

duced the most efficient gains. However, because of the high price of wheat, cost per cwt. gain was high for lambs in lot 4.

Lambs in lot 3 fed the nonpelleted ration went off feed several times during the test. Several foundered from overeating but no death loss occurred in this lot. For some reason four lambs fed the corn-alfalfa pellets in lot 2 died from overeating after about 60 days on test.

Because of the nonuniform beginning weights, there were several lambs in each lot that did not reach market weight and finish by the end of the test. The largest number of lambs not sold came from lot 3 fed the nonpelleted ration.

There was about 1/4 USDA carcass grade variation among lots and about 1.5 percent variation in yield among lots.

Heritabilities, Genetic, and Phenotypic Correlations Between Carcass and Live Animal Traits in Sheep (Project 347).

Carl Menzies, Myron Hillman, John D. Wheat, D. L. Mackintosh, and R. A. Merkel

This is a contributing project to the North Central-50 Regional Sheep Breeding Project. The Kansas State project was initiated in the spring of 1959 to determine relationships between various carcass measurements and live animal traits, to estimate heritability of these traits, and to determine how findings may be applied to selection and breeding of meat-type lambs.

Experimental Procedure

Ewes and lambs were handled practically the same in 1960-61 as in 1959-60. Procedure followed in handling ewes and rams and lambs during the 1959-60 season was outlined in Kansas Circular 378. Ewes were the same ones used in 1959-60. Ten different yearling Hampshire rams were obtained from various Kansas breeders. Rams were scored for various characteristics by a group of department members, weighed, and probed for fat thickness and loin eye depth at the second lumbar vertebra at the end of the breeding season. Each ram was randomly assigned to a group of 10 ewes. Breeding season was June 6 to September 1, 1960.

Lambs were weighed at birth and have been weighed every two to three weeks since. They are self-fed a pelleted creep ration consisting of 10% poor-quality field-cured alfalfa, 35% dehydrated alfalfa, 45% ground sorghum grain, 7.5% molasses and 2.5% soybean oil meal plus 10 mgs. of Aureomycin per pound of pellets. Ewes are fed all the sorghum silage they will eat plus 1 lb. of sorghum grain and about 2 lbs. of alfalfa hay per head daily. Salt is available free choice. Lambs suckle ewes until slaughtered.

When lambs weigh between 95 and 100 lbs. they are sheared, probed for fat thickness and loin eye depth at the 2nd lumbar vertebra and 20 body measurements are taken. Lambs are slaughtered at the meats laboratory. Various measurements and scores are obtained on the carcasses. Each hotel rack is separated physically. Percentage of ether extract is obtained on a section of the loin eye and intercostal muscle. Each loin is sent to the Home Economics Department where Warner-Bratzler tenderness scores, total cooking losses, press fluid, and panel scores on tenderness, flavor, and juiciness are obtained.

Results and Discussion

See report on page 59 for a brief description of some of the carcass information obtained on lambs slaughtered in 1959-60.

A portion of the data obtained during 1959-60 is reported in Table 33. There were considerable differences in ram type score and weight, and between performance and carcass characteristics of the 10 lamb groups. Gain data were not corrected for sex or type of birth (single or twin) and have not been statistically analyzed.

The Southdown ram used in 1959-60 served as a clean-up ram after the Hampshire rams had been removed and the ewe groups turned to-

Table 33
1959-60 data on one Southdown and nine Hampshire rams and their lambs.

	Hampshire rams										Southdown ram	
	2	3	4	5	6	7	8	9	10	1		
Ram number												
Ram type score ¹	81.5	90.7	77.8	76.0	79.7	74.0	86.6	82.3	90.5			
Wt. of ram, June 1, 1959	159	206	166	158	153	166	171	174	195			
Total number of lambs	8	8	9	9	6	8	10	9	10			
Av. birth wt., lbs. ²	9.6	8.38	9.54	9.87	9.18	10.20	8.96	10.03	8.6	9.10		
Av. slaughter wt., lbs. ³	86.2	87.5	86.9	86.3	85.8	88.0	85.4	86.8	86.2	78.0		
Av. age at slaughter	127	148	153.7	147	149	137.3	148.8	132.3	157.6	136.9		
Av. daily gain, lbs. ^{3,4} .....	.708	.615	.593	.598	.595	.645	.543	.670	.576	.546	
Av. rib eye area, 12th rib, sq. in.	2.13	2.23	2.20	2.23	2.30	2.22	2.24	2.05	2.06	1.96		
Av. rib eye area per cwt. carcass, sq. in.	4.33	4.48	4.38	4.50	4.67	4.53	4.62	4.24	4.13	4.94		
Av. fat thickness, 12th rib, in. ....	.26	.28	.28	.32	.28	.28	.27	.34	.28	.18	
Av. marbling score ⁵	5.37	6.0	5.77	5.44	6.0	5.37	6.30	5.11	6.40	5.70		
Av. USDA carcass grade ⁶	13.0	13.9	14.3	14.4	14.5	13.4	14.2	13.6	14.1	13.8		
Av. dressing % ⁷	50.8	51.4	50.0	51.6	51.1	50.4	50.6	49.9	51.2	47.5		
Av. % leg	29.4	29.4	31.0	29.5	30.3	30.8	30.5	30.6	30.7	31.2		
Av. % loin	11.8	11.1	11.5	11.6	12.2	11.0	11.1	11.5	10.0	10.3		
Av. % rack	11.6	11.5	11.4	12.4	10.9	11.2	11.3	11.8	11.4	10.6		
Av. % breast	17.5	17.6	17.7	18.5	18.1	18.3	17.7	17.0	17.8	19.1		
Av. % shoulder	24.7	25.4	24.7	23.8	24.7	25.3	25.1	25.2	25.8	25.0		

1. Average general type score, with perfect score being 100.
2. Not corrected for sex or type of birth.
3. Shorn weight taken just before slaughter after lambs had stood over night without feed and water.
4. Based on unshorn weight.
5. Higher score means more marbling.
6. Carcasses graded by USDA grader: Prime, 14; choice, 11; good, 8; etc.
7. Based on shorn slaughter weight and chilled dressed carcass weight.

Table 34
Preliminary 1960-61 data on ten yearling Hampshire rams and their lambs as of March 9, 1961.

Ram number	1	2	3	4	5	6	7	8	9	10
Ram type score ¹	80	78.8	71.6	92.1	78.8	82.3	86.8	86.8	78.3	60.0
Wt. of ram, lbs. 9-2-60	198	161	163	270	189	229	224	222	170	147
Ram probe fat depth at 2nd lumbar, in. ....	.30	.40	.40	.35	.30	.40	.30	.20	.30	.20
(46) Ram probe loin eye depth at 2nd lumbar, in.	1.75	1.60	1.40	2.15	1.60	1.50	1.90	2.10	1.70	1.20
Ram loin eye depth per cwt., in. ....	.92	.99	.85	.92	.84	.65	.84	.94	1.00	.816
Total number of lambs	12	11	13	10	10	8	7	12	11	10
Number twin lambs	6	4	6	4	2	2	2	6	4	2
Av. birth wt., lbs. ²	10.8	9.2	9.0	10.7	9.9	10.6	10.4	9.6	10.0	8.9
Av. daily gain, lbs. ² .....	.786	.762	.801	.819	.773	.785	.756	.823	.755	.761

1. Average general type score, with perfect score, equals 100.
2. Not corrected for sex or type of birth.

either. Preliminary data on rams used in 1960-61 and on their lambs are reported in Table 34. There was considerable variation among rams in regard to type score, weight, probe, fat depth, and probe loin eye depth. Lamb birth weight and gain differ; however, these have not been corrected for type of birth or sex.

A more complete report on the 1960-61 lambs will be made in the 1962 Feeders' Day Report.

Effects of Exercise and Cooling on Reproductive Efficiency of Ewes Bred During Summer Months (Project 441).

H. G. Spleen, C. S. Menzies, W. H. Smith, and S. P. Scott

Failure of ewes to conceive during summer is one of the biggest problems affecting the early spring lamb producer. Workers at other stations have reported that 90° F. temperatures lowered reproductive performance. This study was designed to determine the effects of forced exercise and temperature on reproductive performance of ewes.

Experimental Procedure

Forty-eight five- to six-year-old western ewes of Rambouillet breeding were sheared, drenched, and grazed on brome pasture plus ½ pound of grain per head daily until they were placed in either an air-conditioned room or a control pen. Each group was fed equal quantities of grain and hay during the treatment period. Twenty-four were maintained under a confined, but otherwise normal, outdoor environment and 24 were placed in a temperature-controlled room (60-64° F.) on the seventh day of the first detected estrous cycle until day 3 or 25 of pregnancy. Twelve ewes of each group were exercised on a mechanical exerciser for 30 minutes each day from day 10 of the first detected estrous cycle until day 3 or 20 of pregnancy. Exercised ewes walked about 1.4 miles each day. Two Hampshire rams were used to breed each ewe, on the second detected estrus (first estrus of the experimental period). Rams were kept in a cooled room prior to and throughout the breeding season. Twenty-four ewes (6 exercised and cooled, 6 exercised and not cooled, 6 not exercised and not cooled, and 6 not exercised and cooled) were slaughtered at day 3 of gestation, and 24 ewes given similar treatments were allowed to lamb.

Results and Discussion

Summer temperature, although mild in 1960 (average temperature 77° F. with a range of 48-99° F.) appeared to be detrimental to reproductive efficiency of western ewes. The number of normally cleaved ova at the third day of gestation was lower in noncooled ewes than in cooled ewes (57% vs. 80%). Also the number of ewes returning to heat following breeding and the number of services per conception was higher in the noncooled ewes (50% vs. 0% and 1.8% vs. 1.0%, respectively; see Table 35). Body temperature and respiration rate were used as indicators of physiological stress. Average body temperature and respiration rate of cooled ewes were 102.4° F. and 33.4 respirations per minute compared with 102.5° F. and 64.8 respirations per minute, for the noncooled ewes. Although these differences are not so great as some workers have reported, they were significant. Forced exercise resulted in significantly lower numbers of normal ova at three days postbreeding compared with nonexercise (57% vs. 80%; Table 35). However, since there were no differences in the number of ewes returning to heat between exercised and nonexercised groups (17% compared with 17%; Table 35), the effect of 30 minutes of exercise daily on reproductive efficiency may be questioned. More study is needed before definite conclusions are drawn. The exercised ewes were placed under some physiological stress as indicated by comparisons of body temperature and respiration rate. Exercise caused an average increase of 1.6° F. in body temperature and 79 respirations per minute. Ewes' body temperature and respiration rate returned to normal within one day.