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The Agricultural Experiment Station

OF THE

Colorado Agricultural College.

LAMB FEEDING EXPERIMENTS.

1900-1902.

I. SUGAR BEETS AND BEET PULP.

II. HOME GROWN GRAINS AND CORN.

III. (*a*) SMALL GRAINS AND CORN.
(*b*) WARM AND COLD WATER.
(*c*) SHROPSHIRE GRADES AND NATIVE LAMBS.

—BY—

B. C. BUFFUM and C. J. GRIFFITH.

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PLATE I.

Fed Oats, Wheat, Barley and Alfalfa.
Given Cold Water to Drink.

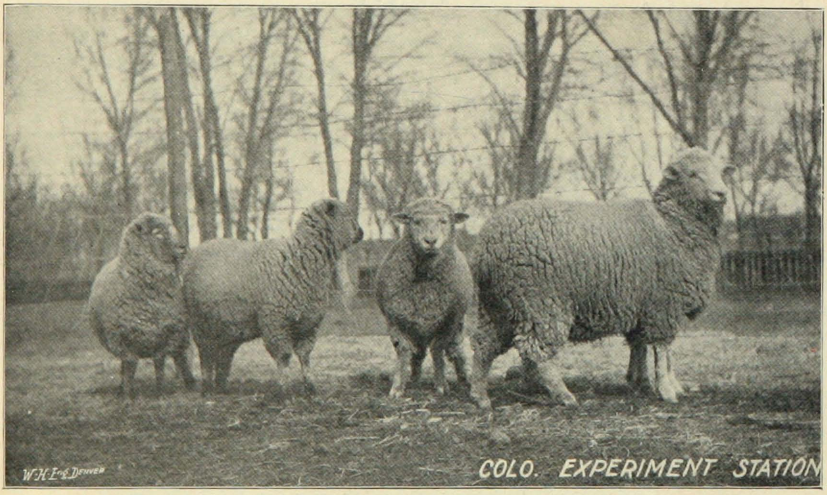

PLATE II.

Fed Oats, Wheat, Barley and Alfalfa.
Given Warm Water to Drink.

LAMB FEEDING EXPERIMENTS.

BY B. C. BUFFUM AND C. J. GRIFFITH.*

The value of the by-products from the beet sugar factories is a prominent subject among lamb feeders. With the remarkable growth of the beet industry within the state there will be a corresponding increase in the tonnage of pulp available to feeders. The pulp sells at a low price per ton, so low indeed that if it has any virtue at all either for fattening or for preparing the lambs to make more profitable gains when put on full feed, it will be a valuable addition to our supply of stock food in Colorado.

To compare the value of pulp when fed with alfalfa, or with alfalfa and grain, and the value of sugar beets when fed in the same manner, we carried out an experiment at the College during the past spring. The pulp was furnished gratis for this purpose by the Great Western Sugar Company at Loveland, through the courtesy of Mr. A. V. Officer. Early in February a car load of pulp was received and hauled to the College barn where it was placed in convenient piles on the ground near the feeding pens.

Much has been written and said during the past year about the value of beet pulp, and many of the statements have been extravagant, or were without any basis of fact. It is not our intention to put any account of the feeding of pulp which has been complied from other sources in the body of this bulletin, but will state simply our own results. In our bulletin No. 73 of this Station, on the "Feeding Value of Beet Pulp and Feeding Sugar Beets and Pulp to Cows," has been published a brief resume of such data as we consider authentic, compiled from all sources to which we have had access. Our tests of sugar beet pulp for fattening hogs are reported in Bulletin No. 74 on "Swine Feeding in Colorado." This last bulletin gives the only information with which we are acquainted on feeding beet pulp to swine.

*Instructor in Animal Husbandry.

Many of our farmers have been convinced of the great worth of sugar beets in a ration for fattening stock, and in some instances they have paid more for beets for feeding than the factory would pay for manufacturing purposes. This makes the question of the value of sugar beets for feeding a live one, and we here report experiments which were carried out to throw light on this subject.

Sugar beets for fattening hogs were tried last year, and the results indicated that they were not so valuable for that purpose as many have supposed. These experiments are reported in the bulletin on "Swine Feeding in Colorado." It is well known, however, that a food suitable for one class of stock may not be suitable for another, and the results obtained with beets or pulp when fed to swine do not indicate what their nutritive quality would be when fed to lambs or cattle. Pigs require a concentrated ration, and while they may be, and in our trials were, able to live and make small gains when fed with beets alone, the ration was a bulky one and did not prove profitable. Pigs do not ordinarily live on dry hay, while lambs or cattle may lay on fat with such bulky rations, making good returns for the roughage consumed. Feeding beets or pulp to lambs along with alfalfa is very different from feeding these products to pigs when given either with or without grains or other concentrated foods.

The second experiment reported was inaugurated to compare home grown or small grains with corn, which is shipped in in great quantities by our sheep feeders, and during the past year, at least, has cost them much more than the grains which they raise on their own farms could be sold for. Many have an idea that stock of any kind cannot be fattened and properly fitted for market without using corn. Investigations in eastern states have shown that wheat is as valuable as corn for fattening stock. Our own experiments with fattening swine reported in the bulletin entitled "Swine Feeding in Colorado," show that mixtures of wheat and barley are preferable to corn for fattening pigs when either grain can be obtained at the same price as corn.

Occasionally there is introduced into the state, something new, either a new grain or a new variety which is given notoriety through the papers and which many go to considerable expense to obtain before they can know much about it. The Russian Spelt or Emmer is one of these, and in our sheep feeding trials its value has been carefully investigated. Russian Spelt, as it is popularly called (more

accurately "emmer"), is a primitive sort of wheat which does not shell out of the hull when threshed. As the kernels remain in the chaff, the grain is lighter than wheat, weighing about the same per bushel as oats, but it produces large yields and is said to be a good drouth resistant variety. In 1901, a field of this spelt on the College farm yielded sixty-three bushels per acre. The grain is very hardy. The present season we have a field of emmer growing on very poor land which is somewhat alkalized, parts of which would heretofore produce nothing but a crop of poverty weed. On this land we will get a very fair crop of grain.

The third experiment given in this bulletin was planned along the same line as the second one reported—a comparison of home grown grains with corn. Cold water was also compared with warm water in this same trial. A third comparison made in this experiment was the relative gain made by Shropshire crosses and native western lambs. These so-called Shropshire crosses were the first cross of pure bred Shropshire bucks on the native merino grade ewes. They were raised at the College farm from some old native ewes which had been purchased for an experiment.

Seven years ago the Station published Bulletin No. 32 on "Sheep Feeding in Colorado," prepared by Professor W. W. Cooke. That bulletin contains some information of general value and some interesting feeding experiments are reported. Those who are making a study of the lamb feeding problem will be interested enough to compare the results reported at that time and those given in the present bulletin, more especially, perhaps, the results from feeding sugar beets. The cost for each pound of gain where beets formed a portion of the ration was higher than the cost per pound of gain with grain rations, and the profit was not sufficiently large to make beet feeding remunerative. Professor Cooke reported a maximum return from feeding beets of $2.77 per ton and gives a low value of grain when added to a beet ration. The investigations reported in the present bulletin tend to substantiate that view. Because of the low cost of beet pulp, however, it forms a cheap substitute for the more expensive roots and the pulp seems to serve the purpose of adding a succulent food so well that there is considerable advantage to be gained from its proper use.

The comparative value of wheat and corn for lamb feeding where the lambs are finished on either of these grains, as reported in Bulletin No. 32, shows wheat to be

worth 15 percent more than corn, but under other conditions and for the entire trials then made, the wheat and corn were almost exactly equal to each other. The results with corn in our more recent trials show that the high prices paid by our farmers for corn during the past year were more than it was actually worth when compared with our home grown grains at their prevailing market prices. The high prices received for fattened lambs made the feeding of corn at $1.30 per hundred pounds profitable, but the man who properly fed wheat and barley at one cent per pound would have an appreciably larger balance on the right side of his ledger. It is the province of the Experiment Station to investigate these subjects and furnish the information to all who desire it. In addition to Bulletin No. 32 on sheep feeding, the Station has published Bulletin No. 52 on "Pasturing Sheep on Alfalfa and Raising Early Lambs."

EXPERIMENT 1.--SUGAR BEETS AND BEET PULP.

KIND OF LAMBS FED.

In the first and second experiments here reported, we used Mexican lambs which averaged 55 pounds per head March 5th, 1902. They were in very poor condition when we received them, a few days prior to the beginning of the experiment. They had trailed a long distance to Albuquerque, New Mexico, at which place they were held until they could be dipped twice. During the interval between the dippings they were kept on the sand hills where there was practically no food to be had. This class of lambs would represent the most unprofitable kind that could be had for feeding anywhere in the west. The resulting profit obtained, then, may be considered a minimum In April the lambs were shorn and the wool credited at ten cents per pound.

OBJECT AND PLAN OF EXPERIMENT I.

The object of this trial was to determine the comparative value of sugar beets and beet pulp when fed with alfalfa hay either alone or in combination with grain. Fifty lambs had been divided into ten lots of five each and five of these lots were to receive beet and pulp rations. Lots I. to IV. are regularly reported. Lot X. was given a ration of beets, grain and straw, in order to show the comparative return from feeding alfalfa and to determine whether the beets and straw could be made to take the place of alfalfa. Some of our farmers have thought that sugar beets had such a high feeding value that they could be made to take the place largely of both hay and grain. We failed to get the lambs in Lot X. fat enough to turn and considered the trial so much out of the ordinary that it would not be worth while to compare the results more than in a general way. So this lot does not appear in our tables. The following rations were fed to those in the sugar beet and pulp trial:

Lot I.—Alfalfa and beet pulp.

Lot II.—Alfalfa and beet pulp with grain consisting of equal parts of barley and wheat added during the last eight

weeks the lambs were fed; cutting off all the pulp during the last thirty days.

Lot III.—Alfalfa and sugar beets.

Lot IV.—Alfalfa and sugar beets with grain consisting of equal parts of wheat and barley added during the last eight weeks the lambs were on feed, cutting off the supply of sugar beets during the last thirty days.

The alfalfa was fed *ad libitum*, a complete record being kept of amount of fed and amount not eaten. It was the intention to feed all the pulp and beets that the lambs would eat, but it was not kept before them all the time.

Each lamb was marked, and weighed separately once a week in order to keep complete individual records of them as well as accounts of the lots. The lambs were selected carefully in order that there should be no advantage of any one lot over another by having in it a superior class of individuals.

In Experiments I. and II., the feeding was done and the notes taken by senior students under the direction and supervision of one of us. Our acknowledgments are due more especially to Mr. E. P. Taylor and Mr. H. J. Faulkner.

In computing comparative values and the cost of food eaten, cost for each pound of gain, etc., local market prices of the food used are as follows:

Alfalfa on the farm, $4.00 per ton.
Beet pulp delivered, $1.00 per ton.
Sugar beets on the farm, $4.00 per ton.
Wheat and barley, $1.00 per hundred pounds.

RESULTS OF EXPERIMENT I.

Nothing occurred to mar or interfere with this experiment except the necessity of feeding a small amount of grain during the first week to induce the lambs to begin eating the pulp and beets at once and a mistake which was made during the last three weeks when Lot III. receiving the beets were given grain. As all the lots received the same amount of grain the first week, the value of the comparisons of one lot with another are not disturbed. By drawing the conclusions for the first five weeks and for the first ten weeks, we are able to eliminate the effect of the grain given during the last thirty days to the pulp and beet lots, and show the comparative value of beets and pulp.

The beets showed a tendency to scour the lambs when they ate too large a quantity of them. The lambs in Lot IV. and one lamb, No. 7, in Lot II., were out of condition

once during the feeding period by having been fed too liberally.

Table I. gives the amounts of food supplied to each lot during each week, with the total amount fed each lot and the orts not eaten which were weighed back each day.

TABLE I.

LAMB FEEDING. SUGAR BEETS AND BEET PULP.
FOOD EATEN IN POUNDS.

	Lot I.					Lot II.					Lot III.					Lot IV.				
	Pulp	Pulp Orts	Alfalfa	Alfalfa Orts	Barley and Wheat	Pulp	Pulp Orts	Alfalfa	Alfalfa Orts	Barley and Wheat	Sugar Beets	Sugar Beet Orts	Alfalfa	Alfalfa Orts	Barley and Wheat	Sugar Beets	Sugar Beet Orts	Alfalfa	Alfalfa Orts	Barley and Wheat
Mar. 5 to Mar. 12	107	40	96	32	8.0	103	53	96	42	8	81	15	96	38	8	75	31	96	32	8
Mar. 12 to Mar. 15	42	2	36	12	....	42	14	36	9	...	42	2	36	14	...	42	3	36	19	...
Mar. 15 to Mar. 22	102	4	84	29	....	102	7	84	22	...	98	3	84	33	...	98	5	84	45	...
Mar. 22 to Mar. 29	124	5	84	19	..	124	1	84	20	...	94	4	84	27	...	104	...	84	23	...
Mar. 29 to April 5	132	9	84	22	....	132	5	84	15	...	108	1	84	21	...	108	...	84	26	...
April 5 to April 12	142	10	84	20	....	97	...	84	15	18	112	2	84	24	...	79	...	84	19	17
April 12 to April 19	147	6	84	24	...	94	...	84	32	22	128	...	84	37	...	97	...	84	25	23
April 19 to April 26	147	8	112	39	.	94	1	84	18	33	140	...	84	18	....	97	...	84	18	33
April 26 to May 3	193	4	112	35	..	90	37	94	40	47	151	3	94	27	...	84	6	91	40	51
May 3 to May 10	280	10	112	11	....	...	...	98	20	51	160	...	98	12	...	...	...	98	11	60
May 10 to May 17	272	21	112	32	5.5	...	...	98	22	49	39	...	102	23	31	...	...	98	21	73
May 17 to May 24	217	38	113	30	6.0	...	...	98	41	45	18	...	112	41	63	...	...	98	28	81
May 24 to May 28	90	22	45	7	....	...	...	40	8	29	....	...	45	6	26	...	...	40	8	30
Totals	1974	199	1155	314	19.5	878	118	1164	279	302	1166	30	1087	321	128	784	45	1061	315	376

Table II. gives the average amount of food actually consumed by each lamb daily. The alfalfa left uneaten

consisted of the coarser stems and these were consumed readily by the stock sheep. It was necessary at first to sprinkle the pulp with grain in order to get the lambs to eat it at all. Near the end of the trial the supply of sugar beets gave out and a little grain was added to the ration given Lot III.

TABLE II.

AVERAGE FOOD EATEN DAILY IN POUNDS.

	Alfalfa.	Pulp.	Sugar Beets.	Wheat and Barley.	Total Food Daily.
Lot I	2.02	4.22		0.04	6.28
Lot II	2.10	1.82		0.72	4.64
Lot III	1.82		2.70	0.30	4.82
Lot IV	1.77		1.76	0.90	4.43

The amount of alfalfa, pulp and grain consumed by the five lambs in Lot I. was 6.28 pounds per head daily; 2.02 pounds of alfalfa, 4.22 pounds of pulp and .04 pounds of grain; or a total of 168.2 pounds of alfalfa, 375 pounds of pulp and 3.9 pounds of grain per head during the 84 days feeding.

Lot III. ate a ration of 1.82 pounds of alfalfa, 2.70 pounds of sugar beets and .30 pounds of grain per head daily, making a total ration of 4.82 pounds consumed daily; or a total amount of food eaten per lamb through the experiment of 153.2 pounds of alfalfa, 227.2 pounds of sugar beets and 25.6 pounds of grain.

There were 2.10 pounds of alfalfa, 1.82 pounds of pulp and .72 pounds of grain consumed daily by the average lamb in Lot II., a total daily food of 4.64 pounds, or a total through the period of 177 pounds of alfalfa, 153 pounds of pulp, and 6.04 pounds of grain.

Lot IV. consumed an average daily ration of 1.77 pounds of alfalfa, 1.76 pounds of sugar beets and .90 pounds of wheat and barley, a total daily ration of 4.43 pounds per lamb. This makes a total of 149.2 pounds of alfalfa, 147.2 pounds of sugar beets, and 75.2 pounds of grain consumed through the experiment by the average lamb in this lot.

The total amounts of food consumed for the entire period are as we should expect to find them, greater in those lots having pulp than in those having the beets, probably because of the greater percent of nutrients in the beets.

WEIGHT AND GAINS PER WEEK ON PULP AND BEET RATIONS.

Table III. gives by weeks the individual weights of the lambs in the four lots during the trial, and the total gain

made by each. Lamb No. 4 in Lot I. did poorly, making a gain of only eight pounds for the whole time, while the other four lambs in the pen made an average of 17 pounds each. For the first five weeks while on pulp and alfalfa the other four lambs in Lot I. made average gains of 9.7 pounds, while lamb No. 4 gained only three pounds. This lamb making a gain so much smaller than the normal will explain in part at least the difference in gains of Lot I. and

TABLE III.

INDIVIDUAL WEIGHTS AND GAINS IN POUNDS.

	Lot I.					Lot II.					Lot III.					Lot IV.				
Tag No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
March 5	61	53	57	53	60	59	64	58	54	54	60	39	52	56	52	69	57	60	54	49
March 12	68	54	60	58	64	64	69	61	60	63	60	47	56	58	57	73	63	64	60	55
March 15	66	57	61	56	65	63	67	60	60	61	61	45	58	58	57	77	68	67	60	59
March 22	68	57	63	55	67	64	69	63	62	64	64	51	59	61	59	75	65	64	63	52
March 29	67	59	63	53	71	67	64	63	66	68	65	52	61	63	62	77	70	61	64	55
April 5	71	62	64	56	73	69	69	64	65	73	68	56	65	65	64	79	72	65	66	56
April 12	69	62	65	57	74	71	70	62	67	75	65	56	65	67	65	80	73	67	68	59
Sheared April 19	67	61	64	56	74	70	68	64	65	75	67	58	65	64	61	78	77	69	68	55
April 26	70	63	66	55	82	75	71	64	70	79	69	59	68	66	65	83	75	72	73	61
May 3	74	69	69	53	85	77	73	69	68	78	71	63	73	63	69	86	83	75	75	60
May 10	75	69	70	62	83	78	73	71	72	77	72	63	70	69	71	84	87	78	78	65
May 17	74	71	71	60	84	74	74	71	74	81	77	61	72	69	74	87	89	78	81	68
May 24	77	72	73	62	86	80	78	73	73	83	78	63	75	71	77	90	90	82	80	71
May 28	74	71	72	61	82	80	77	72	73	81	78	68	74	69	76	90	87	82	79	72
Fleece	4	3	3	4	2	4	4	2	4	3	4	2	3	4	3	6	2	2	3	4
Total Gain	17	21	18	12	24	25	17	16	23	30	22	31	25	17	27	27	32	24	28	27

Lot II. during the first five weeks when both lots were receiving the same ration of pulp and hay.

TABLE IV.

POUNDS GAIN PER WEEK—WITHOUT GRAIN.

	Lot I.*	Lot II.*	Lot III.†	Lot IV.†
March 8	20	28	19	26
March 15	1	6	1	16
March 22	5	11	15	-11
March 29	3	6	9	7
April 5	13	12	15	11
Gain	42	51	59	49

*Lots I. and II. fed pulp and alfalfa.
†Lots III. and IV. fed beets and alfalfa.

TABLE V.

POUNDS GAIN PER WEEK—WITH GRAIN.

	Lot I.*	Lot II.†	Lot III.‡	Lot IV.§
April 12	1	5	2	12
April 19	11	15	11	14
April 26	14	16	12	17
May 3	14	6	17	15
May 10	9	6	1	13
May 17	1	3	8	11
May 24	10	13	11	10
May 28	-10	-4	1	-3
Gain	50	60	63	89
Total Gain Flesh (March 8–May 28)	76	94	106	121
Fleece	16	17	16	17
Total Gain with Fleece Mar. 8–May 28)	92	111	122	138

*Lot I. fed pulp and alfalfa.
†Lot II. fed pulp, alfalfa and grain.
‡Lot III. fed beets, alfalfa (grain three weeks.)
§Lot IV. fed beets, alfalfa and grain.

Table IV. shows that the ten lambs of Lots I. and II. fed pulp and alfalfa for five weeks gained 93 pounds. In order to get the lambs to eat the pulp 16 pounds of grain was mixed with it for the two lots during the first week, and during this time while receiving the grain they made a total gain of 38 pounds, leaving 55 pounds gain due to the pulp and alfalfa fed the other four weeks.

Lots III. and IV. consisted of 10 lambs fed on sugar beets and alfalfa, and they gained 108 pounds during the first five weeks. They were fed the same amount of grain during the first week as Lots I. and II. The gains made by the 10 lambs fed with beets during the first week amounted to 45 pounds, leaving 63 pounds of gain due to sugar beets and alfalfa in the remaining four weeks, or eight pounds more gain for the beets than for the pulp.

Table V. shows that the five lambs in Lot I. made a total gain of 92 pounds, 16 pounds of which was fleece, while those fed beets and alfalfa made a total gain of 122 pounds, 16 pounds of which was fleece. However, the beet fed lambs received 99 pounds of grain more than those which were fed pulp. The pulp fed lambs in Lot I. were given 11½ pounds of grain in the two weeks from May 10 to May 24, and Lot III. which was fed beets received 120 pounds of grain during the last three weeks of the experiment.

In our plan of the experiment it was not the intention that the pulp and beet fed lambs should have any grain at all.

Referring to Table V. it will be seen that the pulp fed lambs made but one pound gain during the last three weeks, while the beet fed lambs made an appreciable gain during this time when the grain was given them. The gain made by Lot III. during the last three weeks was 20 pounds, but during this time they received only 57 pounds of beets, and the principal part of the gain was due, no doubt, to the grain fed.

Lot III., fed beets and alfalfa, gained 122 pounds during the experiment, 16 pounds of which was fleece. Deducting the 20 pounds gain while being fed grain, and the amount of fleece, and comparing with Lot II., the results would indicate that the beet and alfalfa lot gained 10 pounds more than the lot which received pulp and alfalfa. This statement must be taken with due allowance because the five lambs ate almost two and one-half pounds of beets per day during the last three weeks and they may have produced an appreciable effect on the gains.

Lot II., which was fed pulp, alfalfa and grain, gained 111 pounds, 17 pounds of which was fleece, and Lot IV. fed beets, alfalfa and grain, gained 138 pounds, 17 pounds of which was fleece. Then the lots fed beets and grain gained 27 pounds more than the lot fed pulp and grain, the fleece being the same in each case.

Adding grain to the pulp and alfalfa ration gives an increased gain of 10 pounds over the pulp and alfalfa ration during the last eight weeks of the experiment. No comparison can be made between the beet, alfalfa and grain ration and the beet and alfalfa ration for the whole time, because of the amount of grain given to Lot III. during the last three weeks. However, by taking the first 10 weeks of the feeding period, leaving out the last three weeks, we are able to make a fair comparison between the lots.

Briefly stated up to this time, (May 10), Lot I., on pulp, gained in flesh 75 pounds, Lot III., on beets, gained 86 pounds, or eleven pounds more for the beet ration than for the pulp ration. Lot II., fed pulp and grain, gained 82 pounds, or seven pounds more than those on pulp without grain, and four pounds less than Lot III. on beets and alfalfa. Lot IV., on beets and grain, gained 103 pounds for this ten weeks' period, or 28 pounds more than Lot I. on pulp; 27 pounds more than those on beets and alfalfa, and 21 pounds more than those on pulp and grain.

For the ten weeks' period Lot I. ate 1277 pounds of pulp and 640 pounds of hay worth $1.82. Lot III. ate 1079 pounds of beets and 577 pounds of hay worth $3.31. The beet lot gained 11 pounds more than the pulp lot, worth 66 cents. Then $1.82 worth of pulp and hay was equal to $2.65 worth of beets and hay when fed without grain. The hay being the same, the pulp would be worth $1.46 per ton compared with beets at $4.00 per ton when fed with hay alone. There was actually more hay eaten with the pulp than with the beets so the difference would not be quite so great. Making the same comparison between the lots which were fed grain with pulp and with beets, Lot II. ate in the ten weeks 765 pounds of pulp, 720 pounds of hay and 179 pounds of grain, while Lot IV. ate 784 pounds of beets, 566 pounds of alfalfa and 192 pounds of grain. The food eaten by Lot II. was worth $3.62 and that eaten by Lot IV. was worth $4.62. Lot IV. gained 21 pounds more than Lot II. which was worth $1.26. Then $3.62 worth of pulp, alfalfa and grain was equal to $3.36 worth of beets, alfalfa and grain. The beets would be worth a little more than

TABLE VI.

FOOD EATEN AND GAINS IN POUNDS.

	No. lambs	No. days fed	Food Eaten					Average Weight		Total gain flesh	Fleece
			Alfalfa	Sugar Beets	Pulp	Wheat	Barley	At beginning	At end		
Lot I.....	5	84	841	.....	1775	9.75	9.75	56.8	72.2	76.0	16.0
Lot II.	5	84	885	.....	765	151.00	151.00	57.8	76.6	94.0	17.0
Lot III	5	84	766	1136	.....	64.00	64.00	51.8	73.0	106.0	16.0
Lot IV ...	5	84	746	739	.... .	188.00	188 00	57.8	82.0	121.0	17.0

$4.00 per ton compared with pulp at $1.00 per ton when fed in this way with grain at one cent per pound.

The whole discussion indicates that so far as the results of this experiment are reliable, pulp at $1.00 per ton, with alfalfa at $4.00 per ton, is a much more economical ration than beets at $4.00 per ton, with hay at the same price, when no grain is given, but that a ration of pulp, alfalfa and grain is approximately equal to beets, alfalfa and grain at $1.00 and $4.00 per ton respectively.

Table VI. gives the total amount of food eaten by each lot and the gains made.

AMOUNT AND COST OF FOOD COMPARED WITH GAINS.

Table VII. gives the amount and cost of food consumed for one pound of gain made in each lot, also the average percent of dressed weight for the respective lots.

TABLE VII.

FOOD EATEN FOR ONE POUND GAIN.

	Food for One Pound Gain					Cost 1 lb. Gain	Percent Dressed Weight
	Alfalfa	Sugar Beets	Pulp	Wheat	Barley		
	lbs.	lbs.	lbs.	lbs.	lbs.	cts.	
Lot I.....	9.14	.....	19.30	0.02	0.02	2.83	45.7
Lot II.. ..	7.97	.....	6,90	1.36	1.36	4.65	48.1
Lot III. ...	6.28	9.31	.....	0 52	0.52	4.16	46.6
Lot IV . .	5.40	5.35	.....	1.36	1.36	4.87	46.6

Comparing Lots I. and II. we find that 9.14 pounds of alfalfa; 19.3 pounds of pulp, and .04 pounds of grain in Lot I. was equal to 7.97 pounds of alfalfa; 6.9 pounds of pulp and 2.72 pounds of grain in Lot II. In Lot III. where sugar beets took the place of the pulp in the ration of Lot I. it required 6.28 pounds of alfalfa, 9.31 pounds of beets and 1.04 pounds of grain to produce one pound of gain; or it took 9.31 pounds of beets and 1.00 pound of grain in Lot III. to replace 19.3 pounds of pulp and 2.86 pounds of alfalfa in Lot I.

Lot IV., which had a similar ration to Lot II., except that the pulp in Lot II. was replaced with with beets in Lot IV., required 5.4 pounds of alfalfa, 5.35 pounds of beets and 2.72 pounds of grain for one pound of gain. The extra

grain in Lot IV. of 1.68 pounds for each pound of gain replaced .88 pounds of alfalfa and 3.96 pounds of sugar beets in the ration of Lot III.

Because of the cheapness of the food the pulp and alfalfa made the gain cheaper than the other rations. The cost of each pound of gain was 2.83 cents in Lot I. fed pulp, 4.16 cents in Lot III. fed beets, 4.65 cents in Lot II. fed pulp and grain and 4.87 cents in Lot IV. fed beets and grain. As would be expected, the percent of dressed weight was smallest with the pulp fed lambs. They dressed out 45.7 percent of the live weight against 46.6 percent for the sugar beet lot, 48.1 percent for the pulp and grain lot and 46.6 percent for the beet and grain lot. The amount of alfalfa consumed for each pound of gain was greatest in the pulp fed lot and least with the lot fed beets and grain.

When the lambs were slaughtered pieces of the meat were sent to a number of people with the request that they furnish an opinion in regard to the quality of the mutton. With one exception all those who received the samples of mutton stated that the first piece, which was pulp and alfalfa fed, possessed good flavor and quality, but was not so fat as the second piece which was corn fed. The following letter from Mrs. Carpenter is typical of the general opinion. Those receiving the samples did not know what kind of food had been given the lambs:

"We received the two samples of mutton and I cooked them both by boiling. The flavor of the first piece was so delicate that it was hard to realize that it was mutton. Yet we liked the second piece better as it was fatter and juicier, and we prefer fat, juicy mutton. The flavor of the second piece was more like the mutton we are are accustomed to."

NOTE. Lot X. was fed straw, beets, wheat and barley and made a total gain of 74 pounds. They consumed 436 pounds of wheat and barley, worth $4.36, 683 pounds of sugar beets, worth $1.37, 512 pounds of straw which we will estimate at $1.00 per ton or 25.6 cents. The total cost for the food is $5.99. The value of the gain is 62 pounds of flesh at 6 cents, equals $3.72, and 12 pounds of fleece at 10 cents, $1.20, or $4.92. This gives a loss of $1.07, providing the lambs had been fit for market. As they were not fat enough to slaughter this does not express the total loss. The alfalfa, beet and grain ration in Lot IV. above gave a profit on the gain of $2.23. This forcibly illustrates the value of alfalfa and the fact that sugar beets must be supplemented with other nutritious roughage in order to give profitable returns.

PLATE III.

Fed Corn and Alfalfa.
Given Warm Water to Drink.

PLATE IV.

Fed Corn and Alfalfa.
Given Cold Water to Drink.

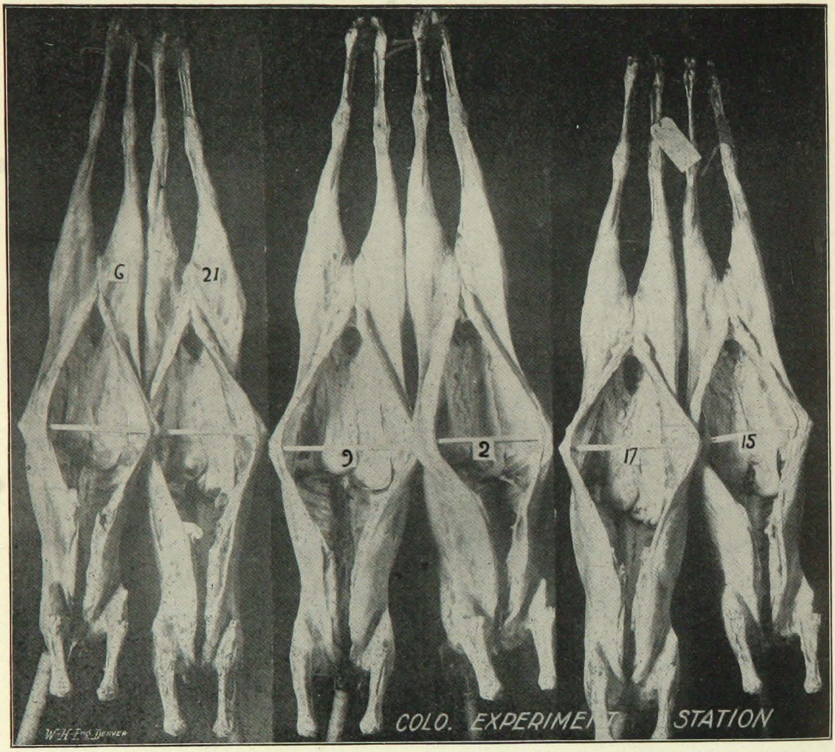

PLATE V.

Representative Carcasses of Lots I, II, III, IV and V.

COST AND PROFIT.

Table VIII. gives the cost and profit from feeding lambs with sugar beets and beet pulp rations. The estimate of profit is based on a price of six cents per pound for the gain made during the feeding period and is the comparative rather than the total profit. The total profit would vary with the first cost of the lambs and the selling price. Our lambs cost us almost five cents per pound, and if sold at an advance of one cent, or six cents per pound when fat, the profit would be increased by the cent per pound for the weight of the lambs when put on feed, or an average of about 55 cents, amounting to $2.75 more for the fat lambs in each pen than the profit indicated in the last column of the table.

TABLE VIII.

COST AND PROFIT.

	Feed.	Cost of Feed.	Cost 1 lb. Gain.	Value Gain @ 6 cts.	Value Wool @ 10 cts.	Total Value of Gain.	Profit.
Lot I.....	Pulp, Alfalfa,	$ 2.76	cts. 2.83	$ 4.56	$ 1.60	$ 6.16	$ 3.40
Lot II.....	Pulp, Grain, Alfalfa	5.17	4.65	5.64	1.70	7.34	2.17
Lot III....	Beets, Alfalfa,*	5.08	4.16	6.36	1.60	7.96	2.88
Lot IV.....	Beets, Grain, Alfalfa	6.73	4.87	7.26	1.70	8.96	2.23

*Fed grain last three weeks.

The cost for each pound of gain was the lowest for Lot I. fed pulp and alfalfa. A good gain was made by this lot and the low cost of the food made the cost per pound of gain only 2.83 cents, while the total profit on the gain is $3.40 which is the highest return made by any lot in either experiment I. or experiment II. (See Table XV. Experiment II). While the profit was greater than that from any other lot their total gain and the per cent of dressed weight was lower than any of the others which might have produced an appreciable effect on their selling price in the open market. All the figures here given account for one day's shrinkage in the yards, but if shipped a long distance it is not unlikely that the shrinkage would be greater from the pulp fed lambs.

The next best profit was from Lot III. given sugar beets and alfalfa with some grain the last thirty days. This lot

ate less food and made larger gains than the pulp fed lambs, but the increased cost of food reduced the profit. Lot IV. fed beets and grain made a greater profit than Lot II fed pulp and grain, though the difference is small. The total value of the food steadily increases as the grain and beets are added to the ration, and the total gains made, also increase but not in proportion to the increased cost of food.

The object of lamb feeding in Colorado is to find a market for the surplus alfalfa and the profit for such feeding is often expressed by the value received for the hay so used. Then giving the other foods their local market values the hay made returns in this experiment of $12.20 per ton in Lot I.; $7.36 per ton in Lot II.; $9.86 per ton in Lot III. and $8.18 per ton in Lot IV. Giving the alfalfa a local value of $4.00 per ton on the farm, the profit for the gains made would show a return from feeding pulp with it in Lot I. of $4.28 per ton and $4.88 per ton on Lot II. Allowing $4.00 per ton for alfalfa and one cent per pound for the grain, the sugar beets made a return in Lot III. of $7.96 per ton and in Lot IV. the return from the beets would be $8.22 per ton. When one begins to compute returns made by any one food in this way he realizes at once that at best the results are only comparative. There is nothing to show that the food which appears to have given the return indicated actually did produce its proportion of the gain. Again the final value will vary greatly with the proportion of each food consumed in the ration. However, as a means of comparison it serves a purpose. The figures we have given show that pulp gave approximately one-half the return pound for pound that was obtained from beets, but because of its cheapness it gave an apparently large value for the hay fed with it in Lot I. All of our estimates of cost and profit are based on amount of food eaten and the value of the gain. This method is sufficient for reliable comparisons and is used with the assumption that the increased selling price over the price paid for feeders will meet all labor expense and necessary waste.

LAMB FEEDING EXPERIMENT NO. 2.

Experiment No. 2 was planned and carried out coincident with and as a part of Experiment No. 1. The lambs used in these trials were from the same flock. The separate lots in the two experiments were all selected at the same time in order to avoid as much as possible any error in individuality due to improper care in selecting. The object of this experiment was to compare our home grown grains and combinations of them with corn. These two experiments—first and second—having the same conditions throughout, and there being no apparent difference in the class of animals used, afford an excellent opportunity to check the comparative profits of pulp, sugar beets, corn and our home grown grains when fed with alfalfa for fattening lambs.

As stated before, these were Mexican lambs and were in very poor condition for that class. The returns then should represent the minimum profits at the price per pound allowed for the grain. In order to eliminate any confusing data the profits are figured on gain only and no attempt was made to show actual profits by taking into consideration the initial cost to us and the final income when the lambs were sold. The lambs in both these experiments were treated alike in everything except the kinds of food given. They were fed and watered at regular hours, twice each day, and the waste not eaten was weighed back daily. The lambs were sheared during the week, April 12th to April 19th and the wool credited to them at the selling price, which was ten cents per pound. Careful notes were kept to put on record complete information of the progress of the experiment. No unusual incidents or accidents occurred which would seriously mar the experiment. Lamb No. 37 in Lot VIII. became entangled in the fence and was found dead the morning of the day the other lambs were slaughtered. His live weight at the end of the previous week having been secured, and the fact that the gain for the last week so nearly offset the shrinkage during the last twenty-four hours when they were off feed, makes no correction necessary in reporting the results. The per cent of dressed weight for Lot VIII. is averaged for four instead of for five lambs.

April 10th lamb No. 43 in Lot IX. dropped a buck lamb which was taken away and she was allowed to remain on

feed until the end of the experiment. She did so poorly, however, that in order to compare this lot with the others in profits, the averages for Lot IX. are taken from the remaining four lambs as indicated by foot notes in the tables when the correction is necessary.

TABLE IX.

FOOD EATEN, IN POUNDS.

	Lot V.			Lot VI.			Lot VII.			Lot VIII.			Lot IX.		
	Corn	Alfalfa	Alfalfa Orts	Spelt or Emmer	Alfalfa	Alfalfa Orts	Barley	Alfalfa	Alfalfa Orts	Wheat and Barley	Alfalfa	Alfalfa Orts	Wheat and Emmer	Alfalfa	Alfalfa Orts
March 5—March 8	6.9	52	24	6.9	52	22	6.9	52	10	6.9	52	10	6.9	52	13
March 8—March 15	17.5	105	46	17.5	105	45	17.5	105	38	17.5	105	48	17.5	105	43
March 15—March 22	19.4	97	41	19.4	97	42	19.4	97	42	19.4	97	44	19.4	97	41
March 22—March 29	21.9	114	54	21.9	114	51	21.9	114	45	21.9	114	53	21.9	114	50
March 29—April 5	23.1	120	53	23.1	120	51	23.1	120	51	23.1	120	54	23.1	120	52
April 5—April 12	26.2	122	58	26.2	122	53	26.2	122	52	26.2	122	61	26.2	122	57
April 12—April 19	26.2	122	55	26.2	122	49	26.2	122	49	26.2	131	53	26.2	122	60
April 19—April 26	32.5	132	55	32.5	132	46	32.5	132	47	32.5	132	57	32.5	132	54
April 26—May 3	36.2	136	67	36.2	135	56	36.2	135	55	36.2	135	81	36.2	135	67
May 3—May 10	40.0	117	44	40.0	117	35	40.0	117	39	40.0	117	64	40.0	117	55
May 10—May 17	48.8	130	76	48.8	130	62	48.8	130	67	41.1	130	54	48.8	130	74
May 17—May 24	43.7	106	55	43.8	106	40	43.7	106	46	43.7	106	59	43.7	106	53
May 24—May 31	43.7	105	47	43.7	105	36	43.7	105	46	43.7	105	58	43.7	105	56
May 31—June 6	15.9	37	18	43.7	37	17	15.9	37	19	63.6	136	54	49.8	106	55
Totals	402.0	1495	693	430.0	1494	605	402.0	1494	606	442.0	1602	750	436.0	1563	730

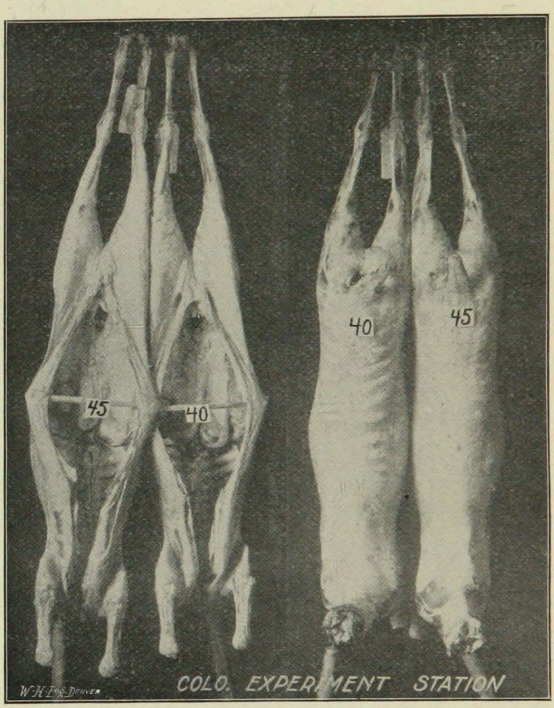

PLATE VII.

Representative Carcasses of Lots VIII and IX.

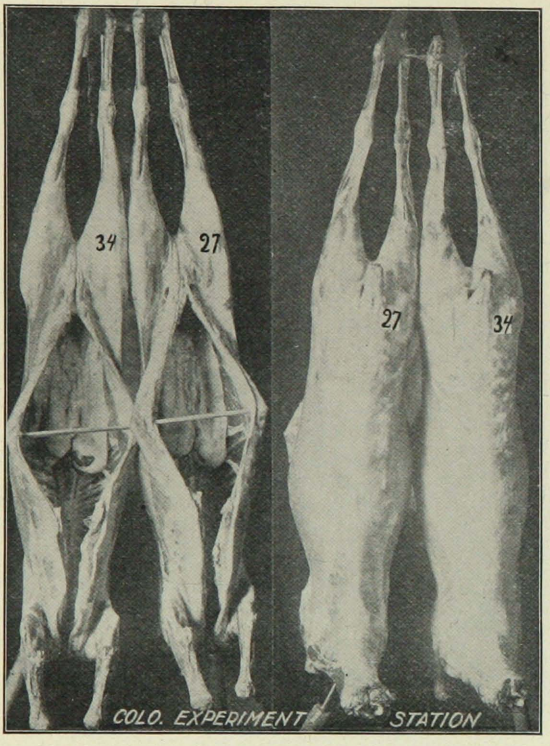

PLATE VI.

Representative Carcasses of Lots VI and VII.

PLAN OF EXPERIMENT NO. 2.

The plan of the experiment was as follows:

Lot V. was fed corn and alfalfa.

Lot VI. was fed spelt (emmer) and alfalfa.

Lot VII. was fed barley and alfalfa.

Lot VIII. was fed wheat, barley and alfalfa, the wheat and barley in equal amounts.

Lot IX. was fed wheat, spelt, (emmer) and alfalfa, the wheat and spelt in equal amounts.

Lots V., VI. and VII. were fed ninety days. Lots VIII. and IX. ninety-five days.

The alfalfa was fed in such quantities that it would be before the lambs all the time. The corn and other grains were fed in small quantities at first, increasing the amount gradually to one and one-quarter and one and one-half pounds daily per lamb. The larger amount was fed only a short time. The feed was charged at local prices, which were at the time of the experiment $4.00 per ton for alfalfa on the farm, $1.30 per hundred pounds for corn, and one cent per pound for the wheat, barley and spelt.

Table IX. shows the amount of food given each lot for periods of one week, also the total amounts given each lot and the amount of waste. This table shows the details of the feeding, the increase in the gain, and any irregularity which may have occurred in the appetites of the animals.

Table X. shows the average amount of each kind of food and the total daily consumption by each lamb. Lot VI. fed alfalfa and spelt, ate more food than any of the others, although the total daily consumption of food differs little in any of the lots. The lambs in Lot IX. ate less alfalfa than those in any of the other lots, and less total food daily. They were given wheat and spelt, which could

TABLE X.

AVERAGE FOOD EATEN DAILY, IN POUNDS.

	Alfalfa.	Corn.	Wheat.	Barley.	Spelt.	Total Food.
Lot V	1.78	0.88	.....	.....	.....	2.66
Lot VI	1.97	....	.....	... .	0.95	2.92
Lot VII	1.96	.....	.....	0.88	....	2.84
Lot VIII	1.80	.....	0.465	0.465	....	2.73
Lot IX	1.75	.....	0.459	... .	0.459	2.67

hardly be considered a variety of food because the spelt is a wheat, differing from the common variety principally in the chaff which encloses the spelt kernels. The lambs got off feed more quickly on this ration than on any other and made comparatively poor gains.

TABLE XI.

INDIVIDUAL WEIGHTS AND GAINS, IN POUNDS.

	Lot V.					Lot VI.					Lot VII.					Lot VIII.					Lot IX.				
Tag No.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
March 5	55	58	53	54	49	56	50	55	54	54	59	58	58	58	54	51	43	48	44	50	61	54	55	52	62
March 8	59	68	57	57	53	57	59	62	60	64	62	63	63	63	63	50	51	50	49	52	65	58	60	55	67
March 15	65	72	65	60	56	65	60	65	63	62	69	64	62	64	62	57	54	59	56	60	67	60	65	54	69
March 22	64	71	63	60	57	61	61	65	63	60	66	62	63	61	63	54	54	57	55	59	66	57	64	53	61
March 29	67	76	65	60	61	66	63	68	66	63	68	67	68	67	68	54	59	61	59	63	69	60	69	56	69
April 5	69	80	69	65	64	62	66	71	68	66	72	68	70	68	68	63	61	62	60	65	71	64	72	58	72
April 12	68	80	65	63	64	71	65	69	66	66	68	67	69	70	66	61	60	62	60	66	72	63	66	58	72
April 19	63	76	62	64	59	67	65	67	64	62	64	67	69	67	62	66	62	61	59	64	71	58	55	56	68
April 26	66	81	65	68	62	70	65	70	68	64	68	68	70	69	68	64	64	63	60	66	78	61	57	58	70
May 3	72	88	63	76	67	76	75	74	73	68	76	75	74	75	74	68	63	62	62	70	76	60	61	63	75
May 10	70	82	68	73	66	78	75	80	74	69	74	75	77	74	74	70	69	69	65	75	79	68	63	64	78
May 17	68	84	68	75	68	78	72	79	72	70	72	70	76	71	72	64	65	60	59	69	65	65	56	59	72
May 24	73	88	69	75	69	78	75	81	74	71	73	74	76	72	77	70	68	61	62	75	79	66	58	64	77
May 31	75	91	74	78	71	82	80	84	77	75	75	75	79	76	79	76	71	69	65	75	82	67	59	64	76
June 3	76	81	73	79	73	82	77	84	78	75	76	76	79	75	78	75	died	66	65	76	82	69	60	71	77
Fleece	2	3	5	3	4	3	3	4	2	3	3	3	5	3	6	3	1	3	4	3	2	4	3	2	3
Total Gain	23	26	25	28	28	29	30	33	26	24	20	21	26	20	30	27	29	21	25	29	23	19	8	21	18

WEIGHTS AND GAINS PER WEEK—CORN AND SMALL GRAINS.

Table XI. reports the individual weights and gains made by each lamb. The weights for April 19th were made after shearing, and the apparent loss that week is due to the removal of the fleece.

Lamb No. 43 in Lot IX. is one previously spoken of which it is necessary to drop out in making the final averages. All the others make fair gains.

Table XII. gives the gain or loss each week for the five lambs in each lot.

TABLE XII.

POUNDS GAIN PER WEEK.

	Lot V.	Lot VI.	Lot VII.	Lot VIII.	Lot IX.
March 8	25	33	27	16	21
March 15	24	13	7	34	10
March 22	-3	-5	-6	-7	14
March 29	14	16	23	17	22
April 5	18	7	8	15	14
April 12	-7	4	-6	-2	-6
April 19	1	3	9	17	-9
April 26	18	12	14	5	11
May 3	24	29	31	8	16
May 10	-7	10	0	23	17
May 17	4	-5	-13	-31	-35
May 24	11	8	11	19	27
May 31	18	19	12	20	4
June 9	-10	-2	0	-3	11
Total Gain Flesh	113	127	97	117	75
Fleece	17	15	20	14	14
Total Gain with Fleece	130	142	117	131	89

The losses on April 19th were due to taking away the fleece that week. There is much variation in the gains week by week. The table shows that all the lambs except those in Lot V. lost weight during the week of May 10th to 17th. This was evidently due to the over feeding of grain. On May 9th the ration of grain was increased in all the lots, from one to one and one-quarter pounds per head daily to one and one-half pounds per head. Our notes show that during this week the lambs refused to eat up all of their grain. This was especially true with Lots VIII. and IX. where wheat was a part of the ration. The ration was reduced to one and one-quarter pounds daily per lamb on May 16th, and all the lambs again began to make gains. Corresponding losses, but not in quite such a marked degree, seemed to have occurred during the third and sixth weeks after the lambs were put on feed. The largest total gain

was made by Lot VI. which received the spelt ration and the smallest gain was made by Lot IX. which was fed wheat and spelt.

FOOD EATEN AND GAINS MADE.

Table XIII. gives the total amount of each kind of food eaten, the initial average weight of the lambs in each lot, and the total gain. The weights and gains in Lot IX. are computed from the averages of the four lambs which made normal gains during the feeding period.

TABLE XIII.

FOOD EATEN AND GAINS, IN POUNDS.

	No. of Lambs.	No. Days Fed.	Food Eaten.					Average Weight		Total gain flesh	Fleece
			Alfalfa.	Corn.	Wheat.	Barley.	Spelt.	At Beginning	At End		
Lot V	5	90	803	402	.....	.....	.....	53.8	78.4	113.	17
Lot VI	5	90	889	.....	.....	.....	430	53.8	78.2	127.0	15
Lot VII	5	90	888	.....	.....	402	.....	57.4	76.8	97.0	20
Lot VIII	5	95	852	....	221	221	.....	47.2	70.6	117.0	14
Lot IX	5	95	833	.....	218	.....	218	57.5*	75.0*	87.5**	14

*Average of four lambs.
**Estimated gain of five lambs from averages of four.

TABLE XIV.

FOOD EATEN FOR ONE POUND GAIN.

	Food for One Pound Gain.					Cost 1 lb. Gain	Percent Dressed Weight
	Alfalfa	Corn	Wheat	Barley	Spelt		
	lbs.	lbs.	lbs.	lbs.	lbs.	cts.	
Lot V	6.17	3.09	.....	.....	.....	5.25	52.1
Lot VI	6.26	.....	.....	.....	3.03	4.28	49.2
Lot VII	7.59	.....	.....	3.43	.....	4.95	48.8
Lot VIII	6.50	.....	1.69	1.69	.....	4.68	49.6
Lot IX	8.20	.....	2.14	.....	2.14	5.93	59.0

Table XIV. gives the amount of each kind of food eaten for each pound of gain produced and the per cent of dressed weight, with the cost of each pound of gain. There is a marked variation in the per cent of dressed weight. Lot IX. dressed 59 per cent and Lot VII. 48.8 per cent, a difference of over 10 per cent. This condition would have much to do with their value on the market and those with the low per cent of dressed weight would give less profit.

The best general result was obtained with the spelt and alfalfa ration fed to Lot VI. These lambs consumed 6.26 pounds of alfalfa and 3.30 pounds of spelt at a cost of 4.28 cents for each pound of gain. This is very close to the amount of hay and corn for each pound of gain, but because of the high price of corn, which cost us $1.30 per hundred pounds, the cost of each pound of gain was nearly one cent higher than in the spelt ration. If corn was obtained for $1.00, which was the price allowed for the spelt, the cost of each pound of gain would be 4.32 cents, or within .04 cents of the cost of each pound of gain with the spelt ration. This difference is very small and the corn ration lambs dressed almost three percent better than the spelt ration lambs.

The next best result was obtained with Lot VIII. fed wheat, barley and alfalfa. These lambs ate 6.5 pounds of alfalfa and 3.38 pounds of grain composed of equal parts of wheat and barley, for each pound of gain, making the gain cost 4.68 cents per pound. At the same price the corn ration would have produced a little cheaper gain than this, but the farmer could not afford to sell his wheat and barley

TABLE XV.

COST AND PROFIT.

	Feed.	Cost of Feed.	Cost 1 lb. Gain.	Value Gain @ 6 cts.	Value Wool @ 10 cts.	Total Value of Gain.	Profit.
Lot V.....	Corn, Alfalfa,	$ 6.88	cts. 5.25	$ 6.78	$ 1.70	$ 8.48	$ 1.65
Lot VI.....	Spelt, Alfalfa,	6.08	4.28	7.62	1.50	9.12	3.04
Lot VII....	Barley, Alfalfa,	5.80	4.95	5.82	2.00	7.82	2.02
Lot VIII...	Wheat, Barley, Alfalfa,	6.12	4.68	7.02	1.40	8.42	2.30
Lot IX.....	Wheat, Spelt, Alfalfa	6.13	5.93	5.25	1.40	6.65	.52

or spelt at one cent a pound and pay the prices which prevailed for corn the past year.

COST AND PROFIT.

Table XV. presents the results of the experiment in the dollars and cents form.

Here is given the cost of food consumed by each lot of five lambs, the value of gain made at six cents per pound, and the total profit on the gains. As before stated, this profit would be increased by the amount of the increased price of the fat lambs over the original cost of the feeders, and the cost would be increased by adding the cost of labor, interest on the investment, etc. Here again the best results were obtained from spelt and alfalfa, the total profit being $3.04. The next best results were obtained with Lot VIII., fed wheat and barley, which produced a profit of $2.30. Lot VII., fed on barley and alfalfa, gave a profit of $2.02, and the profit with the corn and alfalfa fed lot was $1.65. Lot IX., fed wheat and spelt, produced a profit of only 52 cents, probably because this ration was not well balanced.

Had the corn been obtained at the same price as other grains, $1.00 per hundred, the total profit from Lot V. would have been $2.86. This is still not so good a profit as was produced by the spelt ration, but was better than the other grains or combinations of them used in this series of experiments.

It would appear from comparisons of Lots V. and VIII. that when wheat and barley are worth $1.00 per cwt., corn would be worth approximately $1.11 per hundred pounds. This experiment indicates that spelt has a high feeding value, but it would hardly be safe to recommend it without reservation from a single experiment. Further trial will be made with it in the near future. Computing the value of spelt from this experiment, compared with wheat and barley at $1.00 per hundred pounds, it would appear to have a value of $1.13 per hundred, or two cents per hundred more than corn.

Crediting all the profit to the alfalfa as we did in Experiment I., we have a return for the alfalfa fed to Lot V. of $6.42 per ton. The profit on Lot VI. would give the alfalfa a value of $9.48 per ton, Lot VII. $6.77 per ton, Lot VIII. $8.00 per ton, Lot IX. $4.19 per ton.

Comparing profits in Experiment I. and Experiment II., which cover the nine lots of lambs, we have the largest profit from Lot I., fed pulp and alfalfa, and the second best

profit from Lot VI., fed spelt and alfalfa. The third best combination of foods seems to be that given to Lot III., which was fed beets and alfalfa and a small ration of grain during the last thirty days. The wheat and barley gave us slightly better profit than the lot fed pulp, grain and alfalfa. The corn ration gave a lower profit than either of the lots fed pulp or beets with or without grain.

LAMB FEEDING EXPERIMENT NO. 3,

COMPARISON OF HOME GROWN GRAINS WITH CORN. WARM AND COLD WATER. SHROPSHIRE GRADES AND NATIVE LAMBS.

OBJECT AND PLAN OF EXPERIMENT.

During the winter of 1900-01 an experiment was planned to test the value of a mixture of home grown grains compared with corn for fattening lambs, and to determine whether or not there would be any advantage in giving lambs warm water to drink instead of cold water. For this purpose twenty western lambs, half of them Shropshire crosses raised on the College farm, were divided into four lots of five each and given the following rations:

Lot I. was given an equal mixture of oats, wheat and barley with alfalfa and cold water.

Lot II. was fed the same as Lot I., excepting warm water (80-100 F.) was given twice daily instead of cold water.

Lot III. was fed corn, alfalfa and warm water.

Lot IV. was fed the same as Lot III., except cold water was given in place of warm water.

Each lamb was marked with an ear tag and weighed separately once a week. Each lot of lambs was given an equal amount of shed room and the same sized yard to run in, and were treated alike in every respect. Grain, hay and water were supplied twice daily and the orts were weighed back daily. Previous to the time the experiment was begun the lambs had been fed alfalfa and a very small amount of grain, and were in a good thrifty growing condition. One half pound of grain per head was fed daily the first week and this amount was increased to three-quarters of a pound the second week. The grain was gradually increased until March 16, when they were receiving one and three-fourths pounds per head per day.

The prices of food used in this experiment were as follows:

Alfalfa hay on the farm, $4.00 per ton.

Corn, local market, $0.80 per hundred pounds.

Wheat, oats and barley, $1.00 per hundred pounds.

Table XVI. gives for periods of one week, the amounts of the different rations fed and the orts weighed back.

TABLE XVI.

FOOD EATEN, IN POUNDS.

	Lot I.					Lot II.					Lot III.					Lot IV.				
	Oats, Wheat, Barley	Alfalfa	Alfalfa Orts	Water	Water Orts	Oats, Wheat, Barley	Alfalfa	Alfalfa Orts	Warm Water	Warm Water Orts.	Corn	Alfalfa	Alfalfa Orts	Warm Water	Warm Water Orts.	Corn	Alfalfa	Alfalfa Orts	Water	Water Orts
Jan 23-30	17	96	27	233	60	17	95	21	233	33	17	96	19	233	50	17	96	24	233	50
Jan. 30-Feb. 7	26	90	13	185	41	26	90	17	185	18	26	90	17	185	21	26	90	17	185	28
Feb. 7-13	35	105	28	210	29	35	105	25	210	27	35	105	24	210	26	35	105	26	210	37
Feb. 13-20	44	103	27	210	43	44	103	30	210	29	44	103	28	210	20	44	103	30	210	30
Feb. 20-27	52	91	24	210	22	52	91	28	210	35	52	91	24	210	21	52	91	24	210	31
Feb. 27-Mar. 7	61	104	38	240	36	61	104	30	240	77	61	104	28	240	23	61	104	29	240	60
Mar. 7-14	56	91	30	225	29	56	91	24	225	43	56	91	26	225	27	56	91	21	225	47
Mar. 14-21	60	91	52	245	40	60	91	54	245	53	60	91	45	245	31	60	91	58	245	58
Mar. 21-28	61	91	39	241	37	61	91	42	241	34	61	91	35	241	26	61	91	52	241	38
Mar. 28-Apr. 4	61	89	37	245	72	61	91	38	245	48	61	91	31	245	36	24	81	33	245	99
Apr 4-11	49	70	32	245	84	59	84	36	245	48	54	91	15	245	33	41	70	23	245	98
Apr. 11-18	49	70	28	245	81	49	70	42	245	99	52	91	40	245	64	45	70	27	245	107
Apr. 18-25	49	70	21	245	73	49	70	34	245	82	31	70	26	245	66	45	70	23	245	72
Apr. 25-May 2	10	40	26	137	26	13	45	43	139	50	22	45	32	145	47	22	45	33	137	46
Totals	630	1201	422	3116	673	643	1221	484	3118	676	632	1250	390	3124	491	589	1198	420	3116	802
Totals for 4 sheep Jan. 23-May 2	536	1091	355	2672	593	538	1014	403	2620	589	518	1123	326	2597	414	509	1026	363	2717	727

FOOD AND WATER CONSUMED.

One ewe was thrown out of each lot on account of dropping a lamb; from Lot I. on April 4, Lot II. on April 11,

Lot III. on April 17, and Lot IV. on March 27. The "totals for four sheep" at the bottom of the table are corrected totals, and the ones from which the results are computed. Since one lamb was thrown out of each lot the results are all computed by using averages of the remaining four lambs.

The lambs in Lots I. and II. ate more of the mixed grains than the lambs in Lots III. and IV. ate of corn. The corn fed lots in turn consumed more alfalfa than the grain fed lots. The water drank by the two grain lots and that drank by the two corn lots is practically equal. The two lots which were given warm water drank 145 pounds in excess of that drank by the two lots which received cold water. This would be and average of one-fifth of a pint per head daily.

Table XVII. gives the average amounts of food and water actually consumed by each lamb daily.

Lots I. and II. ate more of the mixed grain daily than Lots III. and IV. ate of corn, but the grain fed lots ate a little less hay per day than the corn fed lots.

TABLE XVII.

AVERAGE FOOD EATEN DAILY, IN POUNDS.

	Water.	Alfalfa.	Corn.	Mixed Grain.	Total Food
Lot I	5.17	1.85		1.35	3.20
Lot II	5.12	1.54		1.36	2.80
Lot III	5.51	2.01	1.30		3.31
Lot IV	5.02	1.67	1.28		2.95

WEIGHTS AND GAINS.

Table XVIII. gives the individual weights and gains for each week while the lambs were on feed. This table also gives the amount of wool produced by each lamb, and the total gain including the fleece. The Shropshire crosses are indicated in the table and enable comparison to be made between them and the western lambs.

It will be noticed that the Shropshire crosses made much better individual gains than did the other lambs. The two Shropshire crosses in Lot I. made an average total gain of 35.5 pounds, which was the same as the gains made by the other two lambs. In Lot II. the two Shropshire crosses made an average total gain of 36.5 pounds, and the other two lambs gained an average of 26.5 pounds.

In Lot III. the three Shropshire crosses made an average total gain of 40.6 (plus) pounds, and the other lamb made a total gain of 36 pounds.

In Lot IV. the two Shropshire crosses made an average total gain of 43 pounds, the other two lambs an average gain of 29 pounds.

TABLE XVIII.

INDIVIDUAL WEIGHTS AND GAINS, IN POUNDS.

	Lot I.					Lot II.					Lot III.					Lot IV.				
	Shrop Cross...				Shrop Cross...	Shrop Cross...	Shrop Cross...				Shrop Cross...			Shrop Cross...	Shrop Cross...	Shrop Cross...				Shrop Cross...
Tag No	594	666	669	674	682	670	673	675	679	683	663	664	681	685	591	593	668	678	684	686
January 23	55	109	81	81	85	74	92	97	78	96	80	91	96	93	66	71	84	90	92	92
January 30	55	110	83	82	89	75	90	99	79	97	81	92	98	94	68	71	85	92	94	94
February 7	57	114	83	86	90	79	93	101	80	103	84	94	102	98	68	76	92	98	95	96
February 13	62	118	86	90	94	80	95	102	80	107	87	99	104	101	70	77	94	99	101	97
February 20	64	121	91	93	95	82	95	106	87	110	90	103	111	107	74	81	97	104	105	100
February 27	67	126	90	97	97	84	99	110	87	115	9	106	111	110	81	84	101	109	110	104
March 7	72	131	94	97	103	88	104	116	89	118	97	112	114	113	85	86	105	112	113	108
March 14	74	136	94	103	106	90	108	119	92	124	98	117	120	115	90	88	109	116	117	112
March 21	77	138	105	106	110	91	110	124	91	126	102	122	124	120	94	90	112	118	121	115
March 28	81	147	104	111	112	93	115	128	96	135	105	129	128	122	102	94	119	120	128	118
April 4	85	150	102	114	115	95	116	133	98	136	106	133	129	120	101	93	114	117	*	116
April 11	88	*	109	119	114	102	122	139	103	*	110	138	133	127	108	98	124	125	*	124
April 18	90	*	114	122	122	103	123	136	104	*	112	*	137	129	109	100	125	126	*	126
April 25	86	*	105	111	115	93	115	131	95	*	103	*	125	122	102	93	119	115	*	119
May 2	89	*	104	113	110	96	121	125	90	*	109	*	121	119	110	91	122	112	*	122
Fleece	4		7	9	8	10	7	9	9		8		11	9	6	5	9	11		9
Total Gain	38		30	41	33	32	36	37	21		37		36	35	50	25	17	32		39

*Thrown out.

The nine Shropshire crosses in the experiment averaged 39.1 pounds gain. The seven native lambs averaged 31 pounds gain, or 21.8 percent less than the Shropshire crosses. This shows the advantage of good blood, and of a mutton cross on the native sheep to produce profitable feeders. The Shropshire grades averaged 7.7 pounds of fleece, and the native lambs averaged nine pounds of fleece.

The table indicates that the lambs made remarkably even gains.

Table XIX. gives the pounds gain per week by each lot. There are some variations week by week, but the weeks which record losses are few. Except in the final week of the experiment, when the weights were taken after 24 hours shrinkage with the lambs off feed, there are but two instances of recorded loss of weight, both of them in the corn fed lots. The gains for May 2d were from the final live weight of the lambs after they had been off feed and water for twenty-four hours.

TABLE XIX.

POUNDS GAIN PER WEEK.

	Lot I.	Lot II.	Lot III.	Lot IV.
January 30	7	2	6	5
February 7	7	10	11	20
February 13	16	4	10	5
February 20	11	10	20	15
February 27	8	13	12	16
March 7	15	17	15	13
March 14	11	12	14	14
March 21	21	7	17	10
March 28	10	16	17	16
April 4	8	10	1	-11
April 11	14	24	22	31
April 18	18	0	9	6
April 25	-3	3	-1	3
May 2	-1	-2	7	1
Total Gain Flesh	114	91	124	110
Fleece	28	35	32	34
Total Gain with Fleece	142	126	156	144

Lot III. fed corn, alfalfa and given warm water to drink made the largest total gain. Lot IV., fed the same ration as Lot III., except that they were given cold water to drink, made the second largest gain. Then followed Lot I. and II. in order. The average total gain of Lots I. and II., the mixed grain lots, is 134 pounds; the average total gain of Lots III. and IV., the corn fed lots, is 151 pounds, or an average of 17 pounds more of the four lambs in the corn fed lots than in the two mixed grain lots. As shown in Table XX., Lot I. given cold water, gained 16

pounds in excess of Lot II., given the same ration, but having warm water instead of cold water. Lot III., given the same ration as Lot IV., except they were given warm water to drink, gained 14 pounds more. Warm water appeared to have the advantage in the latter lots, but in the former the greater gain was made when cold water was given.

If then warm water had any effect either way, there are other conditions which obscured the results.

AMOUNT AND COST OF FOOD COMPARED WITH GAINS.

Table XX. gives the total amount of food eaten and water drank and the total gain made by each lot during the experiment. By the use of this table the feeder can compute for himself the cost of food and value of gains under his own conditions.

TABLE XX.

FOOD, WATER AND GAIN IN POUNDS.

	No. of Lambs.	No. Days Fed.	Food Eaten and Water Drank.				Average Weight.		Total gain flesh.	Fleece.
			Alfalfa	Mixed Grains	Corn.	Water Drank	At Beginning	At End		
Lot I	4	99	736	536		2079	75.50	104.0	114	28
Lot II	4	99	611	538		2031	85.25	108.0	91	35
Lot III	4	99	797		518	2183	83.75	114.75	124	32
Lot IV	4	99	663		509	1990	84.25	111.75	110	34

The corn fed lots show a total average gain of 151 pounds, which is to be compared with a total average gain of 134 pounds in the small grain lots. For this gain it took an average of 513.5 pounds of corn in Lots III. and IV., and 537 pounds of oats, wheat and barley in Lots I. and II.

In Table XXI. will be found the amount of food eaten to produce each pound of gain, the cost of each pound of gain and the average percent of dressed weight in each of the trials. As no effect can be traced to the warmth of the water supplied we may average the results from Lots I. and II. fed the grain mixture, and those of Lots III. and IV. fed corn. Then with the corn ration it took 4.89 pounds of alfalfa and 3.37 pounds of corn to produce each pound of gain at an average cost of 3.67 cents. With the home grown grain mixture it took 5.01 pounds of alfalfa and 4.02 pounds

of grain to produce each pound of gain at a cost of 5.02 cents. The corn fed lots made an average dressed weight one and one-half percent higher than the small grain fed lots. Then the alfalfa eaten is so nearly equal in each lot, we may say that 100 pounds of corn was equal in fattening value to 119 pounds of wheat, oats and barley.

TABLE XXI.

FOOD EATEN FOR ONE POUND GAIN.

	Food and Water for One Pound Gain.				Cost 1 lb. Gain.	Percent Dressed Weight.
	Alfalfa.	Mixed Grains.	Corn.	Water.		
	lbs.	lbs.	lbs,	lbs.	cts.	
Lot I..	5.18	3.77		14.64	4.81	63.4
Lot II	4.84	4.27		16.12	5.24	61.2
Lot III	5.17		3.21	14.17	3.60	63.2
Lot IV	4.60		3.53	13.82	3.74	64.7

COST AND PROFIT.

The comparative cost and profit of the different lots is obtained by figuring the gain made at six cents per pound and the wool produced at 10 cents per pound. This gives the total value of the gain from which is subtracted the cost of the food consumed. There is a marked difference in the cost of the food for the different lots even when fed on the same ration. Referring to Table XXII. it will be noted that Lot I. ate 23 cents worth more of food per lamb than Lot II., although both were fed the same ration of grain,

TABLE XXII.

COST AND PROFIT.

	Feed.	Cost of Feed.	Cost 1 lb. Gain.	Value Gain @ 6 cts.	Value Wool @ 10 cts.	Total Value of Gain.	Profit.
		$	cts.	$	$	$	$
Lot I	Cold Water, Alfalfa, Mixed Grain	6.83	4.81	6.84	2.80	9.64	2.81
Lot II	Warm Water, Alfalfa, Mixed Grain	6.60	5.24	5.46	3.50	8.96	2.30
Lot III	Warm Water, Alfalfa and Corn.	5.73	3.60	7.44	3.20	10.64	4.91
Lot IV	Cold Water, Alfalfa and Corn.	5.40	3.74	6.60	3.40	10.00	4.60

and Lot III. ate 33 cents worth more of food per lamb than Lot IV., both being fed corn.

The cost of the food eaten by Lots I. and II. is higher than that eaten by Lots III. and IV., principally because the small grains were more valuable than corn at the time the experiment was carried on. The small grains fed Lots I. and II. were worth $1.00 per hundred pounds, which at that time was 20 cents more than the selling price of corn. The total profit from the eight lambs which were fed wheat, oats and barley was $5.11, while the total profit from the eight lambs fed corn was $9.51.

Attributing all the profit to the alfalfa eaten we find that the average of the small grain fed lot gives a return of $7.58 per ton for the alfalfa consumed, and the corn fed lots gave an average return of $13.03 per ton for the alfalfa consumed. Taking into account the oats in this ration, which are of doubtful value for sheep feeding, and the fact that the lambs were larger than those reported in Experiments I. and II. and were in much better condition at the beginning of the feeding period, the comparative values of the small grains and corn for lamb feeding correspond very closely in all of the experiments reported in this bulletin.

GENERAL SUMMARY.

Beet pulp is a valuable roughage to feed with alfalfa, and we believe would be especially valuable to use during the first part of a feeding period. Pulp fed mutton had good flavor, but was not very fat.

Pulp and alfalfa fed lambs made gains at the least cost per pound, and gave us the largest profit last winter. The second best profit was from lambs which were fed spelt and alfalfa. The third best combination of foods used from the profit standpoint was beets and alfalfa with a ration of grain the last thirty days, decreasing the amount of beets fed at the end of the feeding period. Wheat, barley and alfalfa gave a little better profit than alfalfa, beet pulp and grain. The corn ration gave the least profit when compared with any of the lambs which were fed beets or pulp.

Beet pulp, which does not cost the feeder more than $1.50 per ton at his yards, will give a return sufficiently large to pay for using it in a ration, but we would not recommend letting lambs eat so much of it during the finishing period that they will not consume good rations of hay and grain.

Sugar beets did not prove to have a high feeding value for lambs. It is doubtful if farmers can afford to feed beets to lambs if they can sell them to a factory at $4.50 per ton, and the conditions must be favorable to make beets give a return sufficiently large to pay for raising them. Two pounds of sugar beets were equal to about one pound of pulp.

Sugar beets and poor kinds of roughage cannot be made to take the place of alfalfa hay.

These trials showed that at the same price corn had a feeding value greater than a mixture of wheat, barley and oats, or wheat and barley, or barley alone.

Our single trial with Russian spelt showed it to have a feeding value at least equal to corn, and greater than wheat and barley.

Shropshire grade lambs made much better gains than common western lambs when fed the same ration. Nine Shropshire grades made average gains of 43.6 pounds, and seven native western lambs made an average of 31 pounds.

Our trials with warm and cold water given to fattening lambs did not show any advantage of one over the other.