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Feeding Sheep in South Dakota

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South Dakota Agricultural College

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U. S.
EXPERIMENT STATION,
SOUTH DAKOTA.

IN CONNECTION WITH THE

SOUTH DAKOTA AGRICULTURAL COLLEGE.

Feeding Sheep in South Dakota.

Departments of Agriculture.

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Sheep Feeding Experiments.

E. C. CHILCOTT, Agriculturist.
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The natural importance of the sheep industry to South Dakota is well established by the facts that her rich native grasses furnish abundant pastures and that her climatic conditions favor the grazing industry in all parts of the State. These natural advantages have long been recognized and have been utilized to a greater or less extent in all parts of the State for a number of years past. Another great natural advantage, of possibly even greater importance than those above mentioned, is her geographical location within the natural zone of cheap food supply. She embraces within her borders some of the most productive grain farms in the world, where nearly all kinds of food stuffs required for sheep feeding can be produced at a cost less than anywhere else on the American continent.

These productive grain fields, lying within such easy access to her immense ranges where sheep of good feeding quality can be produced in almost unlimited numbers, and at only a small fraction of the cost of producing them on Eastern farms, brings the ranchman and the feeder closer together and makes South Dakota a better feeding ground than any other State in the Union.

This State should not only finish all the sheep produced on her own ranges, but she should also feed large numbers from the ranges lying farther west.

The U. S. Department of Agriculture, Division of Statistics, gives the number of sheep in the State of South Dakota Jan. 1, 1897, as 336,259, valued at $2.17 per head. It may be conservatively stated that this number of sheep could be supported in a single country. A half dozen counties, even in the most thickly settled portion of the State, might easily range that number during the summer upon their unused lands, and feed

them through the winter upon the coarse forage which is now wasted, because of a lack of animals to consume it.

The immense tracts of unoccupied lands in the more thinly settled portions of the State, upon which the grass now annually goes to waste, would support sheep enough to consume all the coarse grains and fodder produced on the farms, and make the State one of the richest in livestock of any in the Union.

It is a deplorable fact, and one that does not speak well for the enterprise or intelligence of either our sheep raisers or our farmers, that of the small number of sheep which are annually raised, a large percentage is shipped East in an "unfinished" condition. At the same time hundreds of thousands of bushels of grain are annually sold at a price that entails an actual loss to the producer. In the past, and to a large extent at present, our cheap range sheep and our cheap grains are freighted East at great expense and there fed at a handsome profit. We are glad to note, however, that some of the more progressive farmers in this State are availing themselves of these favorable conditions and are thereby realizing handsome profits.

We would not be understood as advising all sheep men to go to raising grain, nor that all grain farmers should go into the sheep business. Neither do we believe that all the successful sheep raisers are fitted by taste, experience, environment or business ability to become successful feeders. But we do believe that many of them are so fitted and that there are a sufficient number of such in every neighborhood to "*feed to a finish*," not only as many sheep as are now produced annually, but enough more to consume all of the coarse grain and fodder produced. We believe that all coarse grains and fodder produced should be fed within our State and that no "feeders" should be shipped out until all such food stuffs are consumed. We believe that the farmers and the sheep men are "too far apart," not only geographically, but also in their way of looking at this important problem. Geographically they might be brought much closer together if all the rough, stony, hilly or unoccupied lands, of which every country has more or less, were utilized for sheep ranges.

On many farms both grain farming and sheep raising can be profitably conducted, but when this does not seem advisable the

two industries can be carried on upon closely adjoining lands with mutual profit to both the farmer and the sheep man. If the grain farmer would take into consideration the value he would derive from having a sheep man for a neighbor, who would buy and consume his surplus grain product and also render him an even greater service by keeping the stubble lands, fallow fields and waste places free from weeds; and if the sheep man would appreciate the advantage of being able to buy cheap grain of his neighbor in order to finish his sheep, we believe they would find it mutually beneficial. In order to aid in bringing about this order of things a series of feeding experiments was begun during the past season, and it is hoped that the work may be continued for some years to come.

OBJECT OF THE EXPERIMENT.

The object of this experiment was to determine the relative value of different food stuffs raised upon the farm, in making up a ration for fattening sheep, and to give some practical suggestions to those who may further develop the industry in this State. It was hoped through the facts suggested by this work that the feeder might be able to adopt the most economical rations, and thus with a minimum amount of experience secure maximum results.

The plan adopted was to compound the several rations of such materials that they should be simple and easily compared. We selected as a standard of comparison, what may be termed a "balanced ration," in which the different elements of the food are supposed to be combined so as to produce the most economical results. In this ration oil meal and shorts were used to furnish the necessary amount of proteids to balance the ration. In the other rations corn, barley, oats, and wheat were used in different combinations to determine which ration would produce a pound of gain with the smallest consumption of food, or at the lowest cost per pound. All these rations were to be compared with each other and with the standard ration.

Five rations were made up, four of which differed from one another by a single food stuff. With these rations we hoped to be able to attribute any difference in gains to difference in kind and amount of food. All lots were to receive millet hay, cut green and well cured, in such amounts as they would eat clean. At the end of the seventh week of the experiment the millet was changed to good, prairie hay, which was afterwards fed to the end of the experiment. Any waste or refuse was weighed back and credited to the proper lot.

The grain rations were as follows:

Lot 1.—Equal weights of shelled corn, oats, shorts, and oil meal.

Lot 2.—Equal weights of corn and oats.

Lot 3.—Equal weights of wheat and oats.

Lot 4.—Equal weights of barley and oats.

Lot 5.—Equal weights of barley and wheat.

These food stuffs were rated at the following prices in order to determine the cost per pound of the gains made:

Millet hay, $3.00 per ton, = $0.150 per 100 lbs.
Prairie hay, $3.00 per ton, = $0.150 per 100 lbs.
Oats, 12 cents per bushel, = $0.375 per 100 lbs.
Barley, 12 cents per bushel, = $0.250 per 100 lbs.
Corn, 20 cents per bushel, (56 lbs.) = $0.357 per 100 lbs.
Wheat, 54 cents per bushel, = $0 900 per 100 lbs.
Shorts, $6.00 per ton, = $0.300 per 100 lbs.
Oil meal, $18.60 per ton, = $0.930 per 100 lbs.

These prices were considered fair and were probably above the average market price at the time the experiment commenced, November, 1896.

The question might fairly be considered whether the waste hay should have been credited to the different lots, or not, since when not consumed its commercial value was destroyed. In considering this matter we decided that the price was sufficiently high to cover this small element of waste, which amounted to about ten per cent on the average. While $3.00 per ton may seem a small price to the eastern feeder, it is in fact more than our farmers are always able to secure, even after hauling considerable distances. At this price there are generally more sellers than purchasers, and the farmer can better afford to market his hay on his own farm at less than three dollars, where he may return the refuse to the land as manure, than to sell in the market at the ordinary prices.

SELECTION OF LAMBS.

The limited number of sheep which we could accommodate made it expedient to purchase near home, and after some inquiry we secured a lot of forty-five lambs near Arlington, S. D., which arrived at the farm Sept. 29, 1896. These sheep weighed 2,435 lbs. on arrival, or an average of 54 lbs. per head. They had not been well cared for during the dry season, often going without sufficient water, being coralled at night and not turned out early enough in the morning to enable them to get water by grazing while the dew was on the grass. Of this lot five or six were certainly stunted in such a manner that they did not respond quickly to better treatment, and all were smaller than they should have been with better care, at their age. This fact may have effected the price of gains during the first seven weeks of the experiment, at which time one lamb from each lot

the experiment commenced, tended to put the lambs in good, thrifty condition. Any influence from the conditions under which the lambs were grown must have affected the lots so nearly alike as to have produced no influence on the relative results.

On September 30 the lot of forty-five lambs was turned on a field of rape, where they remained until November 16. They had access to a grass pasture during the last three weeks of the time. They received, in addition to pasture, one-half pound of oats per head daily during the first two weeks, and after that time until November 16, they received three-fourths of a pound per head daily of a ration, two-thirds oats and one-third barley. On the 16th day of November they were sorted into five lots of nine each, as near equal in weight and comparable in quality as it was possible to secure. They were then given a farther two weeks preparatory feeding upon the ration they were to consume while under experiment. Lot 5, which was to continue upon a grain ration of wheat and barley, was given a small proportion of shorts to lighten the feed while becoming accustomed to this heavy grain ration. At the close of the preparatory period each lot was eating ten pounds of grain daily, which was the smallest amount consumed at any time, except during the first week of the experiment, when they consumed only about nine pounds per lot. During this eight weeks of preparatory feeding they had gained in total weight 508 pounds, or something over eleven pounds per head. If the profits on this 508 pounds of gain, made during the preparatory period at a very small cost, were included, the profits on each lamb between the time of purchase and sale would be greatly increased.

After placing in the pens they were fed twice daily, namely, at eight o'clock a. m. and at five o'clock p. m., receiving the grain ration first and the allowance of hay after the grain was eaten. They received water during the middle of each day, but the zero temperature which prevailed during a large part of the experiment prevented their having water continually before them. They had rock and barrel salt always before them.

These lots were fed all the hay they would consume and it was our intention that the grain ration should approach full consumption; but in studying the amount of food consumed the average grain consumption per day seems small, being only

was withdrawn; but the eight weeks preparatory feeding before 1.436 pounds per lamb per day. It is possible that these lambs might have consumed more grain; but in studying the lots at the time, this was not deemed advisable. None of the lots were at any time off feed, but on two occasions it was necessary to reduce the grain in order to prevent overfeeding. This was always at the time of a sudden rise of temperature. The normal ration was quickly regained.

The lambs were confined in a shed, each lot having a pen 12 ft. x 16 ft. with a yard 12 ft. x 30 ft. attached, in which they were allowed to run at will during pleasant days.

They were weighed every Saturday at ten o'clock a. m. just after feeding, but before watering.

AVERAGE DAILY RATION FOR ONE LAMB.

Lot 1.

Corn		.359 lb
Oats		.359 "
Shorts		.359 "
Oil meal		.359 "
Hay		.875 "
Total air dry matter		2.211 lbs
Nutritive ratio	1:5.2	
Total daily cost for one lamb		.835 cts

Lot 2.

Corn		.717 lb
Oats		.717 "
Hay		.851 "
Total air dry matter		2 385 lbs
Nutritive ratio	1:8.6	
Total daily cost for one lamb		.652 cts

Lot 3.

Oats		.718 lb
Wheat		.718 "
Hay		.862 "
Total air dry matter		2.298 lbs
Nutritive ratio	1:8.3	
Total daily cost for one lamb		1.044 cts

Lot 4.

Oats		.718 lb
Barley		.718 "
Hay		.865 "
Total air dry matter		2.301 lbs
Nutritive ratio	1:7.8	
Total daily cost for one lamb		.578 cts

Lot 5.

Wheat		.718 lb
Barley		.718 "
Hay		.897 "
Total air dry matter		2.333 lbs
Nutritive ratio	1:7	
Total daily cost for one lamb		.96 cts

LOT 1.

Weekly Record of Feed, Weight and Gains, in Pounds.

Grain ration: Corn, oats, shorts and oat meal.

Date.	Hay.	Grain.	Waste hay.	Weight at beginning of period.	Weight at close of period.	Gain.
November 28, 1896					587	
December 5, "	59	61	5	587	607	20
" 12, "	66	78	6.5	607	613	6
" 19, "	58	84	2	613	631	18
" 26, "	56	84	2.5	631	638	7
January 2, 1897	56	84	4.5	638	651	13
" 9, "	56	84	5.5	651	685	34
" 16, "	56	84	3	685	699	14
" 16, "				*51		
" 23, "	56	84	6.5	648	654	6
" 30, "	56	84	2.5	654	667	13
February 6, "	56	74	8	667	689	22
" 13, "	56	82	6.5	689	695	6
" 20, "	56	84	5.5	695	693	-2
" 27, "	56	84	8	693	718	25
March 6, "	56	84.5	7.5	718	730	12
" 13, "	56	91.5	5.5	730	757	27
" 20, "	56	98.5	8	757	762	5
" 27, "	56	110.5	6	762	767	5
Totals	967	1,436	92		767	231
	-92				51	
Hay consumed	875				818	

*51-pound lamb withdrawn.

Financial Statement.

Debit—		
To 9 lambs, 587 lbs., @ 3c		$17 61
" 876 lbs. hay @ $3.00 per ton		1 31
" 1436 lbs. corn, oats, shorts and oil meal		7 22
" Profits on investment		6 65
Credit—		$32 79
By 9 lambs, 818 lbs. @ 4c	$32 79	
Profit on one lamb		.74

LOT 2.

Weekly Record of Feed, Weights and Gains, in Pounds.

Grain ration: Corn and oats.

Date.	Hay.	Grain.	Waste hay.	Weight at beginning of period.	Weight at close of period.	Gain.
November 28, 1896					602	
December 5, "	59	61	5	602	616	14
" 12, "	66	76	5	616	628	12
" 19, "	58	84	2	628	634	6
" 26, "	56	84	3.5	634	653	19
January 2, 1897	56	84	6	653	664	11
" 9, "	56	84	6.5	664	684	20
" 16, "	56	84	3.5	684	698	14
" 16, "				*63		
" 23, "	56	84	7.5	635	648	13
" 30, "	56	84	5.5	648	670	22
February 6, "	56	74	9.5	670	673	3
" 13, "	56	82	9	673	672	−1
" 20, "	56	84	6.5	672	673	1
" 27, "	56	84	10	673	686	13
March 6, "	56	84.5	8.5	686	693	7
" 13, "	56	91.5	8.5	693	707	14
" 20, "	56	98.5	11	707	735	28
" 27, "	56	110.5	8.5	735	764	29
Totals	967	1,434	116		764	225
	−116				63	
Hay consumed	851				827	

*63-pound lamb withdrawn.

Financial Statement.

Debit—		
To 9 lambs, 602 lbs. @ 3c		$18 06
" 851 lbs. hay @ $3.00 per ton		1 27
" 1434 lbs. corn and oats		5 25
" Profit on investment		8 50
		$30 08
Credit—		
By 9 lambs, 827 lbs. @ 4c	$33.08	
Profit on one lamb		.94

LOT 3.

Weekly Record of Feed, Weights and Gains, in Pounds.

Grain rations: Wheat and oats.

Date.	Hay.	Grain.	Waste hay.	Weight at beginning of period.	Weight at close of period.	Gain
November 28, 1896					600	
December 5, "	59	61	3	600	615	15
" 12, "	66	78	3.5	615	634	19
" 19, "	58	84	1.5	634	641	7
" 26, "	56	84	2	641	647	6
January 2, 1897	56	84	3	647	654	7
" 9, "	56	84	6	654	675	21
" 16, "	56	84	4.5	675	687	12
" 16, "				*54		
" 23, "	56	84	7.5	633	648	15
" 30, "	56	84	5.5	648	662	14
Februrry 6, "	56	74	8.5	662	661	-1
" 13, "	56	82	10	661	669	8
" 20, "	56	84	8	669	681	12
" 27, "	56	84	8.5	681	701	20
March 6, "	56	84	9	701	709	8
" 13, "	56	91.5	8.5	709	723	14
" 20, "	56	98.5	8.5	723	732	9
" 27, "	56	110.5	7.5	732	741	9
Totals	967	1,436	105		741	195
	-105				54	
Hay consumed	862				795	

*54-pound lamb died.

Financial Statement.

Debit—		
To 9 lambs, 600 lbs. @ 3c		$18 00
" 862 lbs. hay @ $3.00 per ton		1 29
" 1,436 lbs. wheat and oats		9 15
" Profit on investment		3 36
		$31 80
Credit—		
By 9 lambs, 795 lbs. @ 4c	$31 80	
Profit on one lamb		.37

LOT 4.

Weekly Record of Feed, Weight and Gain, in Pounds.

Grain ration: Barley and oats.

Date.	Hay.	Grain.	Waste hay.	Weight at beginning of period.	Weight at close of period.	Gain.
November 28, 1896					570	
December 5, "	59	61	5.5	570	586	16
" 12, "	66	78	5.5	586	598	12
" 19, "	58	84	1	598	621	23
" 26, "	56	84	2	621	620	-1
January 2, 1897	56	84	5	626	633	13
" 9, "	56	84	5	633	654	21
" 16, "	56	84	4	654	666	12
" 16, "				*49		
" 23, "	56	84	7	617	627	10
" 30, "	56	84	5	627	641	14
February 6, "	56	74	8	641	657	16
" 13, "	56	82	8	657	663	6
" 20, "	56	84	6	663	654	-9
" 27, "	56	84	11	654	678	24
March 6, "	56	84.5	9	678	683	5
" 13, "	56	91.5	8.5	683	715	32
" 20, "	56	98.5	7.5	715	726	11
" 27, "	56	110.5	6	726	727	1
Totals	967	1,436	104		727	206
	-104				49	
Hay consumed	863				776	

*49-pound lamb withdrawn.

Financial Statement.

Debit—		
To 9 lambs, 570 lbs. @ 3c		$17 10
" 865 lbs. hay at $3.00 per ton		1 29
" 1,436 lbs. barley and oats		4 48
" To profit on investment		8 17
		$31 04
Credit—		
By 776 lbs. lamb @ 4c	$31 04	
Profit on one lamb		.91

LOT 5.

Weekly record of feed, weight and gain, in pounds.

Grain ration: Wheat and barley.

Date.	Hay.	Grain.	Waste hay.	Weight at beginning of period.	Weight at close of period.	Loss or gain.
November 28, 1896					582	
December 5, "	59	61	3.5	582	593	11
" 12, "	66	78	3	593	610	17
" 19, "	58	84	.5	610	614	4
" 26, "	56	84	1	914	630	16
January 2, 1897	56	84	4.5	630	637	7
" 9, "	56	84	4	637	660	23
" 16, "	56	84	3	660	672	12
" 16, "				*55		
" 23, "	56	84	4.5	617	628	11
" 30, "	56	84	2.5	628	646	18
February 6, "	56	74	6	646	657	11
" 13, "	56	82	6	657	663	6
" 20, "	56	84	4	663	672	9
" 27, "	56	84	7.5	672	684	12
March 6, "	56	84.5	5.5	684	705	21
" 13, "	56	91.5	4.5	705	720	15
" 20, "	56	98 5	7.5	720	730	10
" 27, "	56	110.5	5	730	744	14
Totals	967	1,436	72.5		744	217
	72				55	
Hay consumed	895				799	

*55-pound lamb withdrawn.

Financial Statement.

Debit—		
To 9 lambs, 582 lbs. @ 3c		$17 46
" 895 lbs. hay @ $3 per ton		1 34
" 1,436 lbs. wheat and barley		8 25
" To profit on investment		4 91
		31 96
Credit—		
By 799 lbs. lamb @ 4c	31 96	
Profit on one lamb		.54

SUMMARY OF TOTALS.

Period Seventeen Weeks.

Lot.	Millet hay.	Prairie hay.	Corn.	Oats.	Wheat.	Barley.	Shorts.	Oil meal.	Total hay.	Total grain.	Dry matter.	Nutritive ratio.	Weights at beginning of period.	Weights at close of period.	Gain.	Dry matter for pound of gain.	Total cost of feed.	Cost of gain per pound—cents.
1	379	496	359	359	.....	.....	359	359	875	1436	2081	1:5.2	587	818	231	9.	$8.35	3.6
2	376	475	717	717	.....	.....	.....	.....	851	1434	2057	1:8.6	602	827	225	9.14	6.52	2.45
3	384	478	.....	718	718	.....	.....	.....	862	1436	2068	1:8.3	600	795	195	10 6	10.44	5.35
4	382	483	.....	718	.....	718	.....	.....	865	1436	2071	1:7.8	570	776	206	10.	5.78	2.8
5	390	507	———	———	718	718	.....	.....	897	1436	2100	1:7	582	799	217	9.67	9.60	4.42

EXPLANATION.

The tables for each lot contain a summary of the feed, weights and gains The kind of food taken by each lot is indicated in the early pages of this bulletin and also in the "Summary of Totals," where all details are to be found.

Where the minus sign (–) is placed before numbers in the column of gains it indicates a loss in weight.

In the week ending January 16 one of the smaller lambs in Lot 3 died. Its weight was determined as nearly as possible and added to the weight of the eight remaining lambs for the summary of that week. To equalize this loss one lamb was withdrawn from each lot and the experiment continued with lots of eight each. The number of pounds withdrawn is indicated in the table. At the close of the experiment the number of pounds withdrawn was added to the final weights to make it comparable with the weight at the beginning and to give the actual gains.

It should also be noted in figuring the gains per week and the profits on a single animal, that the total gains and profits should be divided by a figure less than nine, since the lots contained nine lambs only seven-seventeenths of the time. This withdrawal of one lamb from each lot has not been recognized in figuring profits per sheep.

The withdrawal of these lambs lead to a careful investigation of the animals. It was known while the animals were on the rape that they were affected by the broad tapeworm (*Monieza expansa*) so common everywhere, but the killing of certain

animals revealed the presence of another parasite (*Thysanosoma actinioides*), or the small fringed cestode, sometimes mistaken for the liver fluke. This led us to select the best and the poorest lamb from each lot and slaughter them, to determine, if possible, whether the fringed cestode had in any way retarded the gains or affected the vigor of the sheep. It was thought by selecting the most vigorous and best-fattened sheep in the lot and comparing them with the poorest and smallest sheep, that we might find the gains proportionate in some way to the number of cestodes present, and if this should be the case we would be compelled to believe that the parasite had been the controlling factor in the amount of gain made. For this purpose we had the ten lambs, five of the best and five of the poorest animals slaughtered. Prof. Dice McLaren, M. Sc., M. D., biologist and bacteriologist of the Station, kindly consented to make the examination of the viscera of the animals slaughtered and his report is herewith attached.

SOUTH DAKOTA AGRICULTURAL COLLEGE AND
EXPERIMENT STATION.
DEPARTMENT OF ANIMAL BIOLOGY.

DIRECTOR J. H. SHEPARD:

In September, 1896, when the experiment lambs were fed growing rape, their droppings contained segments of *Monieza expansa*, R. Bl., the broad tapeworm of sheep, indicating that a previous weakening of the lambs' digestive systems had permitted the lodgement and increase of these parasites. Inquiry revealed the fact that the lambs had suffered from lack of water and grass on their summer range. As these conditions also favor the growth of the more harmful *Thysanosoma actinioides*, Dies., the fringed cestode of sheep, the droppings were carefully examined, but not a trace of the fringed segments could be found.

In February, 1897, two of the sheep died and many fringed cestodes were found in the small intestine near the entrance of the common bile duct, and also in the smaller bile duct, far up into the lobes of the liver. At this time the cestodes were from one-half inch to three inches long, and the egg-bearing segments were not mature enough to be breaking away from the worms. As some of the sheep were not responding properly to their feed, it was predicted that all were infested and the flock

was isolated. Neither at this time nor at later autopsies were any of the broad tapeworms found in the intestines, and it is probable that the purging caused by the rape had expelled them in September.

Throughout the month of April, thirteen of these sheep were slaughtered, the viscera examined, and every sheep was found infested with fringed cestodes. These parasites were most numerous in the enlarged bile ducts of the liver, and in the small intestine near the orifice of the bile duct, which was usually so enlarged as to easily admit an ordinary lead pencil. A few of the gall cysts contained one or two of the cestodes. In six sheep the pancreas was also infested, the fringed cestodes being found far up in the pancreatic ducts, three inches from the small intestine. The condition of the sheep did not vary with the relative number of these internal parasites, some of the largest and fattest sheep containing as many fringed cestodes as the lighter weight sheep. All of the sheep were so carefully fed as to be thrifty and well nourished throughout the experiment. This care, with their rapid fall fattening, caused their mutton to be of the best quality, and by far the best obtainable in Brookings this year. At later stages of the trouble the sheep would have lost flesh and the emaciated would have thus been made unfit for eating. There is no proof that the fringed cestode infests human beings. The fringed cestode resembles a liver fluke both in appearance and effects. Both fatten at first and afterwards emaciate the sheep. The liver fluke is a smooth, bag-like flat-worm, while a magnifying glass shows the fringed cestode to be a jointed tapeworm, with fringes covering the segments. Under liquid these fringes may be seen by the unaided eye, and are diagnostic.

The viscera of the thirty-one sheep slaughtered in Brookings, during April, 1897, were examined. Sixteen sheep which had been summer fed on closely pastured prairie, and watered from nearly dried-up ponds, were found infested with the fringed cestode. The other fifteen sheep had grazed on abundant grass, had access to a plentiful supply of pure water and were entirely free from internal parasites. Thus the region near Oakwood Lakes was remarkable for its exemption from sheep parasites.

The facts already ascertained in this investigation indicate that if the young lambs are fed untainted food in troughs, or on

clean pastures, and given an abundance of clean water, with a liberal supply of salt, there is little danger of their becoming infested with the fringed cestode. As it is generally believed that more prairie sheep die during their first winter from the effects of the fringed cestode than from any other cause, this line of investigation will be continued.

Respectfully submitted,

DICE MCLAREN.

Brookings, S. D., June 15, 1897.

A word might be said relative to the prices at which the sheep are figured in the financial statement. The lambs were purchased at three cents per pound, which was about the price paid for lambs in this locality at the time of purchase. The selling price is placed at four cents (4c.), which is low for the quality of lambs sold. If there had been a car lot they would surely have netted four and one-half cents on track and left the shipper a margin of profit. The price of lambs of their quality was quoted at from $5.00 to $5.60 per hundred at the time the experiment closed, and even reached a higher figure during the month of April. Quotations per Breeders' Gazette, April 14, 1897, reached as high as $6.10 for prime Colorado lambs.

It is evident that with the present undeveloped condition of the sheep-feeding industry in the State, it will pay best to feed in car lots and ship to reliable commission men in market centers rather than to feed in smaller lots and depend on local dealers for a market. The limited trade does not make a market for small lots nor encourage competition among local dealers. But car lots are always marketable and can be shipped without risk, except for the incidental fluctuations in the market, if consigned to any of the standard and reliable commission men of the large market centers.

CONCLUSIONS.

I. While a single experiment cannot be said to settle the relative value of foods, the results obtained from this experiment are so suggestive that they are certainly valuable to the sheep feeder.

II. In a comparison of the balanced ration (which had a nutritive ratio of 1:5.2) with any of the other rations fed, as seen by the table of summaries, we find: Lot 1 (corn, oats,

shorts and oilmeal) required nine pounds of dry matter (estimating hay and grain as 90 per cent dry matter) to produce one pound of gain. This ration produces slightly greater gains for a given weight of food than any of the rations containing a larger percentage of carbohydrates in the food. This relation between the nitrogen content of the ration and the gain produced does not hold good throughout the experiment. Lot 2 (corn and oats), with the widest nutritive ratio, 1:8.6, produces the cheapest gains in point of price, and next to the cheapest gains in pounds of dry matter. Lot 3 (wheat and oats), with a nutritive ratio almost the same as Lot 2, being 1:8.3, requires the largest number of pounds dry matter for a pound of gain (viz: 10.6 lbs.) and it also costs the highest price per pound.

III. In considering these rations we may conclude that they are all favorable to good gains, but that they are not all equally favorable to profits. The rations yielding the best profits are Lots 2,—corn and oats which produce gains at 2.45 cents per pound,—and Lot 3,—barley and oats, which produced gains at 2.8 cents per pound.

IV. In studying the tables we find that the largest gains are not necessarily the cheapest, nor are the smallest gains necessarily the most expensive.

V. We find by observation that the best and the cheapest gains are made in feeding the sheep up to near its full capacity, after it has become accustomed to its diet. Over feeding is always accompanied by loss. The heaviest feeding should be done during the last four or six weeks of the feeding period.

VI. Although dipped upon arrival at the farm, a few of the lambs accumulated ticks during the last weeks of the feeding period. It was very evident that these annoyed the sheep and perhaps lessened the gains. Dipping is absolutely essential to good results in feeding western lambs.

VII. In these experiments we find the price of food stuffs the most important factor affecting the profits of the business. By replacing the 718 pounds of wheat (worth 90c per 100 lbs.) in Lot 3 by barley (worth 25c per hundred), we have Lot 4 and we reduce the price of gain from 5.33c per pound to 2.8c per pound. By changing the 718 pounds of wheat worth 90 cents in Lot 5, to oats worth 37.5c per hundred, we get Lot 4 again

and reduce the cost of gains from 4.42 cents to 2.8 cents per pound. There is no doubt but that the variety of the grain ration in Lot 1 gives it a somewhat unfair advantage over the other rations. The oil meal fed doubtless reduced the amount of food necessary to produce a pound of gain, on account of the richness of oil meal in proteids and fat; but this advantage could not compensate for the high cost of 93 cents per hundred, which must be charged against it.

VIII. Corn and oats have given the cheapest gains, viz: 2.45c per pound. These foods are known to be prime favorites in all the old corn producing states. With us corn will be important as a sheep fattening ration wherever it is as cheap or cheaper than barley. A change in the relative price of food stuffs will always change the materials which can most profitably enter into a ration.

IX. It will be noted that the expense of the ration for one lamb per day exceeds one cent in only one of the five lots. Lot 3 costs 1.044 cents per day, while Lot 4 costs but .577 cents per day. Comparing this with bulletin 107, Michigan Experiment Station, we find the ration for one lamb costing from 2.67 cents per day to as low as 1.54 cents per day. It will be seen from these figures that we have an immense advantage over eastern feeders, and that the Northwest can feed at a profit when other feeders may be feeding at a loss. The fact should be impressed upon the farmers of this State that the Dakotas and Minnesota are eventually to become the feeding ground for immense numbers of the sheep of the Northwest, and that with care, intelligence and enterprise, this industry will become a source of large profit to those who develop its resources.

ERRATUM—The first line on page 9 should be transferred to top of page 8.