day. Replacing the cottonseed meal with 0.72 pound of alfalfa hay cheapened the feed cost per cwt. gain by about 70 cents but increased the daily rate of gain by only 0.02 pound.

Gains made by lambs fed alfalfa hay, milo grain, and salt along with ground Axtell stover, sorghum silage, or Axtell fodder as roughages were approximately the same in all cases. However, use of Axtell fodder cheapened the feed cost considerably at the prices charged for the different roughages. In last year's test, lambs fed sorghum silage plus alfalfa hay as roughage gained faster than lambs receiving either sorghum stover or stover plus alfalfa hay as the roughage part of their ration. However, the lambs this year consumed about 1 pound less silage per day than the lambs did last year.

Rather disappointing results were obtained with wheat silage and alfalfa hay as the roughage. This lot had the lowest gain of any in the test and also a much higher feed cost. These lambs gained well the first part of the test but dropped to only 0.07 pound per day for the last 25 days of the experiment.

The feeding of 14.4 mgs. of aureomycin per lamb per day failed to increase the rate of gain or feed efficiency under conditions of this test. The feeding of aureomycin to lambs implanted with 6 mgs. of stilbestrol did not have any additive effect. These lambs gained about the same as those in lot 2 that were implanted with stilbestrol and fed a similar ration without aureomycin.

The largest and cheapest gains were made by the lambs on wheat pasture. The lambs in this lot that were implanted with 6 mgs. of stilbestrol at the beginning of the test gained about 35 percent faster than those that were not implanted. Results were almost identical with those obtained in last year's test. The increased rate of gain made by the implanted lambs resulted in $1.38 difference in the final cost per cwt. of lamb.

Only one lamb was lost during this 101-day test. This lamb was from lot number 3 and died from urinary calculi. One lamb died before the experiment started.

Appreciation is expressed to the Eli Lilly Company at Indianapolis, Ind., which furnished the stilbestrol premix fed to the lambs; to the Syntex Animal Products Division of Foundation Laboratories, Inc., of New York, N.Y., for the estradiol-progesterone (Synovex) pellets; and to the Norden Laboratories of Lincoln, Nebr., for the stilbestrol pellets.

The Relationship of Physical Balance in the Utilization of Pelleted and Nonpelleted Rations for Lambs—Metabolism Studies (Project 236).

D. Richardson, T. D. Bell, R. F. Cox, and W. D. Striegel

Studies at this station and others have shown the importance of ratio of roughage to concentrate in lamb-fattening rations. In recent years, there has been considerable interest in feeding completely pelleted rations. Tests were designed to study the effect of pelleting upon digestibility and percentage of nitrogen retained by lambs fed different ratios of roughage to concentrate, pelleted and nonpelleted. A previous test indicated lowered digestion of fiber in pelleted rations but an increase in digestibility of other nutrients to such an extent that the total digestible nutrient values were essentially the same. Nitrogen retention was greater with the pelleted rations.

Experimental Procedure

Eight crossbred lambs averaging 85 pounds each were used during the winter of 1955-56 to study rations consisting of 60 percent roughage and 40 percent concentrate as pellets, and 50-50 pellets with enough hay to make the ratio 55 percent roughage and 45 percent concentrate.

Also, in the winter of 1956-57 eight crossbred lambs averaging about 90 pounds each were used to study rations containing 65 and 55 percent roughage and 35 and 45 percent concentrate, respectively. Alfalfa and

corn were used as the roughage and concentrate. Where pellets were used, they were made to contain a ratio of roughage to concentrate of 60-40 and 50-50. Enough chopped hay was fed with the pellets to make ratios of 65-35 and 55-45 in the total ration. Each animal served as his own control for the various rations.

Results and Discussion

More work needs to be done to make definite comparisons. The results of these two tests are presented in Tables 12 and 13. They indicate greater digestibility of all nutrients, especially crude fiber, and an increase in nitrogen retention when enough chopped hay was added to 60-40 pellets to make a 65-35 roughage-to-concentrate ratio.

In general, nitrogen retention seems to be greater with pelleted rations; however, quantity of total feed consumption has a great influence on this factor. Rations containing a greater percentage of concentrate seem to be utilized more efficiently. Pelleted rations made from sun-cured alfalfa tended to be more efficient than pelleted rations from dehydrated alfalfa.

Table 12

Results of Digestion and Nitrogen Balance Studies with Lambs Using Varying Ratios of Roughage to Concentrate in Pelleted and Nonpelleted Rations, November, 1955, to January, 1956.

No. of lambs	Ration	% protein	% apparent digestibility ether extract	% apparent digestibility crude fiber	% apparent digestibility of nitrogen-free extract	% total digestible nutrients	% nitrogen retained
8	60-40 SP[1]	59.46	64.62	20.64	77.58	58.37	7.53
8	60-40 DP[2]	51.55	69.26	21.56	72.72	53.32	9.75
7	60-40 HC[3]	54.87	57.69	27.11	75.16	55.08	—15.25[4]
7	50-50 SP[5]	69.32	69.42	33.59	83.51	65.85	21.79
7	50-50 DP[5]	65.92	75.52	35.63	82.59	66.03	16.96

1. 60% sun-cured alfalfa and 40% corn in pellet.
2. 60% dehydrated alfalfa and 40% corn in pellet.
3. 60% chopped alfalfa hay and 40% ground corn nonpelleted.
4. Lambs ate less than one half of normal quantity of feed.
5. Pellets contained 50% sun-cured alfalfa hay and dehydrated alfalfa, respectively, and 50% corn. Enough chopped hay was added to make a 55-45 ratio.

Table 13

Results of Digestion and Nitrogen Balance Studies with Lambs Using Varying Ratios of Roughage to Concentrate in Pelleted and Nonpelleted Rations, November, 1956, to February, 1957.

No. of lambs	Ration	% protein	% apparent digestibility ether extract	% apparent digestibility crude fiber	% apparent digestibility of nitrogen-free extract	% total digestible nutrients	% nitrogen retained
8	60-40 SP[1]	72.98	61.90	38.31	82.31	63.79	14.18
7	60-40 DP[1]	66.70	67.76	36.81	78.93	59.71	12.20
8	65-35 HC[2]	69.24	63.75	44.62	79.81	61.98	5.71
8	50-50 SP[1]	72.12	72.91	36.34	84.02	67.16	19.87
8	50-50 DP[1]	65.32	81.78	36.00	80.77	64.67	17.39
8	55-45 HC[2]	72.65	70.84	44.76	83.07	66.73	18.13

1. Sun-cured (SP) and dehydrated (DP) alfalfa was used to make pellets consisting of 60-40 and 50-50, respectively, of roughage and corn. Enough chopped hay was added to make the ratio of roughage to concentrate 65-35 and 55-45.
2. Ration made up of chopped hay and ground corn.

The Relationship of Physical Balance to the Utilization of Pelleted and Nonpelleted Rations for Lambs (Project 236).

C. Menzies, T. D. Bell, D. Richardson, R. F. Cox, and W. D. Striegel

Physical balance of lamb-fattening rations has been studied in this project for several years. This is the fourth year that this project has

been set up to study the effect of pelleting rations of varying proportions of roughages and concentrates upon feed-lot performance and feed efficiency compared with similar unpelleted rations. For the past two years both dehydrated and field-cured alfalfa hay have been used as roughages.

Experimental Procedure

The lambs used in this test were purchased on the Kansas City market October 10, 1956. They were primarily white-faced fine-wool wether and ewe lambs with a few black-faced crossbreds. November 6 the lambs were started on test, weighing approximately 75.5 pounds.

Six lots of 21 lambs each were fed as follows:

Lot 1—Pelleted ration, 60 percent field-cured alfalfa hay and 40 percent corn. In addition .4 pound of chopped alfalfa hay was fed per lamb per day. Total ration was approximately 65 percent alfalfa hay and 35 percent corn.

Lot 2—Pelleted ration, 50 percent field-cured alfalfa hay and 50 percent corn. In addition each lamb received .4 pound of chopped alfalfa hay per day. Total ration was approximately 55 percent alfalfa hay and 45 percent corn.

Lot 3—Nonpelleted ration, 65 percent chopped alfalfa hay and 35 percent ground corn.

Lot 4—Nonpelleted ration, 55 percent chopped alfalfa hay and 45 percent ground corn.

Lot 5—Pelleted ration, 60 percent dehydrated alfalfa hay and 40 percent corn. In addition each lamb received .4 pound of chopped alfalfa hay per day. This ration was made up of approximately 65 percent dehydrated alfalfa hay and 35 percent corn.

Lot 6—Pelleted ration, 50 percent dehydrated alfalfa hay and 50 percent corn. In addition .4 pound of chopped alfalfa hay was fed per lamb per day. Total ration was approximately 55 percent dehydrated alfalfa hay and 45 percent corn.

The alfalfa hay and dehydrated alfalfa hay used in this test both came from the same college field. A portion was dehydrated at the time of cutting and was later used with ground corn to make the pellets for lots 5 and 6. The remainder of the hay was baled and stored in the barn until part of it was ground and used with ground corn to make the pellets fed to lots 1 and 2. The chopped hay used in all lots came from the baled-hay supply. This hay was chopped with an ensilage cutter. All the corn used in this test was purchased in a bulk lot from a Manhattan mill.

The rations were fed twice a day; in addition, all the lambs had access to water and salt at all times. Individual weights were taken at the beginning of the trial and every two weeks thereafter. Carcass grades were obtained on the lambs when slaughtered.

The feed prices and processing charges used in determining the feed cost were as follows: chopped alfalfa hay, $28 per ton ($25 per ton baled plus $3 per ton for chopping); ground corn, $1.50 per bushel; dehydrated alfalfa hay, $37 per ton ($12 per ton for hay in the field plus $25 per ton for cutting, hauling, and dehydrating); grinding hay for pellets cost $5 per ton and mixing and pelleting cost $5 per ton. With these figures, the 60-percent field-cured hay-40-percent corn pellets cost $44.44 per ton, the 50-percent field-cured hay-50-percent corn pellets cost $46.80 per ton, the 60-percent dehydrated hay-40-percent corn pellets cost $48.62 per ton, and the 50-percent dehydrated hay-50-percent corn pellets cost $50.28 per ton.

Results and Discussion

The average daily gain, feed intake, feed consumed per cwt. pounds of gain, feed cost per cwt. gain, feed cost per lamb and carcass grades are shown in Table 13. Chemical analyses of feeds used are shown in Table 19. Results of digestion trials using the rations fed in this test are reported on pages 14 and 15.

The lambs fed the field-cured alfalfa hay and corn pellets gained faster

and more efficiently than did the lambs fed the unpelleted rations or those fed the dehydrated alfalfa hay and corn pellets.

In contrast to last year's results, lambs fed dehydrated alfalfa hay and corn pellets did not gain significantly faster than lambs fed similar unpelleted rations.

The lambs in lots 1 and 2, that were fed the field-cured pellets, consumed about .3 to .5 pound more total feed per lamb per day than did the lambs fed either the pellets containing dehydrated hay or the unpelleted rations containing the same proportions of roughages to concentrates.

In agreement with last year's results, slightly larger gains were produced by the pellets containing the higher proportion of roughage. However, the lambs fed these pellets were no more efficient than lambs fed pellets containing the lower proportion of roughage.

In previous years the ration of 55-percent roughage and 45-percent concentrates has been the most efficient and economical when nonpelleted rations were fed. The best results in this year's test, however, were obtained with the 65-percent roughage and 35-percent concentrate unpelleted ration.

The 65-percent roughage and 35-percent concentrate unpelleted ration produced the cheapest gains of any lots in this year's test. Due to the increased rate of gain and efficiency the two lots fed field-cured alfalfa hay and corn pellets produced gains just about as economically as the unpelleted rations. The gains made by the lambs fed dehydrated alfalfa hay and corn pellets cost considerably more than those made when other rations were fed.

There was little difference in the carcass grades of the lambs fed the different rations; however, lot 2 produced the highest grading carcasses. All lambs sold for the same price.

Table 14

Feed-Lot Performance of Lambs Fed Pelleted and Nonpelleted Rations of Varying Concentrations.

Lot number	1	2	3	4	5	6
Ration fed	60% field-cured alfalfa hay, 40% corn pelleted*	50% field-cured alfalfa hay, 50% corn pelleted*	65% chopped alfalfa hay, 35% cracked corn unpelleted	55% chopped alfalfa hay, 45% cracked corn unpelleted	60% dehydrated alfalfa hay, 40%-50% corn pelleted*	50% dehydrated alfalfa hay, 50% corn pelleted*
Number lambs per lot	21	21	21	20	21	21
Days on feed	88	88	88	88	88	88
Initial wt. per lamb, lbs.	77	75.4	75.3	75.3	75.5	75.1
Final wt. per lamb, lbs.	117.5	115.0	108.8	106.1	110.6	106.2
Total gain per lamb, lbs.	40.5	39.6	33.4	31.0	35.1	31.1
Av. daily gain per lamb, lb.	.459	.450	.380	.352	.399	.353
Lbs. feed per lamb daily:						
Pellet	3.15	2.92			2.94	2.62
Cracked corn			1.16	1.33		
Chopped hay	.418	.408	2.20	1.70	.408	.408
Lbs. feed per cwt. gain:						
Pellet	684.7	647.9			735.5	740.7
Cracked corn			304.6	377.7		
Chopped hay	87.6	90.6	577.9	483.7	102.1	115.4
Feed cost per cwt. gain, $	16.44	16.43	16.25	16.89	19.31	20.24
Feed cost per lamb, $	6.66	6.51	5.43	5.24	6.78	6.29
Number lambs died				1		
Carcass grades:						
Prime				2	1	
Choice	10	17	12	9	10	11
Good	11	4	9	9	10	10
Av. daily gain per lamb fed similar rations in '55-56, lb.	.416	.398	.336	.355	.381	.377

* Each lamb received, in addition, .4 lb. chopped alfalfa hay daily.

(18)

Table 15

Lamb Production by Ewes of Different Types from Sires of Different Breeds in 1956.

Breed or breed-type	No. ewes bred	No. ewes lambing before Dec. 20	No. ewes lambing after Dec. 20	No. lambs weaned	% lambs weaned	Lamb weight at 100 days of age	Average weaning weight, lbs.	Lbs. of lamb weaned per ewe bred
Ewe types:[1]								
Finewools	47	43	2	54	114.9	72.7	100.2	100.2
Northwest Whiteface	40	23	12	40	100	75.4	96.6	96.5
Northwest Blackface	49	35	8	48	95.9	76.0	103.3	103.3
Total[1]	136	101	22	42	103.6	74.6	99.5	99.5
Sire groups:[2]								
Hampshire	34	26		30	107.1	75.1	100.5	88.7
Suffolk	34	27		32	100	76.7	101.9	95.9
Southdown	33	25		29	87.8	72.0	97.8	85.9
Shropshire	35	23		24	68.7	74.8	101.2	69.4

(19)

1. Results include 22 ewes that lambed after December 20. These ewes were bred after July 25, 1955, when the three ewe groups were run together and rams of all four breeds were placed with them.
2. Ewes that lambed after December 20 are figured as dry ewes.

Table 16

1957 Lambing Data and Lamb Production from Ewes of Different Types and from Sires of Different Breeds.

	No. ewes bred	No. ewes lambing	Average lambing date	Av. birth wt., lbs. Singles	Av. birth wt., lbs. Twins	% lambs born	No. lambs alive Mar. 29	Av. wt. of lambs Mar. 29
Ewe groups:								
Finewools	48	43	Nov. 17	11.2	10.2	135.4	58	84.6
Northwest Whiteface	39	31	Dec. 15	12.3	8.8	117.9	44	72.3
Northwest Blackface	47	40	Dec. 10	13.6	9.2	127.6	57	75.1
Sire groups:								
Hampshire	33	28	Nov. 28	10.5	9.0	127.2	35	85.4
Suffolk	33	33	Dec. 6	12.7	9.2	145.4	46	84.0
Southdown	34	24	Dec. 6	10.7	8.2	97.0	32	70.8
Shropshire	34	29	Dec. 2	10.6	9.2	141.1	46	70.9

The Effect of Stilbestrol on Digestion and Nitrogen Balance in Lamb Rations (Project 370).

D. Richardson, T. D. Bell, and R. F. Cox

The feeding of stilbestrol to ruminants has, in general, increased rate of liveweight gain and decreased the quantity of feed required per unit of gain. This test was conducted to determine the effect of stilbestrol upon digestibility of nutrients and nitrogen retention when used in a lamb's ration.

Experimental Procedure

Fifteen crossbred lambs weighing about 90 pounds each were used in this test. The ration, composed of 65 percent alfalfa and 35 percent corn, was fed as a pellet. The lambs had been on this ration for a previous test and were accustomed to it. Collections of feces and urine were made over seven-day periods. After the first collection period, 2 mgs. of stilbestrol was added to the ration of each lamb. After a 10-day adjustment period, feces and urine were again collected for seven days. In this way, each animal served as his own control. The total quantity of feces and urine was measured each day and a sample obtained for chemical analysis.

Results and Observations

The results of this test are presented in Table 17. There were small but nonsignificant differences in the digestibility of protein, crude fiber, nitrogen-free extract, and total digestible nutrients. There was a significant decrease in digestibility of ether extract. Nitrogen retention increased but the amount was not significant. These results indicate that stilbestrol has very little or no effect upon the utilization of the nutrients studied.

Table 17

Average Digestion and Nitrogen Balance Results with 15 Lambs on a Ration with and without Stilbestrol.

Ration	% apparent digestibility of: crude protein	ether extract	crude fiber	N-free extract	TDN	% nitrogen retained
Control	68.06	64.99	35.68	84.84	64.40	14.74
Control plus 2 mgs. stilbestrol daily per animal	67.53	60.10	33.50	84.86	63.59	15.11

Table 18

Chemical Analyses of Feeds Used in Garden City Lamb-Feeding Trials, 1956-57.

Description	Protein (Nx6.25), %	Ether extract, %	Crude fiber, %	Moisture, %	Ash, %	N-free extract, %	Carbohydrates, %
As received							
Wheat silage	5.92	0.89	13.37	55.26	6.43	18.13	31.50
Wheat pasture	7.50	1.09	4.51	69.23	4.44	13.23	17.74
Sorghum silage	2.49	0.89	10.87	53.85	3.82	28.08	38.95
Sorghum fodder	3.63	2.01	20.66	9.91	10.11	53.68	74.34
Sorghum stover	2.94	1.27	20.08	16.88	7.52	51.31	71.39
Alfalfa hay	14.38	1.80	31.33	5.89	9.24	37.36	68.69
Dry basis							
Wheat silage	13.24	1.99	29.90		14.34	40.53	70.43
Wheat pasture	24.40	3.55	14.65		14.44	42.96	57.61
Sorghum silage	5.39	1.93	23.54		8.28	60.86	84.40
Sorghum fodder	4.03	2.23	22.93		11.22	59.59	82.52
Sorghum stover	3.54	1.53	24.16		9.05	60.72	84.88
Alfalfa hay	15.28	1.91	33.29		9.82	39.70	72.99

Table 19

Chemical Analyses of Feeds Fed in This Test and in the Digestion Trial Reported on Pages 14 and 15.

	Protein (Nx6.25), %	Ether extract, %	Crude fiber, %	Moisture, %	Ash, %	N-free extract, %	Carbo-hydrates, %
Ground corn	11.31	3.86	2.14	8.55	1.83	72.31	74.45
60-40 field-cured pellets	15.38	2.81	15.15	6.58	6.43	53.65	68.80
60-40 dehydrated pellets	15.38	3.63	18.12	6.03	8.55	48.29	66.41
50-50 field-cured pellets	14.13	3.07	13.10	6.85	5.48	57.37	70.47
50-50 dehydrated pellets	13.56	4.39	15.51	6.47	6.65	53.42	68.93
Chopped alfalfa hay*	15.50	1.66	29.30	5.94	9.28	38.32	67.62
Chopped alfalfa hay*	18.00	1.78	25.59	5.77	10.02	38.84	64.43

* These two samples were both obtained from the same lot of chopped field-cured hay.

The Use of Management Techniques and Hormones to Control the Time, Rate, and Regularity of Lambing (Project BJ-441).

E. Nelson, W. Smith, J. Wheat, T. D. Bell, and C. S. Menzies

Large, uniform lambs of high quality on the market at the right time provide the sheep man with his margin of profit. Because this is true, there has been considerable concern among producers of fall lambs concerning the control of the time, rate, and regularity of fall lambing. Many producers have found that their ewes will not breed regularly during the summer months and the lambing interval tends to be extended with lapses occurring occasionally.

To attack this problem, it is necessary to have basic information concerning the influence of each sex in the production of fall lambs.

The animals used in connection with this study were a flock of approximately 136 head of western ewes of three predominant types (Texas or finewools, Northwest Blackface Crossbreds, and Northwest Whiteface Crossbreds), and four breeds of rams (Hampshire, Suffolk, Shropshire, and Southdown). Observations on these sheep at this station during the past four summers indicate that the ewes may be sexually active during the summer months, at least above marginal levels, and failure to settle may be due to poor semen-quality production by the rams used. Factors affecting semen quality are being observed at Kansas State College.

Some seasonal variation in semen quality has been observed at this station. However, the data now being collected are still incomplete, and no definite conclusions can be drawn from them. It is evident that individual rams tend to vary considerably more in regard to semen quality than do the breeds being observed. During the summer of 1956, four of the eight rams used on the experimental ewes exhibited some sterility for varying periods during the active breeding season (June 1 to September 7). One ram of each breed was so affected.

This preliminary observation indicates that a smaller ratio of ewes per ram be allowed during the summer than for normal fall breeding, and that even small groups of ewes should have at least two rams available. Other management techniques that tend to show promise are the feeding of high roughage rations, providing as cool a place as possible for the rams during the day, and shearing the rams at the beginning of the breeding season or shortly thereafter.

The scope of the entire project has not been fully investigated. Hormones have not been used in this study to attempt to change reproductive efficiency, because of their inconsistent results in previous studies (reported in Circulars 283, 1952; and 308, 1954). Their use, however, is still considered to be a possible method of control for fall lambing.

Adaptability of Breeds of Rams and Breed-Types of Range Ewes to Market Lamb Production in Kansas (Project 347).

Carl Menzies, T. D. Bell, L. A. Holland, and Edward Nelson

Western ewes of the three predominant types (Texas ewes or finewools, Northwest Blackface Crossbreds, and Northwest Whiteface Crossbreds) commonly found in Kansas were obtained as ewe lambs in the fall of 1951 and bred to Hampshire, Suffolk, Shropshire, and Southdown rams for five seasons. A different set of rams has been used each year, and the ewes have been rotated so that they were bred to a different breed of ram each year. Lamb and wool production records have been kept on the different types of ewes, and lamb production figures have been obtained for the four sire groups.

Results

Lamb production figures for the 1955-56 lamb crop are presented in Table 15 and the preliminary lambing data and lamb production for 1956-57 are shown in Table 16.

January 30, all lambs were separated into sire groups except 12 late lambs that were added to their respective groups February 26. Each group