per cent level. Oxfords were significantly fatter than two-breeds at the one per cent point and significant at the five per cent point over Rambouillet lambs. Shropshire lambs were significantly fatter over the eye muscle than two-breed lambs at the five per cent point.

An analysis of variance of percentage of ether extract in the lean of the hotel rack suggests that Shropshire and three-breed lambs have a significantly higher percentage of ether extract in the lean than Rambouillet and two-breed lambs, at the one per cent level. Hampshires and Oxfords have a significantly higher percentage at the five per cent level than Rambouillet and two-breed lambs.

Summary

The 32 lambs used in this study were slaughtered weighing approximately 85 pounds. Nineteen of the lambs were purebred Hampshire, Oxford, Shropshire and Rambouillet wethers. There were thirteen cross-bred lambs, seven of which were sired by a Cotswold ram out of Rambouillet ewes. The other six were sired by a Hampshire ram out of the Cotswold X Rambouillet ewes.

A definite system of measuring and cutting was used to insure uniformity in the data.

The average width of lamb was the measurement having the highest relationship with average daily gain. The muscular growth of the lamb is important in rapid growth. As a measure of constitution and ruggedness, the depth of forerib, width of rack and grams per centimeter of bone were added and the correlation with daily gain was significant. Practical breeders have for years believed this to be true. Other correlations that were significant at the one per cent level, in the order of their importance are: grams per centimeter of bone, depth of forerib plus width of rack, width of rack, average width plus average depth, heart girth plus grams per centimeter of bone, length of body, the proportion $\frac{L}{W}$, the ratio $\frac{L + C}{W}$, and depth of forerib. At the five per cent level, heart girth, and the ratio $\frac{P + C}{W}$ were significant. From the data we find that although three of the ratios of measurements are significant, some of the individual measurements and sums of individual measurements give higher correlations with daily gain. This indicates that typy lambs tend to gain more rapidly than poor type lambs, but in predicting average daily gain, there are single measurements of more importance.

Those correlations with average daily gain that were not significant were: Length of body plus average length of leg, length from hooks to base of throat, average depth, the ratio $\frac{P + C}{W + D}$, length from hooks to base of throat plus average length of leg, carcass grade, average length of leg, and thickness of fat over the eye muscle. From the data we find that average depth and average length of leg were of little importance in predicting daily gain. Also, when these two measurements were added to other measurements with significant correlations, the coefficient between the sum and daily gain was reduced. The more rapid gaining lambs were not necessarily the higher grading lambs. The average daily gain was not dependent upon thickness of fat over the eye muscle.

The most important factor in the eyes of the graders influencing slaughter grade was the degree of fatness, e. g. thickness of fat over the eye muscle. The lambs short from the hooks to base of throat and short-legged were graded higher. The ratio of $\frac{P + C}{W}$ was significantly correlated with average daily gain and indicates that typy lambs grade higher than poor type lambs. From these data, the deep-ribbed lambs were the low grading lambs. This is probably due to the Rambouillet and two-breed lambs which were deep-bodied, but graded low because they lacked finish. The wider lambs tended to grade higher than narrow lambs, but not significantly higher. The measurements of length of body, and average width plus average depth were unimportant in predicting slaughter grade.

The lambs grading high at slaughter were the lambs having a high percentage of loin due to the increased fatness. Low grading lambs had a higher percentage of leg. The length of shank and length of cannon were positively correlated with the percentage of leg. The long-shanked, long-legged lambs probably were correspondingly long in the femur, thus, increasing the length of the meated area. Percentage of leg was negatively correlated with length from pinpoints to hooks. This was pronounced in the Rambouillet and two-breed lambs. The width of thurls had a positive influence on percentage of leg, but it was not significant. Width of loin and length of loin were negatively correlated, but not significant with percentage of loin.

Neither slaughter grade or width of rack were correlated with percentage of hotel rack. Slaughter grade and depth of shoulder were not significant in predicting percentage of shoulder. There was an indication that higher grading lambs had a higher percentage of rack and lower percentage of shoulder, than low grading lambs. Width of shoulder did influence the percentage of shoulder. The wide-shouldered lambs had a significantly higher percentage of shoulder.

Using the analysis of variance, a significant difference was found between breeds in average daily gain. At the one per cent level, Oxfords made higher gains than Shropshires and Rambouillets; Hampshires made significantly higher gains than Shropshires. At the five per cent level, Oxfords gained significantly faster than two-breeds, and three-breed lambs gained faster than Shropshire lambs.

By the analysis, Shropshire, three-breed, Oxford and Hampshire lambs graded higher at slaughter than two-breeds at the one per cent level. The slaughter grade of Shropshires was also higher than Rambouillets at the one per cent level and three-breeds were graded higher than Rambouillets at the five per cent level.

In dressing percentage and carcass grade, Shropshire, three-breed, Oxford and Hampshire lambs are significantly better than two-breeds and Rambouillets at the one per cent level.

From these young lambs, the data indicated no significant difference in the area of the eye muscles. This is probably due to the late maturity of the depth of eye muscle.

Three-breed and Hampshire lambs were significantly fatter over the eye muscle than two-breed and Rambouillet lambs at the one per cent level. Oxfords were significantly fatter than two-breeds at the one per cent point and Rambouillets at the five per cent point. Shropshires were fatter than two-breeds at the five per cent point.

In ether extract, Shropshire and three-breed lambs have a significantly higher percentage of ether extract in the lean than Rambouillet and two-breed lambs at the one per cent level. Hampshires and Oxfords have a significantly higher percentage at the five per cent level than Rambouillet and two-breed lambs.

Conclusions

1. These data indicate that certain body measurements bear a definite relationship to average daily gain.

2. The highest correlation coefficient was between average width and daily gain. The average width was due more to muscular growth than to thickness of fat over the eye muscle, as the area of the eye muscle was significantly correlated with daily gain, and thickness of fat was not.

3. Depth of forerib, plus width of rack, plus grams per centimeter of bone were used as an indication of constitution and ruggedness and were significantly correlated with growth rate.

4. The ratios: length of body to average width, and length of body plus average length of leg to average width, led to correlations significant at the one per cent level with average daily gain. These correlations indicated that wide lambs in proportion to length gain more rapidly. However, a number of the individual measurements and sums of individual measurements were more highly correlated with daily gain.

5. In these data, gain influenced width of rack more than depth of forerib.

6. Average depth, average length of leg, carcass grade and thickness of fat over the eye muscle were influenced only slightly by average daily gain. None of these independent variables were significantly correlated with the dependent variable.

7. The most important measurement influencing slaughter grade, in the eyes of the grading committee, was thickness of fat over the eye muscle, or finish.

8. Short-legged lambs that were also short from hooks to base of throat were the higher grading lambs at slaughter.

9. The ratio obtained by dividing the measurement, length from hooks to base of throat plus average length of leg, by average width, was correlated with slaughter grade indicating that typy lambs graded higher than poor type lambs.

10. An attempt was made to arrive at a figure for type by the use of ratios. However, many things influence type which cannot be measured in centimeters or pounds.

11. Lambs grading high at slaughter gave a higher percentage of loin due to increased fatness. The lower grading lambs had the higher percentage of leg.

12. The length of shank (upper breakjoint to twist), also length of cannon (upper breakjoint to lower breakjoint) were the best measurements in predicting percentage of leg. The long-shanked lambs had the higher percentage of leg. A lamb long in cannon and tibia, probably is long in femur, thus increasing the length of the meated area if not the plumpness.

13. Lambs long from the hooks to the pinpoints have a lower percentage of leg. In this study the long-legged, long-shanked lambs were also the shortest in the rump and poorest in finish, (Rambouillet and Rambouillet X Cotswold.

14. No mechanical measurement was significantly correlated with percentage of loin. Neither slaughter grade or width of rack influenced the percentage of rack.

15. The wider-shouldered lambs had the higher percentage of shoulder.

16. Higher correlations may be received between certain measurements and percentages of wholesale cuts if the breeds of lambs were treated separately.

17. Oxfords made significantly higher daily gains than Shropshire, Rambouillet and two-breed lambs. Hampshires and three-breeds gained significantly faster than Shropshires.

18. Shropshire and three-breed lambs graded significantly higher at slaughter than two-breed and Rambouillet lambs. Oxford and Hampshire lambs graded significantly higher than two-breed lambs.

19. Shropshire, three-breed, Oxford and Hampshire lambs have a significantly higher dressing percentage and carcass grade than two-breed and Rambouillet lambs.

20. There was no significant difference in the area of the eye muscles in these spring lambs.

21. Three-breed, Hampshire and Oxford lambs were significantly fatter over the eye muscle than two-breed and Rambouillet lambs. Shropshires were significantly fatter than two-breeds.

22. Shropshire, three-breed, Oxford and Hampshire lambs had a significantly higher percentage of ether extract in the lean than two-breeds and Rambouillets.

23. On the present market, it is questionable whether the high quality Shropshire lambs would return as much profit to the producer as the more rapid gaining Oxford and Hampshire lambs.

24. The three-breed lambs tend to yield a high quality carcass and also gain rapidly.

25. In the production of spring lambs, the two-breed and Rambouillet lambs lacked the quality of carcass and rapidity of growth to compare with the Hampshire, Oxford, Shropshire and three-breed lambs.

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A P P E N D I X

Lamb Number	Slaughter Weight	Slaughter Age	Average Daily Gain	Empty Body Weight	Chilled Carcass Weight
Hampshire					
26	90.7	122	0.64	83.9	50.6
31	80.0	136	0.51	71.0	41.8
40	82.0	131	0.52	75.1	42.4
37	76.7	150	0.45	58.9	34.6
33	81.7	178	0.41	73.8	39.8
Oxford					
103	94.0	115	0.73	80.0	48.5
90	87.0	121	0.65	76.6	42.9
94	76.0	164	0.41	69.3	38.4
95	82.6	161	0.45	73.4	42.6
Three-Breed					
82	86.0	129	0.58	77.1	46.5
84	82.5	161	0.47	70.7	39.5
83	77.5	157	0.44	69.0	37.2
89	75.3	126	0.51	66.7	39.0
146	87.2	179	0.42	79.0	42.6
87	81.0	212	0.34	72.0	40.5
Two-Breed					
17	77.8	129	0.53	67.9	37.6
18	84.0	136	0.52	73.6	39.0
13	81.0	140	0.49	70.5	36.5
5	86.9	169	0.44	77.7	39.5
15	81.2	187	0.39	72.4	37.4
8	79.5	196	0.35	69.4	34.7
16	77.7	180	0.37	69.4	34.5
Shropshire					
54	77.0	226	0.30	71.8	40.5
62	87.0	219	0.35	75.3	42.5
707	87.0	239	0.33	74.2	42.1
723	80.0	236	0.31	66.3	37.2
Rambouillet					
131	83.4	147	0.50	70.8	35.8
133	78.3	171	0.42	69.7	37.6
143	89.5	174	0.45	80.5	41.5
140	77.3	187	0.36	68.3	36.0
128	87.5	214	0.36	79.5	39.5
137	85.0	216	0.35	77.5	40.5

Carcass Grade	Slaughter Grade	* Dressing Percentage	% Ether Extract in the Lean	Depth of Fat Over Eye Muscle	Area of Eye Muscle	Average Width
3.2	4.0	60.3	13.6	0.35	2.3	20.6
4.8	4.8	58.9	11.0	0.44	1.8	20.2
2.3	6.0	56.5	10.9	0.31	1.8	19.8
7.5	9.0	58.7	9.3	0.19	1.5	18.9
4.0	6.7	53.9	8.6	0.25	1.5	18.7
3.5	5.5	60.6	10.2	0.28	2.1	20.7
5.8	7.0	56.0	10.1	0.25	1.9	20.2
4.7	6.0	55.4	12.5	0.30	1.6	18.7
4.7	6.0	58.0	10.6	0.35	1.8	18.7
3.2	4.4	60.3	13.5	0.44	2.1	20.0
4.5	4.0	55.9	12.4	0.28	1.6	20.6
5.0	8.5	53.9	15.2	0.28	1.3	19.2
3.0	4.8	58.5	9.4	0.31	1.7	19.5
6.0	8.0	53.9	8.2	0.28	1.8	19.4
2.0	3.3	56.3	13.9	0.44	1.7	17.5
11.2	9.0	55.4	8.6	0.16	1.9	18.8
10.3	10.0	53.0	8.2	0.06	1.9	19.2
14.5	10.0	51.8	8.5	0.13	1.6	18.3
12.7	7.0	50.8	8.3	0.22	1.9	18.6
8.7	8.7	51.7	10.6	0.24	1.4	18.8
10.0	13.5	50.0	7.1	0.16	1.6	17.5
12.3	10.0	49.7	5.5	0.16	1.5	17.4
2.0	2.7	56.4	14.5	0.31	1.5	17.3
4.0	2.7	56.4	14.0	0.19	1.5	17.1
4.7	5.3	56.7	10.9	0.19	1.8	18.4
6.7	6.7	56.1	10.9	0.35	1.5	17.6
12.5	10.0	50.6	7.6	0.09	1.7	19.4
8.7	8.0	53.9	6.3	0.19	1.8	19.6
10.0	6.7	51.6	6.9	0.16	1.7	19.9
13.3	10.0	50.1	7.9	0.21	1.2	17.9
8.0	8.7	49.7	9.0	0.25	1.5	16.5
12.0	8.0	52.3	8.8	0.19	1.7	17.2

$$* \frac{\text{Chilled Carcass Weight}}{\text{Empty Body Weight}}$$

Width of Shoulder	Width of Back	Average Width of Loin	Width of Thurls	Depth of Shoulder	Depth of Forerib	Average Depth
23.0	23.0	16.0	25.0	28.5	28.0	26.0
24.0	22.5	15.0	24.5	27.5	27.0	24.0
22.0	20.5	15.3	26.0	28.0	28.0	25.0
21.0	19.5	14.2	26.0	26.5	25.5	22.8
21.5	19.0	13.5	26.0	28.5	27.0	25.8
24.0	23.0	14.7	27.0	29.0	29.0	26.0
23.5	22.0	14.6	26.2	29.0	26.5	25.0
21.5	20.5	13.0	25.5	27.0	26.0	23.5
21.0	20.5	13.5	25.0	28.0	26.5	25.8
23.5	23.0	15.0	23.5	28.0	27.5	25.0
23.0	22.0	16.0	26.0	29.0	26.5	23.8
22.0	21.0	14.1	24.8	28.5	27.5	24.8
22.5	22.5	14.4	23.5	27.0	25.8	24.4
21.5	20.8	14.2	26.0	28.5	28.0	25.4
19.5	20.0	12.5	22.5	27.0	25.5	22.8
20.5	20.0	14.8	24.0	28.5	27.0	25.0
22.0	21.5	13.9	24.5	29.0	27.5	26.8
21.0	19.5	13.5	24.0	29.0	27.0	24.5
21.5	22.0	13.5	22.5	30.5	28.5	27.3
21.5	21.0	14.0	23.5	28.5	27.5	26.5
20.0	19.0	12.3	23.8	29.0	28.0	26.3
20.0	19.0	12.8	22.5	28.5	27.0	26.3
20.5	19.5	12.3	22.0	26.0	23.5	21.3
20.5	19.5	12.0	21.5	27.5	25.0	24.0
22.0	21.5	12.8	22.8	28.0	26.0	25.6
20.0	20.0	12.5	23.0	28.0	27.5	24.8
20.8	21.8	14.6	25.0	29.0	27.5	25.5
21.0	22.0	15.0	25.0	28.0	27.0	24.5
22.0	23.0	14.0	26.5	28.0	27.5	27.3
20.5	20.0	12.1	24.5	28.0	27.0	24.8
18.5	18.0	12.3	21.5	29.5	26.5	25.0
20.5	20.0	11.8	22.0	29.0	28.5	26.5

Pinpoints to Base of Throat	Pinpoints to Hooks	Hooks to Last Rib	Upper Break-joint to Lower Breakjoint	Upper Break-joint to Twist	Hooks to Base of Throat	Average Length of Leg
66.5	21.0	17.0	15.3	15.5	45.5	30.0
68.0	21.0	14.5	14.0	17.0	47.0	32.5
66.0	20.0	13.0	15.3	16.5	46.0	32.5
64.5	20.5	15.5	15.0	17.5	44.0	31.4
64.5	20.0	16.5	15.0	18.5	44.5	27.5
72.0	21.5	17.5	15.5	17.0	50.5	33.8
68.5	21.0	16.0	16.5	18.0	47.5	32.6
63.5	20.5	13.0	15.0	17.5	43.0	32.3
68.0	20.5	15.0	15.5	17.0	47.5	30.0
70.5	20.5	14.5	15.0	16.0	50.0	31.0
65.0	21.5	15.0	15.5	17.5	43.5	32.8
66.0	19.0	15.5	15.0	18.5	47.0	33.8
63.0	20.5	15.0	15.5	18.0	42.5	33.0
68.5	17.0	20.5	15.5	20.0	51.5	33.9
64.0	20.0	16.5	15.5	18.5	44.0	34.3
68.5	20.0	17.0	17.3	20.3	48.5	36.3
70.0	21.0	13.0	17.5	21.0	49.0	35.0
67.0	19.5	16.5	17.0	21.0	47.5	31.0
68.0	17.0	22.5	17.0	20.5	51.0	32.3
65.0	22.0	15.5	16.0	19.5	43.0	32.5
66.5	21.0	16.5	17.0	21.5	45.5	36.0
67.0	15.5	20.5	17.3	21.0	51.5	34.0
63.5	19.5	14.5	13.8	16.3	44.0	28.0
64.5	21.0	13.5	15.0	16.5	43.5	32.5
65.5	21.5	15.0	14.5	16.5	44.0	28.2
67.0	21.0	15.5	15.5	16.5	46.0	30.2
62.8	20.0	16.0	17.0	21.5	42.8	33.4
67.0	17.0	18.5	15.0	19.0	50.0	30.0
66.0	19.0	15.5	20.3	19.5	47.0	25.8
65.0	19.0	16.0	15.8	19.5	46.0	36.8
69.0	15.0	20.5	16.3	21.0	54.0	39.0
67.5	19.0	18.0	16.0	20.5	48.5	33.5

$\frac{L}{W}$	$\frac{L+O}{W}$	$\frac{P+O}{W+D}$	$\frac{P+O}{W}$	Grams per Centimeter of Bone	Heart Girth
3.23	4.68	1.62	3.66	5.65	74.5
3.37	4.97	1.80	3.93	5.66	71.0
3.33	4.97	1.75	3.96	5.03	71.5
3.40	5.06	1.81	3.98	5.06	68.0
3.45	4.92	1.62	3.85	5.67	71.0
3.48	5.11	1.80	4.07	6.07	74.5
3.39	5.00	1.77	3.96	6.26	69.0
3.40	5.12	1.78	4.02	5.54	69.0
3.64	5.24	1.74	4.14	6.12	72.0
3.52	5.07	1.80	4.05	5.45	71.5
3.15	4.74	1.72	3.70	4.94	71.0
3.44	5.19	1.84	4.20	4.81	70.5
2.24	4.93	1.72	3.88	5.14	69.5
3.54	5.29	1.91	4.41	5.42	72.0
3.66	5.61	1.94	4.47	4.69	70.5
3.64	5.57	1.93	4.51	5.32	69.0
3.65	5.48	1.83	4.39	5.54	70.5
3.66	5.35	1.83	4.29	5.45	69.0
3.66	5.42	1.83	4.50	5.05	71.5
3.46	5.19	1.67	4.01	4.90	70.0
3.81	5.87	1.86	4.67	4.48	72.5
3.85	5.80	1.96	4.91	5.11	69.0
3.67	5.29	1.87	4.16	4.35	70.5
3.77	5.67	1.85	4.44	4.93	71.0
3.56	5.09	1.64	3.92	4.85	68.5
3.81	5.52	1.80	4.32	3.55	67.5
3.24	4.97	1.70	3.93	5.44	67.5
3.42	4.95	1.81	4.08	5.51	67.5
3.32	4.61	1.54	3.65	5.65	69.0
3.64	5.70	1.94	4.63	4.64	68.0
4.18	6.54	2.24	5.64	4.94	69.5
3.92	5.87	1.88	4.77	5.21	72.0

Percentage of Leg	Percentage of Loin	Percentage of Hotel Rack	Percentage of Shoulder	Percentage of Breast and Shank
33.0	16.0	12.8	23.3	14.4
34.7	14.6	12.0	25.3	13.4
33.5	14.2	12.5	25.7	13.2
35.5	12.4	13.9	24.3	13.9
34.9	15.8	12.3	22.1	14.8
33.0	16.1	13.0	23.9	13.6
34.0	13.5	12.1	25.2	15.2
36.2	13.5	13.3	21.9	14.3
34.5	16.2	13.1	21.8	13.6
32.5	17.4	12.7	22.8	13.8
35.9	15.7	12.9	22.0	12.9
35.7	15.9	12.6	21.8	13.4
32.8	17.7	12.6	22.8	13.6
35.2	16.0	12.2	21.6	13.8
35.1	16.0	12.3	22.2	14.1
35.4	14.4	12.8	23.4	14.1
34.9	13.3	11.8	24.9	14.6
36.2	13.7	12.3	22.5	14.8
35.7	14.7	12.4	22.8	14.7
34.5	14.7	11.8	24.1	13.9
35.2	14.7	12.7	23.9	13.5
38.3	11.9	11.9	22.3	15.1
32.6	16.5	13.6	23.2	14.3
33.2	17.2	12.5	21.6	15.3
30.9	17.3	12.8	23.5	14.7
33.3	17.5	12.9	21.2	15.3
36.3	13.4	12.0	24.9	13.4
34.8	14.9	12.5	23.9	13.3
34.9	13.5	11.6	25.1	14.2
35.7	12.9	12.3	24.3	14.9
35.4	14.7	13.4	21.5	14.1
34.3	16.3	12.3	22.5	14.1