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FATTENING LAMBS IN WINTER.

1. FATTENING MINNESOTA LAMBS.
2. FATTENING RANGE LAMBS.
3. FATTENING RANGE LAMBS.

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FATTENING LAMBS IN WINTER.

THOMAS SHAW.

This Bulletin contains three experiments. These were conducted during successive winters beginning with that of 1895-96, and they all relate to the fattening of lambs. In Section No. 1 the lambs fed were reared in Minnesota, and in Sections No. 2 and 3 they were grown on the range.

FATTENING MINNESOTA LAMBS.

SECTION NO. 1.

In the experiment conducted in feeding lambs at our Station during the winter of 1894 and '95, screenings was the principal grain food fed. Prior to that time the writer had not been able to find any experience in our state in finishing lambs entirely on coarse grains other than screenings. The marked relative adaptability of this food for finishing sheep and lambs had already been determined in a general way by the success which had attended such feeding at the stockyards. To further determine the value of screenings for fattening uses in a more precise and elaborate manner seemed to be the ambition of some experimenters, by first analyzing them, and then by feeding them when so analyzed. But the single experiment above referred to soon convinced the writer that experimentation with screenings would not result in any great good. They were a quantity so variable as to render it impossible to classify them, and therefore impossible to convey to the average mind any adequate idea of the different kinds of screenings. No two samples could be found that were alike; while some samples were almost as valuable as wheat in their food constituents and for feed-

ing uses, other kinds were but little better than chaff. The only real tangible good therefore that would seem to arise from experimenting with them further would be to show the farmer the value of the food which he was giving away every year. This had already been demonstrated by the almost exclusive use that had been made of them in fattening sheep at the stockyards. The presence of screenings in quantities so large was not creditable to the farming of the state. It spoke of slovenly and careless methods of cultivation. To spend much time therefore in experimentation with a by-product, the very existence of which in such quantities was a stigma on our agriculture seemed out of place. The Station that did so would unquestionably be better employed in teaching the farmer how not to grow weed seeds than how to feed them when grown.

It was determined, therefore, in the meantime to drop farther experimentation in feeding screenings to sheep and lambs, and to commence a series of experiments that would cover a number of years in ascertaining the relative and also the intrinsic value of the various coarse cereals grown in the state for such a use. The chief of these are corn, barley, oats and flax, all of which grow in fine form within our borders. Heretofore the surplus of all these grains had been shipped over our eastern borders every year in the trail of mill feed sent in enormous quantities in the same direction. These experiments, therefore, were planned in the hope of doing something that would tend to divert this interminable and regretful overflow to the feed yards of Minnesota farmers.

Time Covered by the Experiment.—The preparatory feeding began Dec. 23, 1895, and covered a period of 7 days. The experiment proper began Dec. 30 and ended March 16, 1896, thus covering a period of 11 weeks or 77 days. On March 17 the major portion of the lambs were shipped to Chicago and sold for the Station by the firm of Clay, Robinson & Co., of that place.



Fig. 198.—The Lambs when Starting for Chicago.

Objects Sought in the Experiment.—Prominent among the objects sought in the experiment were the following: 1. To learn the comparative value, in fattening lambs, of certain combinations made up of the chief of the coarse grains grown in the state; 2. To compare feeding such food in limited and unlimited quantities; 3. To ascertain the outcome from feeding such foods to a good type of home grown lambs. The minor objects sought to know: 1. The relative gains that would be secured per month; 2. The relative amounts of food consumed of the various combinations and the gains resulting from them; 3. The relative cost of the gains.

The Animals Used.—The lambs used in the experiment were home grown. They were really good types. In fact they were of a character that would do credit to any grower. One hundred lambs were fed and they were obtained from three sources. The lots from which they were taken numbered 80, 24 and 5 head respectively. The first lot was procured from David M. Fyffe, manager for Hugh Paul, of the Wavertree farm, Dundee, Minnesota. They reached the Station farm on Sept 8, and were kept on pasture with a

supplement of oats until the experiment began. The average weight at the time of purchase was 85 pounds. They cost \$4.00 per 100 pounds at Dundee. They were pastured on blue grass of inferior quality until the experiment began Dec. 23, and were also fed a supplement of oats. They consumed 7,501 pounds, hence this food was in a sense their main reliance. Fifteen cents per lamb therefore was deemed an ample charge for the pasture. The price of lambs went away down later in the season and so remained all the winter. They could have been bought two months subsequent to the date of purchase for at least 50 cents less per 100 pounds. They were chiefly high grade Shropshires, but some of the largest specimens were the offspring of a Cotswold cross on high grade Shropshire ewes. In form and quality the lambs of this lot were really good.

The second lot were purchased from Alexander Gunn, of Janesville, Minnesota. They reached the Station on Dec. 17. The average weight at the time of purchase was 99.1 pounds, and the price paid was \$3.50 per 100 pounds. In form and breeding they were very similar to the first lot. A few specimens showed indications of Lincoln blood, but the major portion were high grade Shropshires.

The third lot comprised home grown lambs. They were Dorset grades, and were the progeny of a first cross of the pure Dorset on grade ewes. Being late lambs they weighed on an average but 80.6 pounds per head. They were valued at 3½ cents per pound. From the first lot 74 animals were chosen, from the second lot 21. These and the 5 home grown lambs made up the complement of 100 lambs, and they contained both wethers and ewes, but the former were much the more numerous.

Conditions Governing the Experiment.—The 100 lambs were divided into five lots of twenty each. They were fed in compartments of the shed that were side by side. These were 18x20 feet and hinged double doors opened from them northward to yards of a similar size. Except in stormy

weather they had access at will to both apartments, and it is worthy of note that they spent much of the time in the yards. They were provided with water in buckets during the day. Salt was likewise kept before them in boxes. They were weighed singly when put upon experiment, and every week thereafter, and the weights were duly recorded.

Food and Feeding.—The lambs in lot 1 were fed oil-cake, corn and oats, in the proportions of 1, 3 and 6 parts. This food was kept constantly before them after they had been led up to full feed. The lambs in lot 2 were fed the same kinds of grain and in similar proportions, but of this they were only given what they would eat clean. And likewise the lambs in the remaining lots were only given what they would eat with a relish. The lambs in lot 3 were fed oil-cake, barley and oats, in the proportion of 1, 3 and 6 parts. Those in lot 4 were given precisely the same kind of grain food during the first six weeks of the experiment, but during the last five weeks of the same the proportions were changed to 2, 3 and 5 parts respectively of the oil-cake, barley and oats. The lambs in lot 5 were fed oil-cake and oats, in the proportion of 1 and 9 parts, during the first six weeks of the experiment, and in the proportion of 2 and 8 parts during the last five weeks of the same. During the first six weeks of the entire experiment, native hay was fed, and miserable dried stuff it was, owing to cutting too long deferred and also to over-curing. But through the last six weeks of the experiment, hay essentially clover was fed, and of good quality. The oil-cake was fed in the pea form. The grain was not ground nor was the hay cut. The aim in feeding was to secure a quick finish, as the lambs were in a good condition of thrift when the experiment began. Some 21 days were occupied in getting the lambs onto full feed.

Estimated Value of the Food.—The food was charged at what were considered the average market values for the same. They were as follows:

Oil Cake, per ton.....	\$14.00
Corn, per bushel of 56 pounds.....	.18
Barley, per bushel of 48 pounds.....	.16
Oats, per bushel of 32 pounds.....	.14
Native Hay, per ton.....	3.00
Clover Hay, per ton.....	3.50

Low as these prices are, with the exception of hay, they are nearly the same as the prices for which the various products were actually laid down at the station, and they should certainly demonstrate the great advantage in this respect that the western feeder has and will probably for long years continue to have over the eastern feeder.

Food Consumed.—Table LIV. gives the respective aggregate amounts of grain and hay consumed by the different lots during the experiment proper.

TABLE LIV.—Aggregate Amounts of Food Consumed.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Grain.....	3821	3710	3645	3655	3695
Hay.....	900	1459	1355	1361	1236
	4721	5169	5000	5016	4931

The total of grain consumed during the experiment proper was 18,526 pounds, and during the 12 weeks of feeding 19,716 pounds. The total consumption of hay during the first half of the feeding period was 6,311 pounds, and during the last half, 6,780 pounds. And it is also worthy of note that during the first 6 weeks of feeding, while the poor quality of hay was being fed, the consumption of the same was but 2,683 pounds; during the last 6 weeks, while good hay was being fed, the consumption was 4,097 pounds. In other words, the proportion of hay consumed during the first half of the experiment was only 39 per cent. of the whole consumption of hay, and during the last half of the same it was 61 per cent. The bearing of this upon the gains will be referred to later.

Table LV. gives the respective quantities of grain and of hay consumed on an average by one lamb in each group during the experiment proper, and also the sum of these eaten by one lamb.

TABLE LV.—Averages of Food Consumed.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Grain.....	2.42	2.41	2.37	2.37	2.40
Hay.....	.58	.95	.88	.88	.80
Totals.....	3.00	3.36	3.25	3.25	3.20

The average consumption of grain by the lambs in each lot was very uniform, and the same is true of the consumption of hay save with the lambs in lot 1. It will be noticed that with them the consumption of hay was 33½ per cent. less than with the lambs of the other lots. The grain, as previously intimated, was fed to them in a self-feeder, and they seemed to make it their chief food. The average daily consumption of grain with the lambs in all the lots was 2.39 pounds, and of hay 1.82 pounds, or a total per day of 3.21 pounds. This consumption of food in proportion to the gains made is small indeed, and speaks much for the high character of the lambs.

Incidents of the Experiment.—On Feb. 20th one lamb died in lot 1, from a digestive trouble. The food was more or less impacted in the stomach, and prompt remedial measures failed to bring relief. This lamb weighed 90½ pounds when put upon experiment, and 104 pounds when he died. Had he lived he would have weighed a little more than 110 pounds at the close of the experiment, on the supposition that the gain made by him subsequently to Feb. 20th had been at the same rate as during the period previous to that time. The value of this lamb is not of course included in the financial summary, nor is any deduction made because of the food consumed by him. But in the reckoning of certain averages, as for instance those which relate to weights

and cost of production, it is necessary to take this lamb into the account.

Two or three of the other lambs in this lot were also somewhat out of health toward the close of the experiment. The troubles were all digestive in their origin, but prompt remedial measures prevented further losses. As the lambs in lot 2 which were fed on precisely the same ration in kind, but limited in quantity, had uniformly good health, it would seem fair to conclude that the unlimited feeding was responsible for the trouble. The lambs in the other lots also maintained good health through the whole of the feeding period.

Value of Food Consumed.—Table LVI. gives the value of the food consumed during the preparatory period and the experiment proper, and also the totals of the same.

TABLE LVI.—Value of Food Consumed.

	Preparatory Experiment	Experiment Proper	Total Cost
Lot 1.....	\$1.11	\$18.83	\$19.94
Lot 2.....	1.14	18.33	19.47
Lot 3.....	7.11	18.03	19.14
Lot 4.....	1.17	18.55	19.72
Lot 5.....	1.40	19.86	21.26
Totals.....	\$5.93	\$93.60	\$99.53

The ration given to the lambs in lot five, composed largely of oats, was the most expensive. The relative cost of the other food factors are very uniform. The cost of food per lamb for 77 days feeding was 93.6 cents, and for 84 days feeding, 99.5 cents.

Profits Made During the Experiment Proper.—Table LVII. gives: 1. The value of the lambs in each lot at the commencement of the experiment proper; 2. The cost of the food fed during the same; 3. The cost of marketing; 4. The total cost of the lambs when sent to the block; 5. The value of the lambs when sold; 6. The profit made on the lambs in each lot during the experiment.

TABLE LVII.—Profit Made During the Experiment Proper.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Totals
Value on Dec. 30 1895	\$78.43	\$81.03	\$78.84	\$80.67	\$80 75	\$399.72
Cost of Food.....	18.83	18.33	18.03	18.55	19.86	93.60
Total Cost.....	97.26	99.36	96.87	99.22	100.61	493.32
Value on Mch. 17, 1896	103.16	110.96	107.78	110.96	109.69	542.55
Profit.....	5.90	11.60	10.91	11.74	9.08	49.23

The total profit made on the 100 lambs from 77 days' feeding was \$49.23. On each of the 99 lambs that survived it was 49.7 cents. In reckoning this profit the lambs were charged at \$4.07 per 100 pounds when the experiment proper began. This charge was on the basis of cost. To this was added the cost of food, and the sum thus obtained was deducted from the estimated value of the lambs in the Chicago market, on the supposition that they had all been sent to that market. The estimated value in Chicago based on the actual net amount received for the lambs at that market, after all expenses had been paid, was \$4.24 per 100 pounds. Of the whole number, 84 were shipped. As the lambs were large this number filled a single deck car. The entire cost of the shipment, including freight, yardage and commissions, was \$45.40. The price received was \$4.65 per 100 pounds, and the cost of marketing was 41 cents per 100 pounds. The net price, therefore, as previously stated, was \$4.24 per hundred. Notwithstanding the excellence and the high finish of the lambs, the firm whose agent sold them expressed the opinion that they would have brought 25 cents more per 100 pounds had they been 30 to 40 pounds lighter per head. The average cost of marketing one lamb was 53 cents, but it should be borne in mind that the lambs were very large, which of course added to the cost of shipping each individual.

The profit mentioned, viz. \$49.23, does not represent the net profit, but simply the profit on the unshrunk weights during the 77 days of feeding. To get the net profit, a shrink of 5 per cent must be deducted from the unshrunk weight. This would reduce the profit from \$49.23 to \$22.09

on the whole lot, and on one lamb from 49.2 cents to 22 cents.

When the lambs were ready for sale, the effort was made to sell them to the dealers of St. Paul and Minneapolis, but when informed of the weights of the lambs and the condition of the same, without even inspecting them, as with one voice they said the lambs were too large for their trade. This to the writer was a revelation, as, when feeding lambs in Ontario as late as 1893, the preference was given there to the largest and best finished lambs and so it had been for years previous. As the Chicago buyers also concluded that the lambs were too heavy to bring the topmost price, the change in the market demand in favor of the lamb of but medium weight was thus further emphasized. It is a change that cannot be ignored.

But when the dealers intimated that because of the high finish of the lambs the meat must of necessity be excessively tallowy in character, the writer was sure they were mistaken. The lambs had been fed with a view to the production of the best quality of meat. To test the question, one of the lambs was dressed and served to a company of experts at a leading café in St. Paul. The St. Paul Pioneer Press contained the following in the issue of April 24th, as the verdict of those who feasted upon the lamb: "The mutton was fine and tender, and was probably as delicious a piece of meat as was ever served." The St. Paul Globe, also of the same date, contains the following: "Such sweet, toothsome, succulent lamb never before graced a banquet table in this country." It is unfortunate that the opinion should ever have been cherished by any one that high finish in lambs should of necessity be associated with an undue proportion of tallow.

Weights of the Lambs.—As each individual lamb was given an ear label when the experiment began, and as the weights were recorded every week, it was easily possible to trace the well or ill-doing of the individual lambs, and also

to ascertain their relative progress during different periods of the experiment. A few comments bearing on these features will be given later.

Table LVIII. gives the aggregate weights of the lambs in each lot at the commencement of the feeding period, and at the beginning and close of the experiment proper, with the totals in each instance.

TABLE LVIII.—Aggregate Weights of the Lambs.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Totals
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Weights on Dec. 23d, 1895.....	1,926	1,978	1,921	1,985	1,952	9,762
Weights on Dec. 30th.....	1,927	1,991	1,937	1,982	1,984	9,821
Weights on March 16th, 1896.....	2,433	2,617	2,542	2,617	2,587	12,796
Total increase in weight.....	506	626	605	635	603	2,975

Taking into account the lamb that died, the gains in lot 1 would have been 616 pounds, only 10 pounds less than the gains made by the lambs in lot 2, fed on a similar ration in kind. The cost in making the gain with the former was also a little more than with the latter. On the whole the gains were very uniform.

Table LIX. gives the average weight of the lambs in each lot when the preparatory experiment began, when the experiment proper began and closed, and the average total increase made by the lambs in each lot.

TABLE LIX.—Average Weights and Average Gains.

	On Dec. 23, 1895.	On Dec. 30, 1895.	On March 16, 1896.	Average Increase.
	Lbs.	Lbs.	Lbs.	Lbs.
Lot 1.....	96.3	96.4	128.0	31.6
Lot 2.....	98.9	99.6	130.9	31.3
Lot 3.....	96.5	96.9	127.1	30.2
Lot 4.....	99.3	99.1	130.9	31.8
Lot 5.....	97.6	99.2	129.4	30.2
Averages.....	97.7	98.2	129.2	31.0

A number of the lambs exceeded 150 pounds in weight. The heaviest lamb weighed 170 pounds when the experiment closed. Taking the dead lamb into the account will

reduce the average increase in Lot 1 to 30.8 pounds, as only 19 lambs are accounted for in the above table when the said increase is found. The average monthly gains made by the lambs of the respective lots, counting in the lamb that died, were as follows:

	Pounds.
Lot 1.....	12.0
Lot 2.....	12.2
Lot 3.....	11.8
Lot 4.....	12.4
Lot 5.....	11.8
Average.....	12.0

These gains, in proportion to the food fed, are unusually good, and they tend to show, first, the marked capacity of well-grown Minnesota lambs to make growth; and, second, the marked suitability of the foods used for making growth in our winter climate. The writer never succeeded in obtaining gains so good when feeding lambs in Ontario on a diet of clover hay, oats, peas and field roots, and

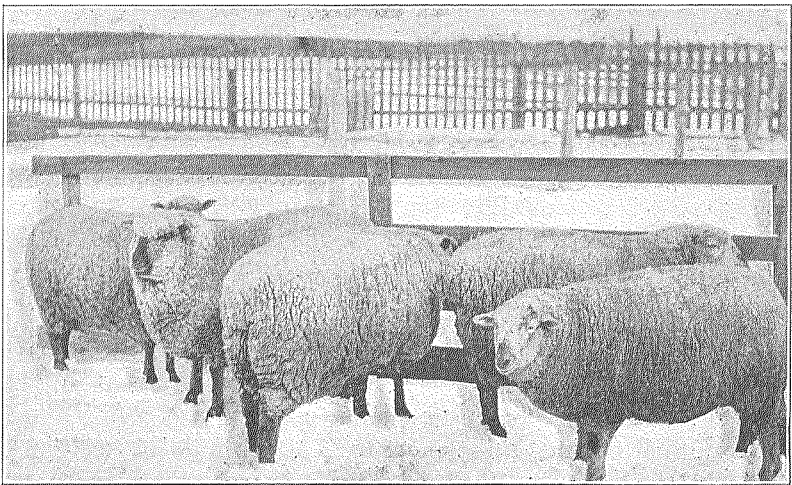


Fig. 199.—Five of the Lambs. Average Weight 155 Pounds.

when it is borne in mind that these foods are all staples on the farms of our state, the possibilities in feeding sheep and lambs in the same would seem to be very great. Some of the individual gains made were extraordinary. One lamb went into the experiment at 96 pounds and came out of it 84 days later at 151 pounds. It thus gained 55 pounds, or .655 pounds per day. The smallest gain made was 8 pounds. It should also be noticed that while during the first six weeks of the experiment the total gains were 1,453 pounds, during the last six weeks they were 1,691 pounds, or 238 pounds more, a very unusual experience in feeding, and doubtless attributable to the good hay fed during the last half of the feeding period.

Increase in Value.—Table LX. gives the value of the food fed during the experiment proper, the value of the increase in weight made by the lambs of the respective lots and the profit on the said increase in weight.

TABLE LX.—Increase in Value During the Experiment Proper.

	Value of Food Fed	Value of Increase in Weight	Profit on Increased Weight
Lot 1.....	\$18.83	\$25.27	\$6.44
Lot 2.....	18.33	26.54	8.21
Lot 3.....	18.03	25.65	7.62
Lot 4.....	18.55	26.92	8.37
Lot 5.....	19.86	25.57	5.71
Totals.....	\$93.60	\$129.95	\$36.35

In the above computation the increase in weight is valued at \$4.24 per 100 pounds, the net price received for the lambs in Chicago. The estimated gain made by the lamb that died, which is put at 20 pounds, is not included in the reckoning. In every instance, therefore, a substantial profit was made on the increased weight during the experiment. The ability to make such gain gives the western feeder a great advantage over the eastern feeder, and this advantage arises, of course, from the greater cheapness of foods in the east. If the lambs could have been sold at the ordinary prices obtainable for such animals in an ordinary

year, the profit made from feeding them would have been a most handsome one.

The average cost of making 100 pounds of increase in weight during the experiment proper, without the gains made by the dead lamb, was \$3.05. The cost of making 100 pounds of increase with the lambs in lot four, which were given more oil-cake than those in lot three, was \$2.92. Cheaper gains have doubtless been made in Minnesota from feeding screenings at from \$3.00 to \$5.00 per ton, but gains so cheap were never made by the writer before when fattening sheep and lambs, and may never be made again, at least in this state. With the increase of live stock production which is sure to come the price of food must rise. The growers of live stock are the truest friends therefore of the farmers who are engaged in growing grain only. The cost of making 100 pounds of increase with the lambs in lot four was \$3.29, or 37 cents per 100 pounds less than with the lambs in lot five; hence the importance of looking well to the relative cost of foods when determining upon them for feeding.

<i>Financial Statement.</i> —Value of 99 lambs	
on March 17, 1896, on the basis of	
shrunk weights and of the net price re-	
ceived for those shipped to Chicago.....	\$515.41
Value of 100 lambs on Dec. 30, when the ex-	
periment proper began, on the basis of	
cost.....	\$399.72
Cost of food.....	93.60
	<hr/>
Total cost.....	493.32
	<hr/>
Total net profit.....	\$22.09
Total net profit on one lamb.....	.22

Observations.—1. In the above statement the value of the lamb that died is not of course included, and the cost of the food fed to it is also charged against the experiment.

2. The food fed is charged at the average market values paid for the same. To charge it at home values, the true basis of valuing such foods fed upon the farm, should still further lessen the price put upon it.

3. Even at the low price for which the lambs were sold, they would have averaged to the grower, shrunk weight, \$5.91 per head.

IMPORTANT FACTS SUMMARIZED.

Values—

1. Average value per 100 pounds on the basis of cost when the experiment began, Dec. 23th, 1895.....	\$4.04
2. Value per 100 pounds when the experiment proper began, Dec. 30th, 1895.....	4.07
3. Value per 100 pounds on the basis of shrunk weights when delivered in Chicago, March 18th, 1896.....	4.65
4. Estimated value per 100 pounds on the basis of actual receipts after deducting the expense incurred in the shipment and sale of the lambs.....	4.24
5. Difference per 100 pounds between the cost price when the feeding began and the selling price in Chicago61
6. Difference per 100 pounds between the cost price when the experiment began and the selling price in Chicago, after deducting the expense of marketing20

Freights—

1. Cost of freight per lamb on each of the 80 lambs brought from Dundee, Minn.....	.18
2. Cost of freight per lamb on each of the 24 lambs brought from Janesville, Minn.....	.15
3. Cost of freight per lamb on each of the 84 lambs shipped to Chicago when marketed.....	.41
4. Cost of freight on a single deck car from the Minnesota transfer to Chicago.....	34.40

Weights—

Lbs.

1. Average weight per lamb of 80 lambs shipped from Dundee to the Station.....	85.
2. Average weight per lamb of 24 lambs shipped from Janesville to the Station.....	99.1
3. Average weight per lamb of the 5 home-bred lambs when put into the experiment.....	86.6
4. Average weight of 100 lambs used in the experiment when the feeding began, Dec. 23th, 1895.....	97.7
5. Average weight when the experiment proper began, Dec. 30th, 1895.....	98.2
6. Average weight at the close of the experiment, without shrink, March 16th, 1896.....	129.2
7. Average weight at the close of the experiment, with a shrink of 5 per cent.....	122.8

Increase in Weight—

1. Average increase in weight made by each lamb during the experiment proper (77 days).....	31.0
2. Average increase per month during the experiment proper.....	12.0

Food Consumed—

1. Average amount of grain consumed per day by each lamb during the experiment proper.....	2.39
2. Average amount of hay consumed per day by each lamb during the experiment proper.....	.82
3. Average amount of food consumed per day by each lamb during the experiment proper.....	3.21

Cost of Increase—

1. Cost of making 100 pounds of increase in weight during the experiment proper.....	\$3.05
2. Cost of making 100 pounds of increase with the lambs in lot 4, which were fed a larger proportion of oil cake.....	2.92

Profits—

1. Average value of each of the 100 lambs put into the preparatory experiment Dec. 23d, 1895.....	\$3.94
2. Average value of each of the 100 lambs put into the experiment proper, Dec. 30th, 1895.....	4.00
3. Average value of each lamb (99) at the close of the experiment, March 16th, 1895, without shrink.....	6.01
4. Average value of each lamb (99) at the close of the experiment with a shrink of 5 per cent.....	5.91
5. Average advance in value over the cost made by each lamb during the entire feeding period.....	3.07
6. Total net profit from feeding 100 lambs for 84 days, the entire period of feeding.....	22.09
Total profit on one lamb without shrink.....	.47
7. Total net profit on one lamb.....	.22

CONCLUSIONS.

The following are among the more important of the conclusions that may be gleaned from this experiment:

1. That all the food combinations used in the feeding proved very suitable for fattening lambs.

2. That of these combinations, barley and oats, with oil meal added in larger quantity, produced the largest increase in weight and at the least cost.

3. That although a combination of oil cake and oats produced fair gains, it was the most costly grain food fed.

4. That the greater consumption of good clover hay as compared with inferior native hay, and the greater gains resulting, emphasizes the importance of feeding good fodder.

5. That the average gains made by the lambs, viz., 12 pounds per month, were extraordinary from the food fed, viz., 3.21 pounds per day.

6. That the low price of western foods makes it possible to produce mutton very cheaply, since in this experi-

ment with the lambs in lot 4, 100 pounds of increase was made at a cost of but \$2.92.

7. That feeding lambs on an unlimited grain ration as in this experiment is not so satisfactory as feeding them on the same in quantity adapted to their daily needs.

8. That very large lambs are not the best adapted to the changed market conditions.

FATTENING RANGE LAMBS.

SECTION NO. 2.

THOS. SHAW.

Sheep and lambs are grown every year upon the vast ranges that lie westward from Minnesota, and in numbers that run up into the millions, and so it is likely to be in all the years that are yet to come. The grazing of cattle upon the western ranges may possibly decrease, but the growing of sheep, from the very nature of things, is likely to increase. In a long succession of train loads, every year, these sheep and lambs pass through our state, while being sent to the feed lot on the market. With the exception of what is being done at the stock yards of South St. Paul and New Brighton, fattening sheep and lambs has received almost no attention at the hands of the Minnesota farmer. This experiment, therefore, was undertaken to ascertain whether a good profit could not be made by the farmers of the state from feeding range lambs.

It would, doubtless, be correct to say that the major portion of the sheep fattened west of Chicago are fattened at stock yards established at various feeding centers along the lines of railway. They are fattened at these in a wholesale way, which is oftentimes, in the very nature of things, attended with a high mortality. The food fed to them must all come from the farm, and the regrettable feature about it is, that the wheat screenings which forms the principal portion of the food is all given away by the farmers, and a large portion of the manure made is utterly wasted. This experiment was undertaken, therefore, in the hope of doing something that would tend to divert this industry to its rightful channel, that is to say, from the stock yards to the farm. It is even now a great industry, but there are good

reasons for believing that it is only in its infancy. It is exceedingly to be desired, therefore, that the Minnesota farmer should participate in the benefits thereof, providing he finds profit in it. And to encourage him in the work all the railroad lines running over the northern half of the state will allow of feeding in transit. This means that the intending feeder may purchase feeding stocks to the westward. He can then pay the freight on them to the point of ultimate delivery, can unload them at his nearest station on the way, can feed them there for a season, and can then re-ship them with no further charge than a nominal sum for shunting the car.

Time Covered by the Experiment.—The lambs were put on food Nov. 10, 1896, and the preparatory feeding then begun continued for six days. The experiment proper began Nov. 16, and ended Feb. 8, 1897. It thus covered a period of 12 weeks or 84 days. They were still kept on full feed until March 24 following, when they were sent to the block. The lambs were fed in all, therefore, for 134 days.

Objects Sought in the Experiment.—Chief among the objects of the experiment were the following: To ascertain, 1. The suitability of range lambs for being fattened under what may be termed farm conditions; 2. The relative adaption of various foods for fattening lambs, such as are easily accessible to the farmer; 3. The probable outcome viewed from the standpoint of profit. The secondary objects sought information bearing upon such points as, 1. The consumption of food; 2. The gains per month; 3. The cost of making 100 pounds of gain; 4. The duration of the fattening period that would show the greatest profit.

The Animals Used.—The lambs used in the experiment numbered 120. They were taken from a lot of 160 shipped down from Crookston on October 28. They formed part of a carload of lambs and wethers that had been purchased by the writer in the range country in Montana late in September. They were bought on Prospect Ranch, of which

Wm. B. Shaw is the manager, and were shipped in a double deck car from Culbertson, 702 miles west from St. Paul. There was one deckload of lambs and one of wethers. The former numbered 187, and the latter numbered 100.

Col. W. M. Liggett, the director, was anxious to ascertain the outcome from pasturing the whole lot for a time at the sub-experiment station farm at Crookston, as native pasture at the time was plentiful there. They were accordingly unloaded at that station. That part of the experiment was not satisfactory. The weather turned cold and stormy that autumn at a period unusually early. The severe frosts killed the native pasture, and in the absence of suitable protection the lambs did not make that progress that had been anticipated. Not a few of them had contracted colds in the meantime, which no doubt hindered to some extent their future well-doing.

The lambs were chosen for the experiment on the ground of uniformity rather than on that of absolute size. They were the offspring of grade Merino dams and Oxford Down sires. Nearly all of them had the dark face and legs of the

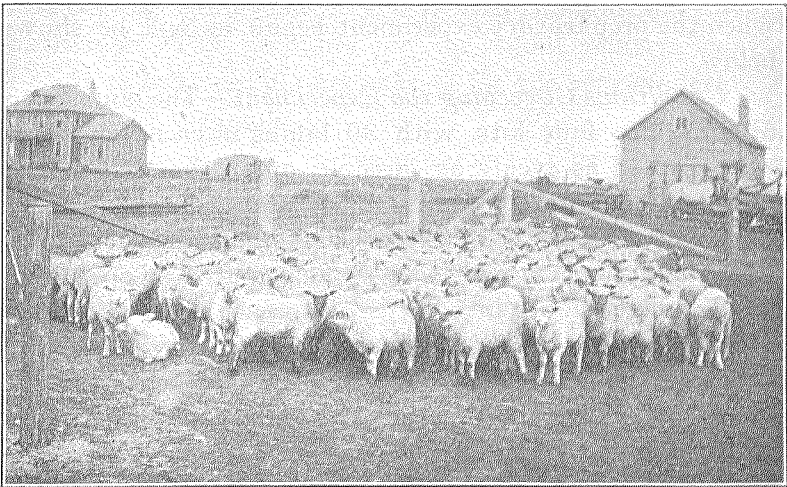


FIG. 200.—The Lambs on Reaching Crookston.

Oxford Down, while some of them still retained the flattish rib and traces of the wrinkly neck which speak of Merino blood. They were late lambs, as Montana lambs must of necessity be. They were dropped in May. They weighed on an average but 43.8 pounds per head when they reached Crookston, but these weights were taken soon after they left the car and when they were greatly shrunken from prolonged fasting. The lambs selected for feeding weighed on an average 57.2 pounds without shrink when put into the experiment.

The whole lot cost on an average \$1.25 per head in Montana. On the basis of the shrunk weights at Crookston, this would make the price \$2.85 per 100 pounds, and on the basis of unshrunk weights, allowing the average weight to be 48 pounds before shipment, it would fix the price at \$2.60 per 100 pounds. As the lambs which were put under experiment were somewhat better than the average, it will be equitable to charge them at \$2.85 per 100 pounds; that is to say, a virtual advance of 25 cents per 100 pounds over the price paid in Montana. This would make the average cost of each lamb \$1.93, or \$3.37 per hundred when the preparatory experiment began, as will be shown below.

Conditions Governing the Experiment.—The lambs were divided into four lots, with 30 lambs in each lot. They were divided as evenly as possible, on the basis of general form and aggregate weights. They were fed in the apartments of a shed, 18x20 feet being allowed to each lot. These apartments were side by side, and each opened by double-hinged doors into yards of similar size. The yards are on the north side of the building, which of course was not favorable to the experiment. They were kept nicely littered, and the lambs had access to them at will day and night, except in stormy weather. Water kept in buckets was virtually accessible at all times during the day, and common salt was kept in small boxes in each apartment of the shed.

The lambs were weighed singly at the beginning of the experiment, and every week thereafter, and a most careful record was kept of the weights.

Food and Feeding.—The grain portion given to the lambs was as follows: Those in lot 1 were fed oil cake, wheat bran, corn and oats in the proportions of 1, 2, 3 and 4 parts respectively by weight. The lambs in lot 2 were fed oil cake, bran, barley and oats in similar proportions. In lot 3 they were fed bran, oil cake, barley and oats in the proportions of 1, 2, 3 and 4 parts. With the lambs in lot 3, therefore, the quantities of bran and oil cake fed respectively were reversed as compared with those of lot 2. And in lot 4 they were fed oil cake and oats in the proportions of 1 and 9 parts. The fodder consisted of native hay only. The experiment therefore was virtually a test between corn, barley and oats as food factors in fattening lambs.

The quality of the food was excellent, except the hay, which was very poor. It had been cut from native prairie meadow, unharvested the previous year, and much of it therefore was simply dead grass, alike unpalatable and unnutritious. This accounts for the small relative consumption of hay, and in part at least for the very moderate gains made by the lambs.

The oil cake was fed in the pea form. The grain was not ground nor was the hay cut. The lambs were given of both grain and hay what they would eat clean with a relish. If any indication of loathing of food was noticed, the quantity of food was reduced. They were gradually led up to a full ration. The time thus occupied was about 21 days.

Estimated Value of the Food.—The food was charged at what were considered average market values in the state as nearly as these could be ascertained. The prices affixed to the various factors of the ration on the above basis were as follows.

Oil Cake, per ton.....	\$14.00
Bran, per ton.....	6.50
Corn, per bushel of 56 pounds.....	.18
Barley, per bushel of 48 pounds.....	.16
Oats, per bushel of 32 pounds.....	.14
Hay, per ton.....	3.00

The prices actually paid for the oil cake, corn, barley and oats were virtually about the same as those given in the estimate, and the bran, which is charged at \$6.50 per ton, only cost \$4.50 at the Minneapolis mills. These figures represent unusually low prices, lower probably than will ever be seen again in the Northwest. The revival in meat production which was manifest while this experiment was being conducted means also an increase in the prices of grain.

Food Consumed During the Experiment Proper.—Table LXI. gives the quantity of food consumed by the lambs in each lot during the experiment proper.

TABLE LXI.—Food Consumed.

	Lot 1	Lot 2	Lot 3	Lot 4	Totals
	lbs.	lbs.	lbs.	lbs.	lbs.
Grain.....	5,127	4,974	5,127	4,771	19,999
Hay.....	1,208	1,200	1,196	902	4,506
Totals.....	6,935	6,174	6,323	5,673	24,505

The lambs in lot 4 were considerably the lowest in consumption of food and next to them in this respect were the lambs in lot 2. They were also the lowest in increase in weight as will be shown below, although the lambs in lot 4 were slightly ahead of those in lot 2 in gains made. In this we have another evidence of the relation between a free consumption of food and good gains, and vice versa. The consumption of fodder was scarcely 23 per cent of the consumption of grain, a proportion that would seem to be too small to produce the best returns, but it was occasioned by the poor quality of the hay.

Table LXII. gives the averages of food consumed per day by the lambs of each lot, and by those in all the lots during the experiment proper.

TABLE LXII.—Food Consumed by Each Lamb.

	Lot 1	Lot 2	Lot 3	Lot 4	All the lots
Grain.....	lbs. 2.03	lbs. 1.97	lbs. 2.03	lbs. 1.89	lbs. 1.98
Hay.....	.48	.48	.47	.36	.45
Totals.....	2.51	2.45	2.50	2.25	2.43

The total consumption of food was relatively low, even for light lambs, but it was occasioned as heretofore stated by the poor quality of the hay. Those who feed a poor quality of fodder purposely, as is sometimes done, to force a greater consumption of grain, are in error. Grain and fodder must be fed in equilibrium to obtain the very best results. To ascertain this equilibrium presents a wide field for investigation. It will be observed that the lambs in lot 3 consumed quite a little more food than those in lot 2. This probably arose from the favorable influence which the larger quantity of oil-cake fed to them exercised on digestion, as this was the only difference in the ration fed to the lambs of these respective lots.

Value of Food Consumed.—Table LXIII. gives the respective values of the food consumed during the preparatory experiment and the experiment proper, and the total cost of the same.

TABLE LXIII.—Value of Food Consumed.

	Preparatory Experiment	Experiment Proper	Totals
Lot 1.....	\$1.29	\$22.64	\$23.93
Lot 2.....	1.30	22.18	23.48
Lot 3.....	1.39	24.74	26.13
Lot 4.....	1.44	23.90	25.34
Totals.....	\$5.42	\$93.46	\$98.88

The lambs in lot 3 cost the most for food and yet they made the largest profit as will be shown below. Those in lot 4, which came second in point of cost, are lowest in point of profit. They are so placed by the relative higher price of the oats fed rather than by the lesser gains made.

Profits Made During the Experiment Proper.—Table LXIV. gives the value of the lambs in each lot: 1. At the commencement of the experiment proper; 2. The cost of food fed during the same; 3. The total cost of the lambs up to the close of the experiment proper; 4. The value of the lambs at that time; 5. The profit made on the lambs in each lot during the experiment.

TABLE LXIV.—Profits Made During the Experiment Proper.

	Lot 1	Lot 2	Lot 3	Lot 4	Totals
Value Nov. 16th, 1896.....	\$59.96	\$58.82	\$58.79	\$59.10	\$236.67
Cost of Feed.....	22.64	22.18	24.74	23.90	93.46
Total Cost.....	\$82.60	\$81.00	\$83.53	\$83.00	\$330.13
Value on Feb. 8th, 1897.....	112.76	110.37	116.51	111.35	450.99
Profit.....	\$30.16	\$29.37	\$32.98	\$28.35	\$120.86

The profit thus made on each lamb from feeding it for 77 days, was \$1.01. This profit is based upon the actual cost of the lambs when the experiment proper began, the cost of the food fed deducted from the sum produced reckoning the lambs at the same rate as they were actually sold for on March 24th, but it does not include any shrink. The statement with shrunk weight included is made later. They were bought by E. M. Prouty & Co., South St. Paul, for W. E. McCormick, also of St. Paul, to be sold by the latter in the dressed form to retailers. The price paid was \$4.87½ per 100 pounds, live weight. The average cost of each lamb was \$1.93 when the preparatory experiment began and the value per 100 pounds was \$3.37. These figures were obtained as now described: The lambs in Montana cost on an average \$1.25 each. This on the basis of greatly shrunken weight, taken at Crookston, viz., 43.6 pounds per

lamb, made the price per hundred in Montana \$2.85 on the basis of unshrunk weight. Averaging the lambs at 48 pounds each, it would make the price per hundred in Montana \$2.60. But, as previously stated, the lambs on going into the experiment were charged at \$2.85 per hundred, as they were considered a little better than the average of the whole lot. The value of each lamb, therefore, put under experiment, was \$1.63 in Montana, as they weighed 57.2 pounds on an average. The average of freight on each lamb on the basis of weights was 19.1 cents; and the average freight for each lamb going into the experiment on the same basis was 23 cents; and 7 cents per lamb was allowed for pasture. Adding \$1.63, therefore, the cost per lamb in Montana, 23 cents, the cost of freight, and 7 cents, the cost of pasture, gives \$1.93 as the cost per lamb on Nov. 10th, and \$3.37 as the cost per hundred. When the experiment proper began, however, the cost had been increased to \$1.97 per lamb and to \$3.44 per hundred. These are higher prices, relatively, than were paid for the average of such lambs in the stockyards at the time.

Weights of the Lambs.—Table LXV. gives the aggregate weights of the lambs in each lot when the preparatory feeding began, and when the experiment proper began and closed, with the total weights and the aggregate increase in weight during the experiment proper.

TABLE LXV.—Weights of the Lambs.

	Lot 1	Lot 2	Lot 3	Lot 4	Totals
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Weight on Nov. 10th, 1896	1,705	1,725	1,685	1,745	6,860
Weight on Nov. 16th, 1896	1,743	1,710	1,709	1,718	6,880
Weight on Feb. 28th, 1897	2,313	2,264	2,390	2,284	9,251
Total increase in weight	570	554	681	566	2,371

It will be noticed that during the preparatory period the 120 lambs made a total increase of only 20 pounds. The bad condition in which they reached the station seemed to tell against them during the entire experiment.

Table LXVI. gives the average weight of the lambs in each group when the feeding period began, and when the experiment proper began and closed, with the average of increase made by one lamb in each group, and also the aggregate of increase made by the lambs in the respective lots.

TABLE LXVI.—Average Weights.

	On Nov. 10th, 1896.	On Nov. 16th, 1896.	On Feb. 8th, 1897.	Average Increase.	Aggregate Increase.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Lot 1.....	56.8	58.1	77.1	19.0	570
Lot 2.....	57.5	57.0	75.5	18.5	554
Lot 3.....	56.2	57.0	79.7	22.7	681
Lot 4.....	58.2	57.2	76.1	18.9	566
Averages..	57.2	57.3	79.1	19.8	593

It will be noticed that the lambs in lot 3 made an aggregate increase of 84 pounds more than the lambs in lot 1, which came second in the gains made. They also made an aggregate gain of 127 pounds more than the lambs in lot 2, which were fed similarly except that those in lot 3 were given a double portion of oil cake.

The average increase per month during the experiment proper of the lambs of the respective lots was as follows:

Lot 1.....	Lbs. 6.78
Lot 2.....	6.60
Lot 3.....	8.11
Lot 4.....	6.74
Average.....	7.06

These gains are not high in any instance; in fact, they are relatively low, except with the lambs in lot 3. The reasons are doubtless found in the somewhat shaky condition of the lambs when put under experiment, and in the inferior character of the hay fed.

Profit on the Increase Made During the Experiment Proper.—Table LXVII. gives the value of the increase made by the lambs of each lot during the experiment proper, the cost of making the same, and the profit on the said increase.

TABLE LXVII.—Profit on Increase.

	Value of Increase.	Cost of Increase.	Profit on Increase.
Lot 1.....	\$27.79	\$22.64	\$5.15
Lot 2.....	27.01	22.18	4.83
Lot 3.....	33.20	24.74	8.46
Lot 4.....	27.59	23.90	3.69
Totals.....	\$115.59	\$93.46	\$22.13

It will be noticed that in every instance a profit was made on the increase in weight during the experiment proper. When this can be done, substantial profits are assured under ordinary conditions. This profit arose not so much from the good gains made as from the low cost of the food. Much the largest profit was made on the lambs in lot 3, which were given the double portion of oil cake. The least profit was made on the lambs in lot 4, not because of low gains made, but rather on account of the higher relative prices of the grain portion fed to them. The average cost of making 100 pounds of increase during the experiment proper was \$3.94, while the price obtained for the lambs on March 24th was \$4.87½. The lambs were quite ready for the market when the experiment proper closed, and the selling price therefore should be put as high as when the lambs were sold.

Financial Statement.—Value of the lambs
on Feb. 28th, 1897, at \$4.87½ per 100
pounds, and with a shrink of 4 per cent, \$432.95
Value of the lambs when the experiment be-
gan, Nov. 16th, on the basis of cost.....\$236.57
Cost of food fed..... 93.46

Total Cost..... 330.13

Total profit..... \$102.82
Net profit on each lamb..... 1.06

Observations.—The value of the manure is supposed to offset the items of bedding, labor and interest on the invest-

ment. Whether this estimate is too favorable to the experiment, as applied to average farm conditions, must be determined by each farmer for himself.

2. If the food had been charged at home values the profit would be increased, as the home value of food is always less than the market value.

Disposal of the Lambs.—It would be impossible to give a statement bearing upon the disposal of the lambs that would be complete in every detail. On Feb. 28, when the experiment proper closed, the lambs were in a good condition of finish and then it was that they should have been sold. But the sale was delayed to find a home market for them rather than ship them. This resulted in a delay which kept them in the feeding pens until March 24. In the meantime a limited number of them were slaughtered for use in the supply department of the school of agriculture. Five lambs died in the interval between Feb. 28 and March 24. They seemed to be affected similarly, that is to say, the urinary organs were affected. In nearly all instances the bladder was more or less inflamed, and the kidneys were sympathetically affected. The trouble was supposed to originate in the somewhat shaky condition of the lambs induced by autumn exposure, prior to the feeding period, which so weakened the constitution as to unfit them for prolonged heavy feeding. These losses would of course detract from the profits during the entire period of feeding, and their occurrence emphasizes the great importance of promptly disposing of animals when ready for the block. Another lamb was also lost in the autumn, making six in all. It was affected with tapeworm. The entire loss, therefore, was 2.4 per cent as 245 lambs and wethers in all were brought to the station from Crookston, and in nearly all instances the animals lost were relatively low in value. With the exceptions named, the lambs were sold as previously stated.

IMPORTANT FACTS SUMMARIZED.

Values.—

1. Price paid per 100 pounds for the 187 lambs bought in Montana on the basis of unshrunk weights.....	\$2.60
2. Price charged per 100 pounds in Montana against the 120 lambs put into the experiment.....	2.85
3. Price per 100 pounds on the basis of cost for 120 lambs put under experiment Nov. 16, 1896.....	3.44
4. Value per 100 pounds on Feb. 28, 1897, when experiment proper closed, based on the price for which the lambs were sold March 24.....	4.87½
5. Difference per 100 pounds between cost price and selling price.....	1.43½

Freights.—

1. Cost of freight per lamb on 187 lambs brought from Montana, on the basis of weights.....	.19
2. Cost of freight per lamb on 120 lambs put into the experiment, on the basis of weights.....	.23
3. Cost of freight per wether on 100 wethers of same shipment, also computed on the basis of weights.....	.43½
4. Cost of freight on one car carrying 187 lambs and 100 wethers from Culbertson to St. Paul, 702 miles, with \$1.40 added as cost of food.....	79.40

Weights.—

1. Average weight per lamb of the entire shipment on reaching Crookston.....	Lbs. 43.8
2. Average weight of the same in Montana. Estimated.....	48.0
3. Average weight per lamb of the 120 lambs put into the experiment Nov, 10, 1896.....	57.2
4. Average weight per lamb when the experiment proper began, Nov. 16.....	57.3
5. Average weight per lamb when the experiment proper closed, Feb. 28, 1897.....	91.1

Increase in Weight.

1. Average increase in weight made by each lamb during the 77 days of the experiment proper.....	Lbs. 18.9
2. Average increase per month during the experiment proper.....	7.06
3. Average increase per month of lot three, fed a double portion of oil-cake.....	8.11

Food Consumed.—

1. Average amount of grain consumed per day, per lamb, during the experiment proper.....	1.98
2. Average amount of hay consumed per day, per lamb.....	.45
3. Average amount of hay and grain consumed per day, per lamb.....	2.43

Cost of Increase.—

1. Average cost of making 100 pounds of increase during the experiment proper.....	3.94
2. Cost of making 100 pounds of increase with the lambs in lot 3.....	3.63

Profits.—

1. Average value of each lamb put into the experiment when bought in Montana.....	1.63
2. Average value of each lamb at the beginning of the preparatory experiment, Nov. 10, 1896.....	1.93
3. Average value of each lamb at the beginning of the experiment proper.....	1.97
4. Average value of each lamb at the close of the experiment proper, shrunk weight.....	3.61
5. Average increase in value from 77 days' feeding..	1.64
6. Average profit per lamb during the experiment proper, shrunk weights not considered.....	1.01
7. Average profit per lamb on the basis of shrunk weights.....	.86

CONCLUSIONS.

The following are chief among the conclusions to be drawn from the experiment:

1. That the various grain food factors used in the experiment are well adapted for feeding lambs, though not equally so.
2. That of all the grain factors used, a mixture of bran, oil-cake, barley and oats, fed in the proportions of 1, 2, 3 and 4 parts respectively, make a particularly excellent ration for lambs.
3. That oats and oil-cake, when fed as in this experiment, produce good gains relatively, but when so fed a due regard must be had to their cost.
4. That when lambs are ready for the market it is well to market them promptly.
5. That range lambs are well adapted to the purposes of the Minnesota feeder.
6. That under the conditions of the experiment, lambs bought upon the ranges can be more than doubled in value when fed for a reasonable period.

FATTENING RANGE LAMBS.

SECTION NO. 3.

THOS. SHAW.

This experiment was conducted on lines very similar to those which characterized the experiment of the previous winter. The chief points of difference relate to some changes in the foods fed, which will be duly noted below. The great rise in values which characterized all grades of sheep during the year 1897 more than justified the attention given to this branch of the live stock industry at the station.

Time Covered by the Experiment.—The preparatory experiment began Nov. 1st, 1897. The experiment proper began 7 days later, that is to say, on Nov. 8th, and ended on Feb. 28th, 1898, thus covering a period of 16 weeks, or 112 days. But the lambs were continued on full feed until March 12th, the date of delivery for slaughter. The whole feeding period, therefore, covered a period of 131½ days.

Objects Sought in the Experiment.—Among the primary objects of the experiment were the following: 1. To ascertain the suitability of range lambs for being fed under what may be termed ordinary farm conditions. 2. To ascertain the relative adaptation in feeding lambs on certain combinations of grain foods such as are easily accessible to the farmer; and, 3, to ascertain the profit, if any, from feeding range lambs under what may be termed ordinary Minnesota conditions.

The secondary objects sought to learn: 1. The relative resulting increase in weight from feeding the foods used in the experiment; 2. The relative cost of one pound of increase in weight received; and, 3, the probable duration of the period during which lambs may be fed profitably on

such foods. In brief, the experiment sought to confirm the results obtained the preceding winter from feeding range lambs.

The Animals Used.—One hundred and twenty lambs were fed. They were purchased by the Hon. W. M. Liggett, the Director of the station, and the writer, from Wm. B. Shaw, manager of Prospect Ranch, Culbertson, Montana. In all 300 lambs and 25 wethers were bought. They were all brought over the Great Northern Railroad in a double-deck car to the Minnesota Transfer, and at the ordinary rates for freight. They reached the station on October 20th, and were kept on blue grass pasture, plentiful but dry in character, until the preparatory experiment began, 10 days later. They were grade lambs, and were evidently possessed of various blood elements. Prominent among these were the indications of Merino and Oxford Down blood. The former of these was evidently the dominant foundation element, though but few traces of wrinkles were

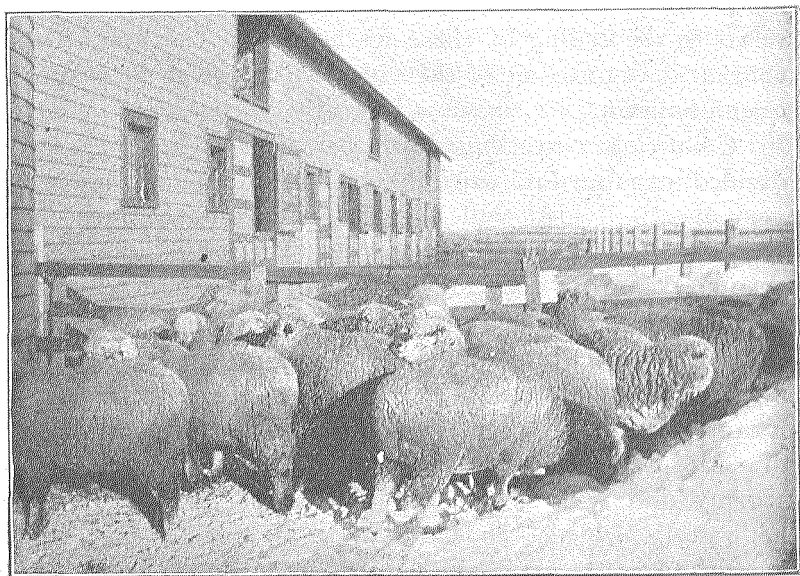


Fig. 201.—The Lambs in Lot 1 when nearly finished.

visible in the lambs. The sires were unregistered Oxford Down rams, but evidently pure in breeding. The dark face and legs had been engrafted on nearly all of the lambs.

In choosing the lambs for the experiment, uniformity in size and shape was sought rather than size alone. While the average weight of the whole lot when they reached the farm was 55½ pounds, those put into the experiment averaged 60.4 pounds at its commencement, 10 days later. As from want of shed room all the lambs could not be accommodated at the farm, 100 of them were sold to Joseph Carroll, of Rosemount, in our state. The price paid was \$2.10 per head, and the average weight was about 59 pounds. Mr. Carroll fed these lambs at his farm, and made a nice profit on them. The balance of the lambs purchased were fed, nearly all of them, under experiment. The particulars of this experiment will be given in a subsequent bulletin.

The wethers, or at least 20 of them, were fed under conditions similar to those which were observed in feeding the lambs in lot 1, as described below. The particulars which relate to the feeding of these wethers, and the actual and comparative outcome of the same, will be given in a subsequent bulletin.

Conditions Governing the Experiment.—The lambs were divided into four lots, with 30 in each lot. That they were very evenly divided will be apparent from the respective weights of each lot given below. The lambs in each lot occupied separate apartments in the shed. These were side by side, and on the north side of the building, which was probably somewhat against the experiment. Each compartment was in size, 18x20 feet, and each opened by means of a double-hinged door into an open yard of similar dimensions. They had access at will to the yards, except in stormy and windy weather. The sheds and yards were kept nicely bedded. The lambs were all wethers, hence the conditions of the experiment were very even.

Each lamb was weighed singly at the commencement of

the preparatory experiment, at the beginning of the experiment proper, and every 14 days subsequently until sent to the block. They had access to water virtually at will, which was given to them in pails. Common salt was also kept accessible to them at all times.

Food and Feeding.—The grain portion fed to the lambs in the respective lots was as follows: In lot 1 they were given oil cake, wheat bran and oats, in the proportions of 1, 2, 3 and 4 parts respectively, by weight. In lot 2, oil cake, bran, barley and oats, in similar proportions. In lot 3 they were given bran, oats and barley in the proportions of 3, 3 and 4 parts; and in lot 4, oil cake, bran and oats, in the proportions of 1, 2 and 7 parts. The fodder given was mixed hay, clover predominating in the mixture, and sorghum ensilage. The ensilage was made from sorghum grown thickly and cut when approaching the mature stage. The sorghum was not fed until December 28th, and it was continued until the lambs were sold.

As the fodder fed to each lot was the same in kind, the experiment sought to ascertain the respective values of corn with oil cake, barley with and without oil cake, and oats with the same, for fattening lambs. The grain was fed unground, and the oil cake was given in the "pea" form. The lambs were led up gradually to a full ration, and were virtually given all of each kind of food that they would eat with a relish. The hay was fed uncut. The grain and hay were fed in two feeds, morning and evening, and the ensilage was given in the evening only.

Estimated Value of the Food.—The food was charged at the average market values in the state, when delivered at the place of sale. Though these values were based on careful estimates, they are to be regarded only as close approximations. They fixed the prices of the respective kinds of food used as follows:

Oil Cake, per ton.....	\$22.00
Wheat Bran, per ton.....	7.50
Corn, per bushel of 56 pounds.....	.22
Barley, per bushel of 48 pounds.....	.20
Oats, per bushel of 32 pounds.....	.17
Mixed Hay, Clover and Timothy, per ton.....	4.00
Sorghum Ensilage, per ton.....	1.20

With some of the food products these values were less than the prices actually paid at the station. Corn, for instance, which was charged at 22 cents per bushel, actually cost the station 25½ cents. In other instances the price charged was in excess of the price paid. Bran, which was charged at \$7.50 per ton, actually cost the station but \$4.50 per ton. It had been bought some time previously, but the necessity for using average prices for the state will be apparent.

Food Consumed.—Table LXVIII. gives the respective amounts of grain, hay and sorghum ensilage consumed by the lambs during the 112 days of the experiment proper.

TABLE LXVIII.—Food Consumed During the Experiment.

	Lot 1	Lot 2	Lot 3	Lot 4
	Lbs.	Lbs.	Lbs.	Lbs.
Grain.....	6,330	6,256	6,005	6,252
Hay.....	2,771	2,773	2,735	2,655
Ensilage.....	1,024	1,026	1,034	6,252
Totals.....	10,125	10,055	9,774	9,933

The lambs in lot 3 consumed considerably less grain than those in the other lots, and it will be noticed that the gains were correspondingly low. When barley is an important factor in the grain fed, it would seem to be decidedly advantageous to feed more or less oil cake along with it. This conclusion is based upon the behavior of the lambs in lots 2 and 3, the latter of whom did not receive any oil cake until near the close of the experiment. A small amount of oil cake added to the mixture would seem to have a stimulating effect on the appetite.

Throughout the experiment proper each lamb consumed daily on an average the following amounts of the respective kinds of food:

	Pounds.
Grain.....	1.85
Hay.....	.81
Ensilage.....	.45
	<hr/>
Total.....	3.11

Incidents of the Experiment.—On the night of January 25th, or 78 days after the commencement of this experiment, one of the best lambs in lot 2 got “cast,” that is to say, it rolled on its back, and being unable to recover its natural position, it died. This circumstance to some extent proves a disturbing factor in nearly all the computations which relate to the experiment. Apart from this, the experiment was remarkably free from unusual accidents of any kind. The health of the lambs was good throughout, and the gains were also fairly uniform. One hundred and five days after the beginning of the experiment proper, about 10 per cent. of oil cake was added to the grain portion given to the lambs in lot 3, and 7 days later this proportion was further increased. But during the succeeding interval of 26 days which elapsed before the lambs were sent to the block, the only perceptible influence of the oil cake was an improvement in the appetite. Near the middle of the experiment, the oil cake given to the lambs in lot 4 was increased from one to two tenths of the grain fed, and the bran was correspondingly decreased. This change was designed from the first, but the only perceptible result that followed was some little improvement in the appetite of the lambs.

Value of Food Consumed.—Table LXIX. gives the respective values of the food consumed during the preparatory experiment, the experiment proper, and the period intervening between the close of the experiment and the sale of the lambs, and also the total cost of the food consumed.

TABLE LXIX.—Values of Food Consumed.

	Preparatory Experiment:	Experiment Proper.	Subsequently to the Experi- ment Proper.	Total Cost.
Lot 1.....	\$1.66	\$38.77	\$3.69	\$44.12
Lot 2.....	1.68	38.85	3.63	44.16
Lot 3.....	1.48	32.93	3.32	37.73
Lot 4.....	1.68	43.13	4.22	49.03
Totals.....	\$6.50	\$153.68	\$14.86.	\$175.04

It will be noticed that during the experiment proper and subsequently, the cost of the food consumed by the lambs in lot 4 was considerably in excess of the cost of food for the lambs in any of the other lots. This was owing to the dearer prices, relatively, of the oats which made up so large a portion of the grain fed, and also to the dear price of the oil cake which was fed most freely to the lambs in this lot. The gains secured were somewhat ahead of those made by the lambs in any of the other lots, as is shown below. But the greater relative cost of the food fed far more than counterbalanced the greater increase made in weight, hence, considerably less profit was made on the lambs in this lot.

The cost of food was considerably less for the lambs in lot 3 than for any of the other lots, and yet, as shown below, the least profit was made from them. This arose from the smaller amount, relatively, of the grain food consumed, and from its failure to produce sufficient gains. This fact would seem to emphasize the close relation between a free consumption of food during the fattening period and good gains. The only reasonable explanation that can be given for the low consumption of food by these lambs as compared with the lambs in lot 2 is the absence of oil cake in their ration. In other respects the foods fed were similar, except that more bran was fed to the lambs in lot 3. More bran in the ration, therefore, would not seem to atone for the entire absence of oil cake.

Profits Made During the Experiment Proper.—Table LXX gives: 1. The value of the lambs in each lot at the commencement of the experiment proper; 2. The cost of food fed during the same; 3. The total cost of the lambs up to the close of the experiment proper; 4. The value of the lambs at the close of the experiment; and 5, the profit made on the lambs in each lot during the experiment.

TABLE LXX.—Profit Made During the Experiment Proper.

	Lot 1	Lot 2	Lot 3	Lot 4	Totals
Value on Nov. 8th, 1897....	\$64.64	\$63.79	\$64.90	\$63.67	\$257.00
Cost of food.....	38.77	38.85	32.93	43.13	153.68
Total cost.....	\$103.41	\$102.64	\$97.83	\$106.80	\$410.68
Value on Feb. 28th, 1898....	159 61	153.45	149 38	158 66	621.00
Profit.....	\$56.20	\$50.81	\$51.55	\$51.76	\$210.32

In the above table the value put upon the lambs at the beginning of the experiment was their actual cost. And this would be very nearly the proper market value for such lambs at the time that these were bought. It was rather under, perhaps, than over average market values. At the close of the experiment they were valued at 5½ cents per pound, live weight, the price paid for them 12 days later. No allowance is made for shrinkage. Had such allowance been made, it would reduce the total profit during the experiment proper from \$210.32 to \$179.25. The less profit made on the lambs in lot 2 was owing to the loss of one lamb in that group, as previously stated. Taking that lamb at its full weight, 98 pounds, when it died, on Jan. 25th, and adding 7 pounds as the probable gain that it would have made before the close of the experiment, and then adding its value if alive to \$50.80 the actual profit on the lambs in lot 2, the result, \$56.58, would represent the highest profit made by the lambs of any one lot. This would indicate that barley, when not too dear, can be turned to excellent account in feeding lambs for the block.

Weights of the Lambs.—At the commencement of the experiment, each lamb was given an ear label, and was then weighed singly. As these labels were duly recorded, and also the individual weights at each successive period of weighing, it was easily possible to compare the gains made. While there was much difference in the increase in weight of individuals, there were only one or two instances of decided ill-doing. The highest individual increase in weight made was 48 pounds, and the lowest was 17 pounds.

Table LXXI. gives the aggregate weights of the lambs in each lot at the commencement of the preparatory experiment, at the beginning of the experiment proper, and at the date of shipment, with the totals in each instance.

TABLE LXXI.—Aggregate Weights of the Lambs.

	Lot 1	Lot 2	Lot 3	Lot 4	Totals
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Weights on Nov. 1st, 1897..	1,824	1,795	1,837	1,795	7,251
Weights on Nov. 8th.....	1,848	1,835	1,843	1,813	7,339
Weights on Feb. 28th, 1898	2,902	2,790	2,716	2,888	11,291
Weights on March 12th.....	2,985	2,855	2,750	2,970	11,560

The increase in weight made by the lambs during the 131½ days in which they were being fed, was nearly 60 per cent. of the weight when the feeding period began. The weights of the lambs in lots 1, 2 and 4 would have been nearly even at the close of the experiment proper, but for the loss of the one lamb. Including its weight and probable gain, the aggregate weight of the lambs in lot 2 would have been 2,895 pounds.

Table LXXII. gives the average weight of the lambs in each lot when the preparatory experiment began, when the experiment proper began and closed, the average total increase in weight made by the lambs in each lot, and the aggregate total increase.

TABLE LXXII.—Average Weights and Average Gains.

	On Nov. 1st, 1897.	On Nov. 8th.	On Feb. 28th, 1898	Average Increase.	Aggregate Increase.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Lot 1.....	60.8	61.6	96.7	35.1	1,054
Lot 2.....	59.8	61.2	93.0	31.8	955
Lot 3.....	61.2	61.4	90.5	29.1	873
Lot 4.....	59.8	60.4	96.1	35.7	1,070

The greatest aggregate gains were made by the lambs in lot 4. Next comes lot 2 with the dead lamb accounted for. He weighed 98 pounds when he died, and would doubtless have gained 7 pounds more prior to the close of the experiment. Adding the 105 pounds thus obtained to 955 pounds, the aggregate gains made by the lambs in lot 2 would bring it up to 1,060 pounds. The third place is assigned to the lambs in lot 1. The gains thus made are remarkably uniform, except with the lambs in lot 3.

The average increase in weight made by the lambs in each lot in 30 days, that is to say, per month, is as follows:

	Pounds.
Lot 1.....	9.4
Lot 2.....	8.5
Lot 3.....	7.8
Lot 4.....	9.6

If the dead lamb is taken into the account the gains per month made by the lambs in lot 2 would be changed from 8.5 to 9.5 pounds. On this basis the average increase per month made by each lamb under experiment would be 9.07 pounds, and for the entire period of feeding, 8.3 pounds. These are not extraordinary gains, but in the absence of field roots in the ration, they are good average gains for so long a period of feeding.

It may also be noted here, that while, during the first half of the experiment, the lambs made an aggregate in-

crease in weight of 2,433 pounds, during the last half of the same, the increase made was but 1,724 pounds. The increase in the former period, therefore, exceeded the increase in the latter by 709 pounds. This fact would emphasize the importance of not feeding lambs for too long a period.

Increase in Value.—Table LXXIII. gives the cost of the food fed to the lambs of each lot during the experiment proper, the value of the increase in weight, and the profit on said increase.

TABLE LXXIII.—Increase in Value During Experiment Proper.

	Value of Food Fed.	Value of Increase in Weight.	Profit on Increased Weight.
Lot 1.....	\$38.77	\$57.97	\$19.20
Lot 2.....	38.85	58.30	19.45
Lot 3.....	32.93	48.01	16.08
Lot 4.....	43.13	58.85	15.72

The dead lamb is included in this computation. The figures in the third column should certainly tend to encourage western feeders. It would be well-nigh if not quite impossible for eastern feeders to get results so satisfactory, owing to the higher relative value of the food stuffs with them.

Accounting for the dead lamb as above, the cost of making 100 pounds of increase with the lambs of each group during the experiment proper was as follows:

Lot 1.....	\$3.68
Lot 2.....	3.67
Lot 3.....	3.77
Lot 4.....	4.03
Average Cost.....	\$3.78

The greater relative cost of the increase made by the lambs in lot 4 emphasizes the importance of using cheap foods, since the lambs in lot 4 made the largest increase in weight.

Financial Statement.—A summary of the facts relating to the financial side of the whole transaction is now submitted:

Cash return for 119 lambs delivered to Peter Van Hoven, at New Brighton, Minnesota, on March 12th, 1898.....	\$604.01
Cost of 120 lambs in Montana.....	\$217.53
Cost of freight.....	30.57
Cost of pasture.....	2.40
Cost of food in the preparatory experiment	6.50
Cost of food during the experiment proper..	153.68
Cost of food subsequently.....	14.86
	<hr/>
Total outlay.....	\$425.54
	<hr/>
Profit on 120 lambs.....	178.47
Profit on each lamb.....	1.49

Observations.—1. It will be noticed that in the above computation, the lamb that died is charged against the experiment, and also the food eaten by him, nor is the 50 cents included that was received for his pelt.

2. The manure made is supposed to offset the value of the bedding, the cost of the labor, and the interest on the investment. Whether such a value put upon the manure is too dear must be determined by each farmer for himself.

3. It should also be borne in mind that the food fed was charged at market values. The market value of food is usually in excess of the home value of the same, that is to say, in excess of the cost of production. Charging it thus, therefore, is unfavorable to the experiment.

IMPORTANT FACTS SUMMARIZED.

Values—

1. Price paid per hundred for the lambs in Montana.....	\$3.00
2. Value per hundred on the basis of cost, when the preparatory experiment began, Nov. 1st, 1897.....	3.45
3. Value per hundred when the experiment proper began, Nov. 8th.....	3.41
4. Value per hundred when the lambs were delivered at New Brighton, March 12th, 1898.....	5.50
5. Difference per hundred between cost price and selling price.....	2.05

Freights—

1. Cost of freight on each of the 299 lambs which were brought to the station.....	.23.3
2. Cost of freight on each lamb in the experiment, computed on the basis of weights.....	.25.5
3. Cost of freight on each wether of the shipment, computed on the basis of weights.....	.50.0
4. Cost of freight on the double-deck car from Culbertson to St. Paul, 702 miles, with a cargo of 25 wethers and 299 lambs.....	82.10

Weights—

1. Average weight of 299 lambs, bought in Montana, on reaching the station.....	Lbs. 55.5
2. Average weight of 120 lambs used in the experiment on reaching the station and when the experiment began, Nov. 1st, 1897.....	60.4
3. Average weight at the close of the experiment proper, without shrink, Feb. 28, 1898.....	97.1
4. Average weight when sent to the block, March 12th, with a shrink of 5 per cent.....	92.3

Increase in Weight—

1. Average increase in the weight of each lamb during the experiment proper.....	Lbs. 36.7
2. Average increase per month during the experiment proper.....	9.07
3. Average increase per month during the entire feeding period.....	8.30

Food Consumed—

1. Average amount of food consumed per day by each lamb during the experiment proper.....	3.11
2. Average amount of grain consumed per day by each lamb during the experiment proper.....	1.85
3. Average amount of fodder consumed per day by each lamb during the experiment proper.....	1.26

Cost of Increase—

1. Average cost of making 100 pounds of increase in weight during the experiment proper.....	\$3.78
2. Average cost of making 100 pounds of increase during the whole period of feeding.....	3.97

Profits—

1. Average value of each lamb (120), at the beginning of the experiment, Nov. 1st, 1897.....	2.08
Average value of each lamb at the close of the experiment proper, Feb. 23th, 1898, without shrink	5.22
2. Average value of each lamb (119) at the close of the experiment, March 12th, 1898, with shrink	5.08
3. Average advance in value over the cost made by each lamb during the entire feeding period....	3.00
4. The total net profit from feeding 120 lambs for 131½ days.....	178.47
5. The total net profit from feeding one lamb.....	1.49
6. The per cent. of profit on all money invested.....	Per Ct. .42

CONCLUSIONS.

The following are chief among the conclusions that may legitimately be drawn from the experiment:

1. That corn, barley and oats are about equally valuable in producing an increase in weight in lambs that are being fattened, when fed with suitable adjuncts.

2. That barley, not much used in fattening lambs in the Northwest, compares favorably with corn in feeding value when fed with suitable adjuncts.

3. That in fattening lambs, barley, without a small supplement of oil cake, is inferior to barley or to corn with a supplement of the same.

4. That the light gains made, relatively, by the lambs in lot 3, to which oil cake was not fed, and the correspondingly low profit, would seem to indicate the wisdom of feeding a small quantity of oil cake with barley, even when the price is relatively dear.

5. That the less net profit from the lambs in lot 4, notwithstanding that they stood first in the gains made, emphasizes the importance of weighing carefully the relative value of food, when choosing them for feeding uses.

6. That since, in the experiment proper, the average increase in the weight of each lamb per month was 9.07 pounds, good gains may be secured from range lambs when fattening them, in the absence of field roots.

7. That when, as in this experiment, 100 pounds of increase can be made for \$3.78, and sold for \$5.50, the farmers who feed lambs should make a much greater profit on the food so fed, as compared with selling it in the market.

8. That since in this experiment an added value of \$3.00 was put upon range lambs which cost \$2.08, by feeding them 131½ days, and at an outlay for food of \$1.46, the question of fattening lambs is surely worthy of the careful consideration of the farmers of the Northwest.

AVERAGES FROM THREE EXPERIMENTS.

The following statements contain averages gleaned from the three experiments of the bulletin.

Period of Feeding—

	Days.
1. Average time covered by the preparatory feeding.	7
2. Average time covered by the experiment proper..	91
3. Average duration of the feeding period	98

Values—

1. Average value of the lambs per 100 pounds on the basis of cost when the feeding began.....	\$3.45
2. Average value per 100 pounds, shrunk weight, when the lambs were sold.....	4.88
3. Difference per 100 pounds between the cost price and the selling price.....	1.43

Increase in Value—

1. Average value of each lamb when the feeding period began.....	2.65
2. Average value of each lamb at the close of the feeding period, without shrink.....	5.03
3. Average value of each lamb at the close of the feeding period, with shrink.....	4.87
4. Average increase in value of each lamb during the feeding period.....	2.38

Weights—

1. Average weight of one lamb when the experiment proper began.....	Lbs. 72.2
2. Average weight of one lamb when the experiment proper closed, that is to say, from 91 days' feeding	105.8

Increase in Weight—

1. Average increase in weight of one lamb from 91 days' feeding.....	33.6
2. Average increase in weight per month of 30 days,	9.4

3. Highest average increase in weight per month from all the lambs in a single experiment.....	Lbs. 12.0
4. Lowest average increase per month from all the lambs in a single experiment.....	7.1

Food Consumed—

1. Average of grain consumed per day by one lamb.	2.07
2. Average of hay consumed per day by one lamb...	.84
3. Average of food consumed per day by one lamb..	2.92

Cost of Increase—

1. Average cost of making 100 pounds of increase in weight during the experiment proper.....	\$3.59
2. The lowest cost of making 100 pounds of increase by the lambs of any one lot.....	2.92
3. Average increase in value per 100 pounds, of the added weight, over the cost of producing it during 91 days of feeding.....	1.29

Profit—

1. Average profit on one lamb during the experiment proper (91 days), shrunk weight not included....	1.08
2. Average profit on one lamb during the experiment proper (91 days), shrunk weight considered	.96
3. Average net profit per lamb during the entire period of feeding.....	.86

CONCLUSIONS.

The following are some of the more important of the conclusions that may be drawn from the three experiments:

1. That both range lambs and home-grown lambs are well adapted for feeding.
2. That the value of the increase made from feeding lambs in our state is more than the cost of the food used in making it.

3. That the coarse cereals which Minnesota produces are well adapted to the fattening of lambs when suitably blended.

4. That when lambs are being fattened, considerably superior gains will be obtained when the grain food contains at least 10 per cent. of oil cake.

5. That oil cake, barley and oats, suitably blended, with or without bran, makes an excellent grain food for fattening lambs.

6. That while good gains may be secured by feeding oats and oil cake, suitably blended, the dearness of the mixture makes it too costly to furnish the highest profit.

7. That excellent gains can be secured when fattening lambs in our climate in the absence of field roots or ensilage.

8. That under the conditions which have prevailed during the past three years, an average of about \$1.00 per head could be secured from feeding lambs judiciously for about 100 days.