UNIVERSITY OF ILLINOIS

Agricultural Experiment Station

BULLETIN No. 167

PROPORTIONS OF SHELLED CORN AND ALFALFA HAY FOR FATTENING WESTERN LAMBS

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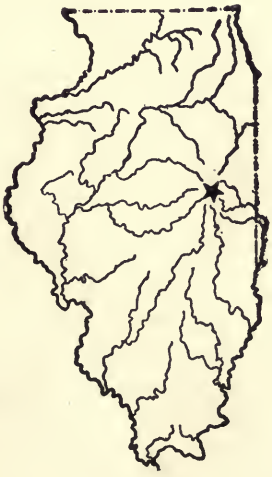

URBANA, ILLINOIS, MARCH, 1914

Summary of Bulletin No. 167

1. Objects.—(a) To determine the proportions in which shelled corn and alfalfa hay should be fed to western lambs. (b) To compare the feeding and market qualities of wether and ewe lambs. (c) To ascertain the effects of early and late shearing on the feeding operation as a whole. Page 53

2. Plan of Experiments.—Western lambs were fed shelled corn and alfalfa hay in proportions ranging from the largest quantity of corn that it was possible to get the lambs to consume, with just enough hay to keep them healthy and thriving, to a large amount of hay, with just enough corn to put them in choice market condition by the close of the feeding period. In Experiment No. 1, four lots of wether lambs were fed, and in addition two lots of ewe lambs were fed as nearly as possible like two of the lots of wether lambs. In Experiment No. 2, three lots of lambs sheared early were fed as nearly as possible like three lots sheared late. Page 53

3. Consumption of Feed.—The proportions of corn and hay varied from 1 part corn and 0.86 part hay to 1 part corn and 3.45 parts hay, but the total weight of feed consumed was about the same, regardless of proportions, in all lots within an experiment. The greatest proportion of corn that it was possible to get the lambs to consume at any stage of the feeding period was 1 part corn to 0.66 part hay. The lambs fed the greatest proportion of corn (which was also the greatest amount) were rather difficult to keep on feed. In Experiment No. 1 the lots consuming the largest amount of grain also consumed the largest amount of water. Page 55

4. Gains and Market Quality.—In each experiment the lambs receiving the largest proportion of corn made the largest gains. Proportions ranging from 1 part corn and 0.86 part hay to approximately 1 part corn and 2 parts hay were about equal in their effect on market quality.

With the exception of one lot, the ten heaviest lambs in each lot made greater gains than the ten lightest lambs. Page 61

5. Financial Aspects.—With various combinations of prices for corn and hay, excepting a combination of very dear corn and very cheap hay, it was demonstrated that the lots fed the greatest proportion of corn to hay produced the cheapest gains and returned the most profit. It was also demonstrated that in order to make the feeding operation profitable with feeds of high cost, a margin of $1.00 per hundredweight based on home costs and weights, is necessary, but that with feeds of comparatively low cost this margin is not necessary.

The fact is emphasized that the lamb feeder should grow all or part of his feed at the base of his feeding operations. Page 66

6. Comparison of Wether and Ewe Lambs.—The difference between wether and ewe lambs in feeding and market qualities was slight. Page 74

7. Effects of Early and Late Shearing.—Shorn lambs ate more feed than unshorn lambs in warm weather, but there was little difference between them in gains and no difference in market quality. Lambs left in the fleece until the end of the experiment sheared from 2 to 2.75 pounds per head more than early-shorn lambs, and on this account returned more profit. Page 76

PROPORTIONS OF SHELLED CORN AND ALFALFA HAY FOR FATTENING WESTERN LAMBS

By W. C. COFFEY, Chief in Sheep Husbandry

OBJECT OF THE EXPERIMENTS

Practically all sheep and lamb feeders want to know the proportions in which grain and roughage should be fed to fattening lambs. In this bulletin there is presented and discussed the data obtained from two experiments conducted at this station during the winter of 1906-07 for the purpose of ascertaining what quantities of shelled corn and alfalfa hay should be combined in the rations of fattening lambs in order to secure the most profitable returns. Such returns are dependent chiefly on the extent and cost of the gains produced and on the market quality secured in the animals.

In the first experiment, a secondary object was a comparison of the feeding and market qualities of wether and ewe lambs; in the second experiment, a secondary object was a consideration of the effects of early and late shearing on fattening lambs.

PLAN OF THE EXPERIMENTS

In each experiment the lambs were divided into lots of twenty each. Corn and alfalfa hay were fed to these various lots in proportions ranging from the largest quantity of corn that it was possible to get the lambs to consume, with just enough hay to keep them healthy and thriving, to a large amount of hay with just enough corn to put them in choice market condition by the close of the feeding period.

In Experiment No. 1, for the main part of the experiment, four lots of wether lambs were fed; and in order to accomplish the secondary object, two lots of ewe lambs were fed as nearly as possible like two of the lots of wether lambs. In Experiment No. 2, six lots treated as three pairs of duplicates were fed corn and alfalfa hay in three different proportions, or combinations. Early in the experiment one lot from each combination was sheared, while the other lot was left in the fleece until near the close of the experiment.

The Lambs

Western feeder lambs direct from the range were purchased on the Chicago market for each experiment. Those in Experiment No. 1 were "fancy selected." Their dark markings indicated a strong infu-

sion of English Down blood, and they averaged about 69 pounds in weight at the beginning of the experiment. Such lambs are considered suitable for finishing in a short feeding period.

The lambs in Experiment No. 2 were of choice grade and weighed about 65 pounds at the beginning of the feeding period. They did not grade so high as the lambs in Experiment No. 1 because they were not quite so good in quality.

TREATMENT OF LAMBS FROM TIME OF PURCHASE UNTIL PLACED ON EXPERIMENT

Experiment No. 1.—The lambs used in Experiment No. 1 were purchased in Chicago on October 11 and were dipped on the following day. They arrived at the University Farm on October 13, and until October 17 were grazed on very short timothy and blue-grass pasture. This run was given them in order to provide an opportunity for them to take on a fill gradually, to rest after their long journey from the range, and to recover from the effects of dipping. On the evening of October 17, they were put in a dry lot; and from that time until October 23, the date on which the experiment began, they were fed a small quantity of oats and shelled corn and 1.5 pounds of hay (clover and alfalfa) per head per day.

Experiment No. 2.—In order to get lambs direct from the range, it was necessary to purchase them early in December. Because it was winter, they were shipped from the Chicago market without being dipped. Upon reaching the University Farm, they were placed in a dry lot, where they were fed clover hay and corn stover until a few days before the experiment began, when the ration was changed to alfalfa hay. The corn stover contained a little corn; hence the lambs were partially accustomed to this feed when they were placed on experiment.

The lambs were kept on approximately a maintenance ration and so made practically no gains, but when the experiment began on February 19 they were thrifty and thoroly rested from their shipment from the West, and well prepared for the fattening period.

FEED

The corn used in each experiment was grown in the vicinity of the Experiment Station and would grade as No. 2 Yellow. In Experiment No. 1, the alfalfa fed for the first 47 days was locally grown, but because of unfavorable weather at harvesting, it was not of first quality. During the remainder of this experiment and thruout Experiment No. 2, choice alfalfa from the West was fed.

Toward the close of Experiment No. 1, some soybeans were used to give variety to the ration, but since the largest total amount fed in any case was only 1.1 pounds per lamb, they are disregarded as such in the following discussion and reported as corn.

EQUIPMENT

In each experiment the feeding was carried on in the north side of a shed that was 8 feet high at the center and 6 feet high at the side walls. Ventilators in the roof and numerous doors and windows in the sides provided a good circulation of air. Exclusive of racks, there were approximately 6 square feet of floor space to each lamb inside the shed and 12 square feet in a cinder lot just outside and north of each pen. In fair weather the lambs had access to the cinder lots during the day.

This shed was of cheap construction and about the type that the average feeder would expect to use. It sheltered the lambs from storms and winds, but was only a fair protection against the cold.

METHOD OF FEEDING

The daily ration was given in two equal portions, one at 7:00 a.m. and the other at 4:00 p.m. All feed was placed in combination grain and hay racks inside the shed. Just before feeding time, the troughs were carefully swept, and the refuse from the previous feeding was placed in canvas bags, from which it was weighed at the close of every week. Before the grain was placed in the troughs, the lambs were driven out into the lots in order to make possible an even distribution of grain and give each lamb an equal opportunity to get feed. Hay was fed after all the grain had been eaten.

It was a part of the method of feeding to have all edible feed consumed. When any such feed was left, some adjustment was made to prevent a repetition of the occurrence. If any clean corn was left, it was taken as an indication of over-feeding, and at the next feeding a reduction was made proportionate to the amount not eaten.

During the day the lambs had access to clean, fresh water, but at night it was withheld, since there was no way to keep it from freezing. Salt was either given twice a week or kept before the lambs all the time. Oat straw was used for keeping the pens and lots well bedded.

Once each week the lambs were weighed in lots in the morning before they were given water or feed. They were also weighed individually at the beginning and at the close of the feeding period.

CONSUMPTION OF FEED

Table 1, dealing with the consumption of feed per lamb per day during each period of each experiment, suggests three topics that are of importance to the lamb feeder, namely: the proportions in which corn and alfalfa hay may be fed in each period of the feeding operation; the influence of the proportion of corn to hay upon the total amount of feed that lambs are able to consume; and the increase or decrease in the ability of lambs to consume feed as the feeding period advances.

PROPORTIONS IN WHICH CORN AND ALFALFA HAY MAY BE FED IN EACH PERIOD OF THE FEEDING OPERATION

It will be noted that in the first period (29 days) the proportions in which corn and hay were fed ranged in Experiment No. 1 from 1 of corn to 2 of hay in Lot 1, to 1 of corn to 5.47 of hay in Lot 4. In Experiment No. 2, the range was not so wide, being 1 of corn to 1.57 of hay in Lot 1, and 1 of corn to 3.34 of hay in Lot 3. It will also be noticed that in all lots the corn formed a larger part of the ration in each succeeding period.

The small proportion of corn in the ration in all lots during the first period, as compared with that of the other periods, is explained by the fact that it was necessary to limit the corn during this period; for, as is well known, it is not safe to give sheep or lambs all they will eat of a heavy concentrate like corn until they become accustomed to it. As a result of limiting the corn, the hay in this period formed the greater part of the ration in all lots.

But why was it possible for the corn to form a larger proportion of the ration in the third period than in the second? It is evident that this question applies only to those lots in which the lambs were fed as much corn as they would eat. The writer believes that there were two conditions present which help to answer the question:

First, the lambs did not become well accustomed to corn until about the second week of the second period. This was particularly true of the lambs of Experiment No. 1, which, it will be remembered, received no corn prior to the beginning of the experiment. In Experiment No. 2, this condition was not so great a factor because the lambs had received a little corn in the stover that was fed them during the time they were on the University Farm prior to the beginning of the experiment, and consequently they were more nearly accustomed to it at the beginning of the second period than were the lambs of Experiment No. 1. This fact is evident in Table 1, which shows that the increase of corn in the third period was smaller in Lot 1, Experiment No. 2, than in Lot 1, Experiment No. 1.

Second, the appetite of the lambs for corn seemed to increase gradually. Being direct from the range, the lambs were wholly unaccustomed to this feed. It is true they ate it the first time it was offered to them, but with time their liking for it seemed to increase, and hence it was possible to make it a larger part of the ration in the third period than in either of the preceding periods.

Altho the appetite of lambs for corn gradually increases, it is not to be assumed that the proportion of it in the ration can be increased indefinitely, for lambs are ruminants—animals that are adapted to handling a bulky feed—and hence, even in the process of fattening, they require a certain amount of roughage. It will be noted that in the third period about 3 parts of corn to every 2 parts of hay were fed to Lot 1 of each experiment. It was found that if the lambs were

TABLE 1.—FEED CONSUMED PER LAMB PER DAY BY PERIODS

(All weights expressed in pounds)

Lot	Proportion of corn to hay		Corn per head per day	Alfalfa hay per head per day	Total feed per head per day (corn and hay)	Proportion of corn to hay		Corn per head per day	Alfalfa hay per head per day	Total feed per head per day (corn and hay)	Proportion of corn to hay		Corn per head per day	Alfalfa hay per head per day	Total feed per head per day (corn and hay)
	corn	hay				corn	hay				corn	hay			

Experiment No. 1

Feeding period 90 days, Oct. 23 to Jan. 20. Twenty wether lambs in each lot. Approximate initial weight per lamb, 69 pounds

	First period: 29 days				Second period: 28 days				Third period: 33 days			
1	1 : 2.00	.71	1.42	2.13	1 : 0.86	1.41	1.21	2.62	1 : 0.69	1.56	1.07	2.63
2	1 : 2.82	.56	1.58	2.14	1 : 1.36	1.11	1.51	2.62	1 : 0.85	1.42	1.20	2.62
3	1 : 4.07	.41	1.67	2.08	1 : 2.40	.76	1.83	2.59	1 : 1.80	.92	1.65	2.57
4	1 : 5.47	.32	1.75	2.07	1 : 3.64	.56	2.03	2.59	1 : 2.57	.72	1.85	2.57

Experiment No. 2

Feeding period 98 days, Feb. 19 to May 27. Twenty wether lambs in each lot. Approximate initial weight per lamb, 65 pounds

	First period: 29 days				Second period: 28 days				Third period: 41 days			
1	1 : 1.57	.90	1.41	2.31	1 : 0.76	1.41	1.07	2.48	1 : 0.66	1.65	1.07	2.72
2	1 : 2.24	.70	1.57	2.27	1 : 1.30	1.12	1.46	2.58	1 : 1.00	1.46	1.46	2.92
3	1 : 3.34	.53	1.77	2.30	1 : 1.80	.92	1.66	2.58	1 : 1.70	1.10	1.87	2.97

to be kept on feed, it was not possible to reduce the proportion of hay further, at least to any appreciable extent.

Just here it should be stated that thruout the experiment the lots which were fed a maximum amount of corn (Lot 1 of each experiment) were at times difficult to keep on feed. On rainy or foggy days they were more likely than the other lots to go "off feed." Lots 3 and 4 of Experiment No. 1 were never "off feed," and the same was true of Lot 3, Experiment No. 2. There were a few times, however, when one or two lambs of Lot 2 in each experiment refused corn, but on the whole the lambs of those lots were not difficult to keep on feed.

It would therefore seem best for persons without extended experience in lamb feeding not to feed corn according to the proportions employed in Lot 1 of either experiment, but it would seem safe to use the proportions employed in Lot 2. As will be seen from Table 3 (page 63), the proportion of total corn to total hay in Lot 2 of each experiment was about 1 to 1.3, while in the lots where a maximum amount of corn was fed, the proportion was 1 part corn to less than 1 part hay.

Influence of Proportion of Corn to Hay on Total Consumption of Feed

Under the heading "Feed per head per day" (Table 1), it will be seen that within any given period the total feed consumed (corn and hay) was very nearly the same in all the lots. The third period of Experiment No. 2 was the only period in which there was sufficient variation to be worthy of notice. The fact that the proportions in which corn and hay were fed had no profound influence upon the total feed consumed seems to indicate, at least within the limits of these experiments, that the total capacity for feed is very nearly a fixed quantity within which the feeder may operate in the use of corn and hay in whatever way may be the most economical, providing he can secure a proper finish. As a matter of fact, this finish was secured in all the lots of these experiments except Lots 3 and 4, Experiment No. 1.

Ability of Lambs to Consume Feed with Advance of Feeding Period

An examination of Table 1 will show that in nearly every lot of the two experiments the power to consume feed increased in the succeeding periods of the experiments. The one exception was during the third period of Experiment No. 1, when the consumption of Lot 2 remained stationary and that of Lots 3 and 4 decreased slightly. However, in view of the fact that during this period there were 6.59 inches of rainfall and 6.5 inches of snow, it is significant to note that the consumption was not materially reduced. The depressing effect

of these adverse weather conditions on the appetites of the lambs was evident, and undoubtedly kept the feed consumption from being larger.

In Experiment No. 1 the daily consumption of feed per lamb (if the average of all lots is considered) was about 23 percent greater during the second and third periods than during the first period; while in Experiment No. 2 it was only about 11 percent greater during the second period than during the first, and during the third period than during the second. It has been the experience of the writer that the increase in the capacity of lambs to consume feed as the fattening period advances is, if conditions are normal, about as indicated in Experiment No. 2.

The much greater difference, in consumption of feed, between the first and second periods of Experiment No. 1 than between the first and second periods of Experiment No. 2 is probably explained by the fact that the lambs of Experiment No. 1 were placed on experiment within a very few days after they had come from the market, and, since corn and alfalfa were new feeds to them, it was necessary for a time to limit both to such an extent that the appetites of the lambs were not appeased. On the other hand, the lambs of Experiment No. 2, as already stated, had eaten some corn in the stover that was fed them before the fattening period began, and consequently it was unnecessary to limit their feed during the first period to such an extent as it was necessary to limit the feed of the lambs in Experiment No. 1.

Lambs grow as well as fatten during the feeding period. That their added growth increases their power to consume feed seems quite possible, especially in view of another experiment conducted by the writer in studying age and weight as factors in lamb feeding. Three lots of native lambs were fed for a period of ninety-eight days. One lot was approximately 8½ months old at the beginning of the experiment, another lot 7 months, and a third lot 5 months. The amount of feed consumed by the oldest lambs was about 30 percent greater than that consumed by the youngest lambs and 18 percent greater than that consumed by the lambs of intermediate age.

But there are other factors which very likely have an influence on the ability of lambs to consume feed. Becoming accustomed to the confinement of the feed lot apparently has something to do with this ability. From the open range to the feed lot is a radical change for western lambs, and altho they may not be noticeably restless in their new surroundings, they have to learn to be content with mere eating and idleness. It would also seem that becoming accustomed to the feeds in the ration is another factor that plays a part in the increasing ability of lambs to consume feed. For example, the lambs used in these experiments had never eaten either corn or alfalfa on the range. Both feeds were at once palatable to them, but as they became more and more

accustomed to them, their desire for them seemed to increase. In this connection, the writer has observed native sheep learning to eat rape, a feed which is universally acknowledged as palatable to sheep. At first they ate of it sparingly and clearly showed their preference for an adjoining blue-grass pasture, but in time they learned to like the rape as well as the blue-grass, or even better.

CONSUMPTION OF WATER IN EXPERIMENT NO. 1[1]

It is generally supposed that animals consuming a large quantity of protein will drink more water than those taking a less amount, but such was not the case in this experiment. As will be seen from Table 2, the lots receiving a large quantity of grain (a smaller amount of protein) were the largest consumers of water. For instance, in Lot 1, in which the protein consumption was smallest (0.235 pound per lamb per day[2]), the amount of water taken from the pail was largest (4.02 pounds per lamb per day), while in Lot 4, in which the protein consumption was largest (0.251 pound per lamb per day[2]), the amount of water taken from the pail was smallest (3.85 pounds per lamb per day). Thus, while the total quantity of protein consumed by Lot 4 was greater by 1.44 pounds per lamb than that consumed by Lot 1, the total quantity of water taken from the pail by Lot 1 was greater by 15.30 pounds per lamb than that taken by Lot 4.

It should also be noted that the lambs of Lot 1 took 19 times as much water from the pail as from feed, and those of Lot 4 almost 21.4 times as much.

These figures adequately demonstrate that clean, wholesome water is a very necessary requisite in lamb feeding.

TABLE 2.—WATER CONSUMED PER LAMB PER DAY IN EXPERIMENT NO. 1

Lot	Proportion of corn to alfalfa hay	Moisture in feed[1]	Water in pails	Total in feed and pails
		lbs.	*lbs.*	*lbs.*
1	1 : 0.99	.21	4.02	4.23
2	1 : 1.36	.22	3.89	4.11
3	1 : 2.42	.19	3.87	4.06
4	1 : 3.45	.18	3.85	4.03

[1]Amount of water in feeds calculated from figures given in Henry's "Feeds and Feeding."

[1]Owing to various causes, it was impracticable to keep a record of the consumption of water in Experiment No. 2.

[2]See Table 3.

GAINS AND MARKET QUALITY

In Table 3 is shown the proportion of corn to hay and the average amount of feed consumed per lamb per day during the entire feeding period. There is also shown the digestible nutrients consumed per lamb per day, the daily gain per lamb, and the feed required for one pound gain. This table offers an opportunity to study two things of importance and interest to those engaged in lamb feeding: first, the effect of different proportions of corn and alfalfa on the rate of gain and the market quality produced; and second, the economy of the gains from the standpoint of the amount of feed required to produce a pound of gain.

EXTENT AND NATURE OF GAINS

Under the heading "Gain per lamb per day," it will be seen that, within each experiment, the greater the proportion of corn in the ration, the larger was the rate of gain. This is explained by a study of the data under the heading "Digestible nutrients per lamb per day," which show that the rations fed varied with respect to their content of digestible nutrients, and that the lots in which corn formed the larger part of the ration received a greater amount of digestible carbohydrates and a lesser amount of digestible protein than those lots in which corn formed the smaller part of the ration. It would seem that the quantity of protein was sufficient in all lots to satisfy the needs of fattening lambs, but that the proper quantity of digestible carbohydrates was lacking when a comparatively large part of the ration was composed of alfalfa hay.

Another point that should be kept in mind is that alfalfa hay is coarser and more bulky than corn. Very likely its bulky nature accounts for the fact that, taking the two experiments as a whole, those lots in which alfalfa formed a comparatively large part of the ration could not eat a materially greater weight of feed than the lots in which corn formed a comparatively large part of the ration, even tho the amount of digestible nutrients in the former ration was, on the whole, lower. Furthermore, undoubtedly more of an animal's energy is required to convert a coarse, bulky feed like alfalfa into utilizable form than is required with a more concentrated feed like corn; and this, too, reduced the efficiency of the rations in which the proportion of hay was comparatively large. This statement, however, does not at all presuppose that the less bulky the ration, the more efficient it is for fattening lambs. As stated in the discussion under Table 1, it was not possible to increase the proportion of corn beyond 3 parts corn to 2 parts hay, for lambs are ruminants—animals that are adapted to handling a bulky feed—and they therefore require, even in the process of fattening, a certain amount of roughage.

At the close of the feeding period, Lots 1 and 2 of Experiment No. 1 were in prime condition and sold on the Chicago market for

$7.85 per hundredweight; Lot 3 sold for $7.65, and Lot 4 for $7.50. Manifestly, the smaller gains made by Lots 3 and 4 were the chief cause for their selling below the price paid for prime lambs, but it also seemed that another cause lay in the fact that the gains were due, at least to a slight degree, more to growth and less to fat than were the gains made by Lots 1 and 2. If this was true, then the nature of the gains had a bearing on the way the lambs graded and sold.

With the exception of a few unusually heavy individuals, all the lambs of Experiment No. 2 sold as prime lambs at $8.50 per hundredweight. It is well to state, however, that Lot 6, which was a duplicate of Lot 3 except that it was sheared earlier (see Table 9, page 77), was considered worth slightly less than the other lots. That it sold at the same price was probably due to the urgent demand for fat lambs at the time the experiment closed. At such a time the market is not inclined to make such sharp distinctions with respect to quality and condition as in times when the supply is normal. The difference in the extent and nature of the gains of the remaining lots was not sufficient to make a discriminating difference in finish with respect to market value even had conditions been normal. The fact that Lot 3 clearly belonged in the prime grade while Lot 6 barely squeezed into it, indicates that the proportions in which corn and hay were fed to those lots mark approximately the lower limit to which the proportion of corn in the ration can be reduced and a desirable market finish still be secured in a period of ninety-eight days.

It is important for the feeder to know that within certain limits different proportions of corn and hay will produce an equally satisfactory finish in the same length of time. For example, in Experiment No. 1, a ration composed of 1 part corn and 1.36 parts hay equaled a ration composed of 1 part corn and 0.99 part hay in producing a desirable market finish; and in Experiment No. 2, rations in which the proportions varied from 1 of corn and 0.86 of hay to 1 of corn and 2.03 of hay were also equal in respect to producing a market finish. Since the above is true, the feeder is free to adjust, at least within the limits mentioned, the proportions of corn and hay in the ration. The economic significance of this point is discussed later on page 66.

ECONOMY OF GAINS

From the standpoint of the amount of feed necessary to produce a pound of gain, the rations containing a comparatively large proportion of corn are clearly shown by the last three columns of Table 3 to have been the most efficient. In Experiment No. 1, it took approximately 12 percent more feed to produce a pound of gain in Lot 2 than it did in Lot 1; 36 percent more in Lot 3, and 44 percent more in Lot 4. In Experiment No. 2, it required 7½ percent more feed to produce a pound of gain in Lot 2, and 18 percent more in Lot 3, than it did in

TABLE 3.—AVERAGE FEED, DIGESTIBLE NUTRIENTS, AND GAIN PER LAMB PER DAY DURING ENTIRE EXPERIMENT; AND FEED REQUIRED PER POUND GAIN

(All weights expressed in pounds)

Lot	Proportion of corn to hay		Average corn per lamb per day	Average alfalfa hay per lamb per day	Average of total feed (corn and hay) per lamb per day	Digestible nutrients per lamb per day		Gain per lamb per day	Corn required for one pound gain	Alfalfa hay required for one pound gain	Total feed (corn and alfalfa) required for one pound gain
	corn	hay				Protein	Carbohydrates and fat[1]				
Experiment No. 1											
Feeding period 90 days, Oct. 23 to Jan. 20. Twenty wether lambs in each lot. Approximate initial weight per lamb, 69 pounds											
1	1	: 0.99	1.24	1.22	2.46	.235	1.441	.300	4.12	4.08	8.20
2	1	: 1.36	1.05	1.41	2.46	.241	1.370	.269	3.89	5.27	9.16
3	1	: 2.42	.71	1.71	2.42	.247	1.233	.216	3.27	7.91	11.18
4	1	: 3.45	.54	1.87	2.41	.251	1.169	.203	2.66	9.18	11.84
Experiment No. 2											
Feeding period 98 days, Feb. 19 to May 27. Twenty wether lambs in each lot. Approximate initial weight per lamb, 65 pounds											
1	1	: 2.03	1.36	1.17	2.53	.258	1.651	.331	4.11	3.53	7.64
2	1	: 1.31	1.14	1.49	2.63	.281	1.641	.320	3.56	4.66	8.22
3	1	: 0.86	.88	1.78	2.66	.290	1.460	.294	2.99	6.06	9.05

[1]Fat reduced to equivalent of carbohydrates by multiplying fat in ration by factor 2¼.

Lot 1. Were the value of a ration determined solely by the quantity of feed required to produce a pound of gain, the data presented would be conclusive in favor of a ration in which the grain slightly exceeded the hay, as in Lot 1 of each experiment.

Effect of Initial Weight on Rate of Gain

No matter how carefully selection is made, it is practically impossible to secure a band of feeder lambs without including individuals considerably different in weight. These differences may be in size of body or in condition, or both. In selecting the lambs for the experiments under discussion, a great deal of care was taken by parties accustomed to handling thousands of feeder lambs to select uniform animals, and yet in Experiment No. 1, in which the average initial weight was about 69 pounds, the lightest lamb weighed 52.5 pounds and the heaviest 86.5 pounds; and in Experiment No. 2, in which the average initial weight was about 65 pounds, the lightest lamb weighed 44 pounds and the heaviest 80 pounds. It is next to impossible to avoid these variations, for they exist in the feeder end of almost every band of lambs sent to market. Moreover, it is not feasible to break up the feeder part of the band and mix those lambs with lambs from other bands in the hope of securing greater uniformity in weight. It is therefore of interest to study the gains of light and of heavy lambs in a given band, and Table 4 is presented for the purpose of such a study.

Table 4.—Average Gain of Lambs of Largest Initial Weight in Each Lot Compared with Average Gain of Lambs of Smallest Initial Weight

Lot	10 lambs of *largest* initial weight, average gain	10 lambs of *smallest* initial weight, average gain	Difference in favor of heavy lambs
	Experiment No. 1		
	lbs.	*lbs.*	*lbs.*
1	29.20	23.90	5.30
2	28.65	21.60	7.05
3	17.65	20.70	—3.05
4	17.95	17.40	0.55
	Experiment No. 2		
1	30.25	28.00	2.25
2	34.10	27.65	6.45
3	29.10	25.40	3.70

It will be noted that in all the lots except one (Lot 3, Experiment No. 1) the ten lambs with the largest initial weight made a larger average gain than the ten lambs with the smallest initial weight. This fact seems to be sufficient evidence to warrant the statement that in a given band of typical feeders the 50 percent belonging in the group of heavy lambs will, in general, make a greater average gain than the 50 percent belonging in the group of light lambs. There are good reasons for the careful limitations placed on this statement. First of all,

it is necessary to limit the statement to a given band of lambs because a band of heavy lambs may not surpass or even equal a band of lighter lambs in extent of gains. Second, it is necessary to make the statement apply specifically to two large groups within a band, one representing the upper half of the band and the other the lower half, with respect to weight, because the heaviest lamb in a band may not surpass or even equal the lightest lamb in extent of gains.

That in individual cases initial weight is not a sure indication of ability to make gains is shown by the fact that in Lot 1, Experiment No. 1, of two lambs, each weighing 61.5 pounds, one made a gain of only 19 pounds while the other made a gain of 31 pounds. Again, in the same lot, a lamb with an initial weight of 63 pounds gained 31.5 pounds, while another weighing 86.5 pounds gained only 25 pounds. Yet the ten heaviest lambs in the lot made an average gain of 5.3 pounds more per head than the ten lightest lambs.

But why do the 50 percent belonging in the heavy group of lambs make a greater gain than those in the light group?

On such markets as Chicago, Omaha, and Kansas City, the feeder lambs are usually those that are left of the large shipments from the West after the fattest lambs have been sold to the packers. Some of the lambs rejected by the packers are not far under the requirements for the "killing class," and these usually make up the heavier lambs in a feeder band. Others are more noticeably lacking either in size or condition, or both, and as a rule (there are exceptions of course) these make up the group of lightest lambs. This latter group, therefore, being made up of less thrifty individuals and those that thru some defect have been the least able to attain size and fat, does not make so much gain in the feed lot as the group of heavier lambs.

With respect to economy of gains, there is no information that will afford a comparison of the two groups, for in these experiments there was no way to determine whether the lambs of smallest initial weight consumed less or more feed than those of largest initial weight.

Neither could it be determined from these experiments what effect unevenness of size among lambs of the same lot may have on the gains. It may be well to state, however, that practical feeders do not like to have large, strong lambs and smaller, weaker lambs together in the feed lot; for it has been found by experience that the smaller lambs are crowded away from the feed and hence are retarded in fattening, while the larger lambs may get too much feed.

While this discussion of the effect of initial weight on rate of gain does not bear directly upon the main topic of this bulletin, it has been included here because it emphasizes the importance to lamb feeders of one or two points in connection with the buying of lambs: First of all, even tho a band of lambs is carefully selected, there will always be considerable variation in weight. This means, of course, that all the lambs in a particular band will not reach market finish at

approximately the same time, and thus emphasizes the advantages of buying lambs in lots of at least two carloads, so that an early shipment can be made of those that finish early and the underfinished ones can be retained for later shipment. This practice, known as "topping out," is advocated by many who have had considerable experience in lamb feeding. Further, if a feeder buys only one load of lambs with a view to returning all of them to the market at the same time, especial care in selection is necessary, for, as stated above, altho carefully selected, the lambs will still vary considerably in weight. Disregard of this point will lead to such variations in gains that returning all the lambs to market in desirable market finish at the same time will be quite out of the question.

A FINANCIAL STUDY OF THE EXPERIMENTS

Several facts have already been brought out in this bulletin relative to the effect that the feeding of different proportions of shelled corn and alfalfa hay had on the extent of gains and on the market quality of the animals in these experiments. There yet remains to be studied the effect of these different proportions on the cost of gains, which of course has a significant bearing on the profit or loss of the feeding operation. After the feeder learns what proportions of corn and alfalfa hay will put lambs in prime condition, he must then determine the particular proportions that will be most profitable to him; and in this determination he must be guided by the relative prices of corn and hay, and by the efficiency of the proportions in which these feeds are used in the production of gains. Both of these factors are involved in the study shown in Table 5, altho only the first receives direct consideration.

COST OF GAINS

What effect has the proportion in which corn and hay are fed on the cost of a pound gain when both these feeds are cheap, when they are dear, or when they are of medium price?

In the column under corn at 35 cents per bushel and hay at $8 per ton it will be seen that when these feeds are comparatively cheap, the greater the proportion of corn fed, the lower is the cost of gain per pound. In Experiment No. 1, in which the range in the proportions of corn and hay was wide, the difference in favor of a large proportion of corn in the ration is pronounced. In Experiment No. 2, however, the difference is so slight as to be almost negligible.

Turning now to the cost of a pound gain when both corn and hay are high, we see that with corn at 65 cents per bushel and hay at $16 per ton, a pound gain is still cheapest in those lots in which the largest proportion of corn was fed. The same holds true when the prices for corn and hay are medium, as will be seen under corn

TABLE 5.—COST OF ONE POUND GAIN WITH CORN AND ALFALFA HAY AT VARYING PRICES

Lot	Corn per bu.[1]	35c			45c			56c			65c		
	Hay per ton	$8	$12	$16	$8	$12	$16	$8	$12	$16	$8	$12	$16
	Proportion of corn to hay												
Experiment No. 1.—Feeding period 90 days. Twenty wether lambs to lot. Approximate initial weight, 69 pounds													
1	1 : 0.99	$0.042	$0.050	$0.059	$0.050	$0.058	$0.066	$0.058	$0.066	$0.074	$0.064	$0.073	$0.081
2	1 : 1.36	.045	.056	.067	.052	.063	.074	.060	.071	.081	.066	.077	.087
3	1 : 2.42	.053	.069	.084	.058	.074	.090	.065	.081	.096	.070	.086	.102
4	1 : 3.45	.054	.072	.091	.058	.077	.095	.063	.082	.101	.068	.086	.105
Experiment No. 2.—Feeding period 98 days. Twenty wether lambs to lot. Approximate initial weight, 65 pounds													
1	1 : 0.86	.040	.047	.054	.047	.054	.061	.056	.063	.070	.062	.069	.076
2	1 : 1.31	.041	.050	.060	.047	.057	.066	.054	.064	.073	.060	.070	.079
3	1 : 2.03	.043	.055	.067	.048	.060	.073	.054	.066	.078	.059	.071	.083

[1]Weight of one bushel of shelled corn, 56 pounds.

at 45 cents per bushel and hay at $12 per ton, or corn at 56 cents per bushel and hay at $12 per ton, altho in the latter case corn is high rather than medium in price.

Hence, whether corn and alfalfa are cheap, dear, or medium in price, the cost of a pound gain is least in those lots in which the proportion of corn in the ration was largest. This may be accounted for by the fact that such a ration produces the largest gains.

From the foregoing it is obvious that with corn cheap and hay dear, a pound of gain would cost least in those lots in which the largest proportion of corn was fed. This fact is clearly brought out by the figures under hay at $16 per ton and corn at 35 cents per bushel, or at 45 cents per bushel, altho the latter might be termed a medium price.

It is also of interest to note the cost of a pound gain when corn is dear and hay is cheap. Under corn at 65 cents per bushel and hay at $8 per ton, it will be seen that in Experiment No. 1 the cost of a pound gain is still a little cheaper in the lot in which the largest proportion of corn was fed (Lot 1). However, the cost in Lot 2 is only a trifle more than in Lot 1; and Lots 3 and 4, in which the cost was considerably greater, are really out of favorable consideration in this discussion because those lambs were not in desirable market condition at the close of the experiment. On the other hand, in Experiment No. 2, under the same combination—namely, corn at 65 cents and hay at $8—the cost of a pound gain is a little less in the lot in which the largest proportion of hay was fed (Lot 3). This is also true of this experiment with corn at 56 cents per bushel and hay at $8 per ton.

Eliminating Lots 3 and 4, Experiment No. 1, and considering each experiment by itself, it might be said that, with respect to the cost of a pound gain when corn costs from 35 to 65 cents per bushel and alfalfa $8 per ton, there is very little preference between the proportions of corn and alfalfa fed. When corn is cheapest, there is a slight tendency for the rations made up of the largest proportion of corn to produce a pound of gain at the least cost. After corn reaches 56 cents per bushel, the tendency seems to be in the opposite direction.

Again eliminating Lots 3 and 4, Experiment No. 1, it is significant to note that with corn at 56 cents and hay at $8, the cost of a pound gain in no case exceeds 6 cents; and with corn at 65 cents and hay at $8 it in no case exceeds 6.6 cents. These are fairly cheap gains; and they serve to explain why a farmer with a great deal of unharvested cheap roughage can feed comparatively high-priced corn with profit. On the other hand, it should be observed that in all lots, whatever the proportions fed, with alfalfa high as well as corn, the cost of a pound gain is comparatively high. This fact helps to explain how it is that the farmer with cheap roughage can afford to feed sheep or lambs under these conditions when the speculator who has to buy all his feed finds it impossible It must be remembered, however, that the

cheap roughage referred to is not alfalfa, altho the cost of alfalfa may be considerably reduced by raising instead of buying it, and the same is true of corn.

Thus, the figures in Table 5 emphasize the fact that the man who feeds sheep or lambs should, if possible, grow his feed.

PROFIT OR LOSS PER LAMB

Any one who has purchased feeder lambs and fattened them for market knows that there are other factors involved in determining the profit or loss of the operation besides market quality and cost of gains.

For example, the margin per hundredweight between the cost of a lamb and the selling price of the same when fat, is a greater factor in this matter than is any other one thing. Still another important factor is the cost price upon which the margin is based. Suppose, for example, that lambs cost 5 cents per pound and sell for 7 cents, and that the gains cost 8 cents. It is clear that each pound of gain would be produced at a loss of one cent, while were the lambs to cost 7 cents per pound and sell for 9 cents, there would be a profit of one cent. The margin in each instance would be the same, and the cost of the gains the same, but the difference in profit would come from the difference in the relation of the cost of the gains to the cost price on which the margin is based.

Still other factors to be reckoned with before the profit or loss of a feeding operation can be ascertained, are the death loss during the feeding period, the shrinkage in shipping, and the expense of shipping and marketing. These are all extremely variable factors. There are times when the feeder with a large band of lambs has scarcely any loss, and again he may have as much as 5 percent or, in extreme cases, even more. Shrinkage in shipping to market is not only exceedingly variable, but in the writer's experience it seems to follow no rule. For example, in Experiment No. 1 the shrinkage was almost 5 pounds per head, while in Experiment No. 2 there was practically none. The lambs in both experiments were treated as nearly alike as possible just before marketing, and in each case they were shipped when the weather was clear and mild, considering the time of year; yet there was this enormous difference in shrinkage. As to the expense of shipping and marketing, it is evident that differences in distance from market are bound to make this expense variable.

In dealing with the profit or loss per lamb in Tables 6 and 7, no allowance is made for death loss during the feeding period because, as stated above, this is an extremely variable factor. It should be noted, too, that the profit or loss is based on the cost at home and the selling price at home. This plan is adopted in order to eliminate those other extremely variable factors—shrinkage, and the expense of shipping and marketing. Further, "Expenditure per lamb" does not

TABLE 6.—PRELIMINARY TO TABLE 7

Lot	Proportion of corn to hay	Feed consumed per lamb[1]		Weight per lamb at beginning of experiment	Cost at beginning of experiment at $7 per cwt.	Weight per lamb at close of experiment	Gain per lamb	Receipts per lamb at feed lot	
		Corn	Hay					No margin, or $7 per cwt.	$1 margin, or $8 per cwt.
Experiment No. 1.—Feeding period 90 days. Twenty wether lambs to lot. Approximate initial weight, 69 pounds									
		lbs.	*lbs.*	*lbs.*	$	*lbs.*	*lbs.*	$	$
1	1 : 0.99	111.6	110.4	69.5	4.87	96.5	27.0	6.76	7.72
2	1 : 1.34	94.2	127.7	69.0	4.83	93.2	24.2	6.52	7.45
3	1 : 2.42	63.7	154.3	69.0	4.83	88.4	19.4	6.18	7.07
4	1 : 3.45	48.8	168.5	68.8	4.82	87.1	18.3	6.09	6.97
Experiment No. 2.—Feeding period 98 days. Twenty wether lambs to lot. Approximate initial weight, 65 pounds									
1	1 : 0.86	133.5	114.7	65.1	4.56	97.5	32.4	6.83	7.80
2	1 : 1.31	111.6	146.2	64.9	4.54	96.2	31.3	6.73	7.70
3	1 : 2.03	86.2	174.9	64.4	4.51	93.2	28.8	6.52	7.45

[1] "Feed consumed" includes all the hay weighed to the lambs; appreciable quantities of corn were weighed back and deducted from the amount fed.

TABLE 7.—PROFIT OR LOSS PER LAMB WITH FEED AT VARYING PRICES

Lot	Proportion of corn to hay	Expenditure per lamb up to beginning of experiment, based on $7 per cwt.	Expenditure per lamb for feed with feed at varying prices			Profit or loss per lamb with no margin and with a margin of $1 per cwt. at the feed lot					
						No margin			Margin of $1		
			I Corn, 35c per bu. Hay, $8 per ton	II Corn, 45c per bu. Hay, $12 per ton	III Corn, 56c per bu. Hay, $16 per ton	Prices as under I	Prices as under II	Prices as under III	Prices as under I	Prices as under II	Prices as under III
Experiment No. 1.—Feeding period 90 days. Twenty wether lambs to lot. Approximate initial weight, 69 pounds											
1	1 : 0.99	$4.87	$1.14	$1.56	$2.00	$0.75	$0.33	—$0.11	$1.71	$1.29	$0.85
2	1 : 1.34	4.83	1.10	1.53	1.96	.59	.16	—.27	1.52	1.09	.66
3	1 : 2.42	4.83	1.02	1.44	1.87	.33	—.09	—.52	1.22	.80	.37
4	1 : 3.45	4.82	.98	1.40	1.84	.29	—.13	—.57	1.17	.75	.31
Experiment No. 2.—Feeding period 98 days. Twenty wether lambs to lot. Approximate initial weight, 65 pounds											
1	1 : 0.86	4.56	1.29	1.76	2.26	.98	.51	.01	1.95	1.48	.98
2	1 : 1.31	4.54	1.28	1.78	2.29	.91	.41	—.10	1.88	1.38	.87
3	1 : 2.03	4.51	1.24	1.74	2.26	.77	.27	—.25	1.70	1.20	.68

include the cost of the labor involved in feeding and handling the lambs, nor the cost of bedding and salt, since it is taken for granted that the value of the manure produced, for which no credit is given in the receipts per lamb, would offset these items.

Up to the beginning of the experiment, the lambs of Experiment No. 1 cost $7 per hundredweight. This cost includes the purchase price of $6.65 per hundredweight at the Chicago market, the commission, the dipping expense, the shipping expense, and the cost of feeds up to the first day of the experiment. The lambs of Experiment No. 2 cost $7.06⅔ per hundredweight up to the beginning of the experiment. This includes the purchase price of $6.80 per hundredweight and the other items mentioned under Experiment No. 1, except the dipping expense (the lambs of Experiment No. 2 were not dipped) and the cost of the clover hay and corn stover fed during the time the lambs were held at maintenance awaiting the beginning of the feeding period. In view of the actual cost up to the beginning of the experiment, it seemed advisable in the tabulations, to place the cost at home at $7 per hundredweight.

Table 6 is presented merely for the purpose of making easily available to the reader the source from which the greater part of the data of Table 7 is derived.

Before the discussion of Table 7 is taken up, it should be explained that "no margin" is used as meaning that the lambs sold at home (i.e., at the feed lot) for the same price per hundredweight as they cost at home up to the beginning of the experiment. If a margin is thought of as the difference between what animals cost per hundredweight at the market and what they sell for when returned to the market, then it is clear that "no margin," as used in Table 7, really amounts to a margin.

The discussion of Table 7 may be divided under the following heads: the effect of the different proportions in which corn and hay were fed upon the cost of feed per lamb with feed at varying prices; the effect of prices of feed on the expenditure per lamb; and the effect of the cost of feed on the profit or loss per lamb when different margins are involved.

Effect of Different Proportions of Feed upon Cost per Lamb with Feed at Varying Prices.—It will be seen that in Experiment No. 1, under each combination of prices, the cost of feed is greatest where the largest proportion of corn was fed. The reason for this is very evident if it is remembered that the total consumption of feed was about the same in all lots, and if it is realized that, taken pound for pound, the price of corn in each combination is greater than the price of hay. For example, corn at 35 cents per bushel sells at $12.50 per ton, or $4.50 per ton more than the hay in that combination; at 45 cents per bushel, it sells for $16.07 per ton; and at 56 cents per bushel, it sells for $20 per ton. In Experiment No. 2, the cost of feed is about the same in all lots under any one combination of prices, partly

because the differences in the proportions in which corn and hay were fed were not so great as in Experiment No. 1, and partly because the lots receiving a large proportion of hay consumed a little more feed than those fed a large proportion of corn.

Effect of Prices of Corn and Hay upon Expenditure per Lamb for Feed.—Perhaps this effect is more keenly realized when it is pointed out that in Experiment No. 1 the expenditure in each lot is 42 cents greater under the second combination of prices than under the first, and under the third combination 86 cents greater. In Experiment No. 2 the expenditure is from 47 to 50 cents greater per lamb under the second combination of prices than under the first, and under the third combination from 97 cents to $1.02 greater. These differences make it unnecessary to state that the cost of feed plays an important part in the profit or loss of a feeding operation.

Effect of Cost of Feed on Profit or Loss per Lamb when Different Margins are Involved.—Under the heading "No margin," the figures in the first column (which are based on the first combination of prices —corn at 35 cents per bushel and hay at $8 per ton) show a profit in all lots. In the second column (second combination) a loss is shown in Lots 3 and 4 of Experiment No. 1; in all other lots, a profit. In the third column (third combination) a loss is shown in all lots except in Lot 1 of Experiment No. 2.

Under "Margin of $1," all three columns (based upon the three different price combinations) show a profit in all lots, and, with the exception of Lots 3 and 4 of Experiment No. 1, enough profit to indicate that under this margin and with any one of these combinations of prices, the feeding operation would have been well worth while.

The contrasting of the profit per lamb under the third combination when a margin of a dollar per hundredweight is allowed, with the loss per lamb under the same combination when no margin is allowed, forcibly illustrates the need of a margin if corn and hay are high. On the other hand, if prices for these feeds are comparatively low, as under the first combination, the feeding operation can be profitably conducted with practically no margin, provided the initial cost approximates that employed in the table; namely, $7 per hundredweight. This again emphasizes the need of the feeder to produce a part or all of the corn and hay he uses, for, in the corn belt at least, the cheapest corn to the feeder is that which he grows near the base of his feeding operations. The same is more than likely true of alfalfa hay.

Attention is called to the fact that the profit per lamb under all three price combinations, under both "No margin" and "Margin of $1," is greatest in those lots in which the largest proportion of corn was fed. Except in the case of Lots 3 and 4 of Experiment No. 1, the only cause for this is the greater rate of gain, and consequently the cheaper cost of a pound gain in spite of the fact that the total cost of feed is greatest where a relatively large amount of corn was fed. In

the case of Lots 3 and 4, Experiment No. 1, an additional cause is found in the fact that these lots were not in desirable market finish when the experiment closed, Lot 3 selling for 20 cents and Lot 4 for 35 cents less per hundredweight than the other lots.

There is only one way to make computations so that the profit per lamb would be greater in the lots in which hay formed a larger part of the ration than it formed in Lot 1 of each experiment. This would be to value corn at a very high price and hay at a very low price. For example, if corn were to value at 65 cents per bushel and alfalfa at $8 per ton, the profit in Lot 2, Experiment No. 1, would be about the same as in Lot 1; and in Lots 2 and 3, Experiment No. 2, it would be slightly more than in Lot 1. Such combinations of prices would be possible in regions where both these feeds are produced should there be a shortage of corn and a normal or unusually large crop of alfalfa. Then, too, in regions where corn is not produced to any great extent, but where alfalfa is plentiful, the more liberal use of alfalfa undoubtedly would prove the more profitable.

COMPARISON OF WETHER AND EWE LAMBS

A secondary object in Experiment No. 1, as stated in the introduction of this bulletin, was a comparison of wether and ewe lambs with respect to consumption of feed, extent of gains, and market quality. For this purpose two lots of 20 ewe lambs each (designated as Lots 5 and 6) were selected. Lot 5 was fed as nearly as possible like Lot 1 (wethers), already discussed under Experiment No. 1, and Lot 6 like Lot 2 (wethers), also discussed under Experiment No. 1; but since the amount of feed consumed was determined largely by the appetites of the lambs, it was impossible to feed, in exactly the same way, all the lots to be compared.

TABLE 8.—COMPARISON OF WETHER AND EWE LAMBS AS TO FEED CONSUMED AND GAINS MADE

	Proportion of corn to hay	Shelled corn per head	Alfalfa hay per head	Gain per head
Fed alike:		*lbs.*	*lbs.*	*lbs.*
Lot 1 (20 wethers).....	1 : 0.99	111.6	110.4	27.05
Lot 5 (20 ewes).....	1 : 1.00	110.4	110.4	27.14
Fed alike:				
Lot 2 (20 wethers).....	1 : 1.36	94.3	127.7	24.22
Lot 6 (20 ewes).....	1 : 1.34	93.5	125.3	22.05

With respect to consumption of feed, it appears that the ewes ate slightly less in a given period than the wethers, but the difference is too small to be of significance.

In extent of gains, Lot 1 (wethers) and Lot 5 (ewes) were practically equal, tho Lot 1 would have exceeded Lot 5 had it not been that in Lot 1 there was one lamb that gained only 11 pounds, the lowest gain made by any lamb of the four lots involved in the comparison. A comparison of the gains made by Lot 2 (wethers) and Lot 6 (ewes) shows a difference of more than 2 pounds per head in favor of the wethers. This is enough difference to be of significance, for, since the consumption of feed was almost the same, it will be seen that the wethers made the cheaper gains. The fact that in one case the ewe lambs equaled the wethers in extent and economy of gains while in another case the wether lambs excelled the ewes, makes inadvisable a positive statement on the comparative extent and economy of the gains, altho it would seem that the advantage is slightly in favor of the wether lambs.

As to market quality and finish, it was generally agreed among the commission men and buyers who saw the lambs, that the ewes were slightly superior to the wethers. Because of their sex, they were slightly more refined in general quality. They were also more plump and rounded in outline. Had they been sold in carload lots, it is thought they would have brought slightly more per hundredweight than the wethers because they looked as tho they would return a higher percentage of carcass to live weight. This opinion was substantiated by the returns from slaughter, which were as follows:

	Percentage of carcass to live weight
Fed alike:	
Lot 1 (wethers)	51.6
Lot 5 (ewes)	52.8
Fed alike:	
Lot 2 (wethers)	52.2
Lot 6 (ewes)	52.5

The higher dressing percentage of the ewes cannot be accounted for by a greater shrinkage resulting from shipment to market, as Lot 1 (wethers) shrank 7.5 pounds per head while Lot 5 (ewes) shrank only 5.7 pounds per head, and Lots 2 and 6 each shrank 4.3 pounds per head.

All four lots sold at $7.85 per hundredweight. On this basis the carcasses cost the purchaser the following per pound (not crediting the by-products):

Lot 1 (wethers).....15.21 cents
Lot 5 (ewes).....14.87 "
Lot 2 (wethers).....15.04 "
Lot 6 (ewes).....14.95 "

In each case the ewes cost the purchaser less in the carcass than the wethers. The poor showing of Lot 1 in percentage of carcass was

undoubtedy greatly influenced by two lambs, the poor one already mentioned, which gained only 11 pounds and was very deficient in market finish, and another one that was noticeably deficient in market finish. It would seem that the difference between Lots 2 and 6 is more nearly typical of the difference one would expect to find between the dressing of wether and of ewe lambs.

It may be that ewe lambs have an advantage over wether lambs in being more uniform in their ability to make gains. In Lot 1 (wethers), the three lowest-gaining lambs made 11, 14.5, and 19.5 pounds, respectively, while in Lot 5 (ewes), the three lowest-gaining lambs made 15, 18, and 19 pounds. Comparing Lots 2 and 6 in the same manner, we find that the three lambs with the lowest gains in Lot 2 (wethers) made 12.5, 12.5, and 13 pounds, while the three with the lowest gains in Lot 6 (ewes) made 13.5, 13.5, and 14 pounds. The differences submitted are small and may have been due to coincidence rather than to any inherent difference between wethers and ewes in their ability to make gains.

In conclusion, it is perhaps fair to say that wether lambs consume slightly more feed and make better gains than ewe lambs in a feeding period of 90 days, and that ewe lambs take on a slightly better finish on account of their better quality and greater smoothness of form. However, it would seem from the results of this experiment that the difference in the behavior of wether and ewe lambs in the feed lot and at the market is so slight that there is little cause for the feeder to prefer one over the other.

EFFECTS OF EARLY AND LATE SHEARING

As stated in the introduction of this bulletin, a secondary object in Experiment No. 2 was a comparison of the effects of early and late shearing on fattening lambs. For this purpose three additional lots, known as Lots 4, 5, and 6, were selected. With respect to the proportions in which shelled corn and alfalfa hay were fed, the six lots were treated as three pairs of duplicates, as follows: Lots 1 and 4; 2 and 5; and 3 and 6. Lots 4, 5, and 6 were sheared March 19, one month after the experiment began; the other lots, Nos. 1, 2, and 3, were not sheared until May 21, near the close of the experiment. All the lots were shorn close by a hand-power machine.

Table 9 shows feed consumed, gain, and yield of wool per lamb.

CONSUMPTION OF FEED

In each duplicate the lambs that were sheared early consumed a little more feed than those left in the fleece. Until the last days of April, the unshorn lambs ate as much feed as the shorn lambs, but from

TABLE 9.—FEED CONSUMED, GAIN, AND YIELD OF WOOL PER LAMB

(Feeding period 98 days, Feb. 19 to May 27. Twenty wether lambs in each lot. Approximate initial weight, 65 pounds)

	Date of shearing	Proportion of corn to hay	Total shelled corn per lamb	Total alfalfa hay per lamb	Total gain per lamb	Wool per lamb
Fed alike:			*lbs.*	*lbs.*	*lbs.*	*lbs.*
Lot 1.....	May 21	1 : 0.86	133.5	114.7	32.45	8.75
Lot 4.....	March 19	1 : 0.85	136.8	117.0	32.15	6.30
Fed alike:						
Lot 2.....	May 21	1 : 1.31	111.6	146.2	31.35	8.40
Lot 5.....	March 19	1 : 1.31	113.1	147.8	30.30	6.40
Fed alike:						
Lot 3.....	May 21	1 : 2.03	86.2	174.9	28.85	8.60
Lot 6.....	March 19	1 : 2.03	86.7	176.2	23.97	5.85

NOTE.—One of the lambs of Lot 6, Experiment No. 2, died during the second period, making the average number of lambs during that period 19.36, and during the third period, 19.

that time until the close of the feeding period they consumed less than the shorn. The warm weather in May evidently had a depressing effect on the appetites of the unshorn lambs, for during that time they were much more difficult to keep on feed than were the shorn lambs.

GAINS

It will be seen from Table 9 that in total gains there was little difference between the early- and the late-shorn lambs except in the case of Lots 3 and 6. Lot 6, sheared March 19, gained considerably less than Lot 3, but the fact that one lamb in Lot 6 was lost may have had an influence on the extent of the gains. However, it is interesting to note that in all cases, contrary to what would generally be expected, the lambs sheared late made slightly more gain than those sheared early. This may be explained by the presence of certain conditions that may have been in favor of the lambs that were sheared late. For example, much of the time from March 19, when Lots 4, 5, and 6 were sheared, until about May 1, the weather was abnormally cold. Such weather had a visible effect on the shorn lambs, often causing them to stand shivering with their backs humped. It probably hindered them in making gains and at the same time aided those left in the fleece; at any rate, the unshorn lambs seemed the more comfortable, while the reverse would have been true during a considerable part of April if the season had been normal. Whoever decides to shear early is obliged to take chances with the weather.

Another condition that worked unfavorably for the shorn lambs was the manner in which they were penned. Each lot was penned by itself in a small inclosure where there was no opportunity for the

lambs to circulate freely. In a large shed each individual has an opportunity to move over the whole shed space and thus keep warmer than if confined to a small pen. Then, too, since each lot was penned by itself the lambs could not gather close together in large numbers. While lambs do not "bunch up," as pigs do in order to keep warm, yet western lambs stay pretty close together if given an opportunity. It is a matter of speculation as to how much gain the early-shorn lambs would have made if they had been handled in one large band within a warm, commodious shed or barn.

YIELD OF WOOL

Another very important consideration in shearing fattening lambs early or late is the amount of wool secured. In this experiment the difference in weight of wool varied from 2 to 2.75 pounds per lamb in favor of late shearing. These significant differences are based on the weight of the wool just as it came from the lambs and not on the weight of the scoured wool, that is, the wool fiber free from all extraneous matter. It is needless to state that the late-shorn lambs, having sixty-three days longer for growth of fleece, yielded a greater weight of wool fiber than those shorn early, tho a large part of the additional weight was due undoubtedly to the presence of a greater amount of yolk (oil from sebaceous glands combined with perspiration). The wool from the late shearing was also longer in staple and more lustrous, these qualities adding to its desirability from the market standpoint. However, the local dealer made no discrimination between the early- and the late-shorn wool, and hence in this instance the time of shearing had no influence on the market value.

The difference in weight of wool in favor of late shearing had an important bearing upon the financial returns. The lambs sold for $8.50 per hundredweight on the Chicago market, or, on the basis of home weight, it was estimated that they brought $8.25, the shrinkage being very slight. The wool was sold locally for 25 cents per pound. At these prices the returns from the various lots were as shown on page 79.

In every instance the difference in financial returns was in favor of the lambs shorn late. This was due to the greater weight of wool secured rather than to the difference in the weight of the lambs, for, with the exception of Lot 6, in which one lamb was lost, the early-shorn lambs outweighed the late-shorn per lot when ready for market. Since the lambs sold for an abnormally high price per hundredweight, the heavier weight per lot was all the more in favor of the lambs shorn early.

A comparison of Lots 1 and 4 shows that the returns per lamb were 42 cents in favor of Lot 1 (sheared late). To offset this difference, due to the greater wool value of Lot 1, the gain in Lot 4 would have had to be a little more than 5 pounds per lamb greater than it

Fed alike:		
Lot 1: sheared late		
By 20 lambs, 1775 lbs. at $8.25 per cwt.	$146.44	
By wool, 175 lbs. at 25c per lb.	43.75	
Total.		$190.19
Lot 4: sheared early		
By 20 lambs, 1822 lbs. at $8.25 per cwt.	$150.32	
By wool, 126 lbs. at 25c per lb.	31.50	
Total.		$181.82
Difference in favor of Lot 1.		$8.37
Difference in favor of Lot 1, per lamb.		.42
Fed alike:		
Lot 2: sheared late		
By 20 lambs, 1756 lbs. at $8.25 per cwt.	$144.87	
By wool, 168 lbs. at 25c per lb.	42.00	
Total.		$186.87
Lot 5: sheared early		
By 20 lambs, 1784 lbs. at $8.25 per cwt.	$147.18	
By wool, 128 lbs. at 25c per lb.	32.00	
Total.		$179.18
Difference in favor of Lot 3.		$7.69
Difference in favor of Lot 3, per lamb.		.38
Fed alike:		
Lot 3: sheared late		
By 20 lambs, 1692 lbs. at $8.25 per cwt.	$139.59	
By wool, 172 lbs. at 25c per lb.	43.00	
Total.		$182.59
Lot 6: sheared early		
By 19 lambs, 1636 lbs. at $8.25 per cwt.	$134.97	
By wool, 117 lbs. at 25c per lb.	29.25	
Total		$164.22
Difference in favor of Lot 3		$18.37[1]
Difference in favor of Lot 3, per lamb.		.49

[1]The difference in favor of Lot 3 ($18.37) should be disregarded because of there being only 19 lambs to sell in Lot 6. 49c per head represents the difference per lamb about as nearly as it can be calculated.

was. The same is true in a somewhat less degree of Lot 5 when compared with Lot 2, and in a greater degree of Lot 6 when compared with Lot 3. The significance of the advantage secured in financial returns from late shearing is apparent when it is realized that Lots 4, 5, and 6 would have had to gain approximately 16⅔ percent more than they did in order to have overcome the greater returns in Lots 1, 2, and 3.

It was thought that shearing early in the feeding period might have a tendency to cause the lambs to sell better on the market, but

such did not prove to be the case. Lots 1, 2, and 3 were sheared only about a week before they were marketed, while Lots 4, 5, and 6 had been sheared about seventy days, and in that time their wool had grown to sufficient length to make them look more rounded in form, less ungainly, and apparently of better quality than the lambs just lately turned out of their fleeces. But buyers on the market said that altho the difference was very slightly in favor of the early-shorn lambs, it was too slight to make a difference in the market price. The only difference to the buyers was that the early-shorn lambs had pelts with more wool, which, altho very short, was worth a little more per pound than the dressed carcass. In times of low prices for wool, a seventy-day growth would probably be of no more value pound for pound than the carcass.

In summing up the effects of early and late shearing on fattening lambs, it may be said that under the conditions existing at the time of this experiment it was better not to shear the lambs until near the close of the feeding period. This was because the late-shorn lambs consumed slightly less feed, made a trifle more gain, and returned considerably more net profit on account of the greater weight of wool produced. The writer does not attempt to say, however, that this one experiment conclusively answers the question as to whether it is advisable always to shear fattening lambs late in the feeding period, for there are many different conditions, each of which, if handled most skilfully, would require different treatment.

Many practical feeders advocate shearing fattening lambs early in the feeding period, their chief arguments being that shearing stimulates the appetite and results in a larger rate of gain. The results from the experiment under discussion tend to support the first argument but not the second. The writer is not disposed to refute either, for, as already pointed out, the conditions of this experiment were different from what they often are when a larger number of lambs are fed together and in a normal season. However, the results have a value because they show that early shearing does not always result in greater gains. They warn the feeder to study his conditions carefully, and unless he is prepared to keep his lambs comfortable under the most adverse weather conditions, he would do well to see large advantages in the procedure before he decides to shear early.

Should the lambs when purchased be badly infested with ticks and the weather too cold to permit of their being dipped without danger of serious injury, it is the best policy to shear, providing shelter is available. Should they have an unusual quantity of burs or other vegetable materials in their wool, it is often advisable to shear them as early as possible in order to keep these materials from irritating and penetrating the skin, thus forming pus pockets in the flesh, which are almost sure to cause the carcasses to be condemned.

There are feeders who believe that, as a rule, as in the case of this experiment, late shearing will secure the most favorable results. Believing that large gains in weight will result after shearing, they plan to shear two or three weeks before marketing, but not until about the first of June, after which there is little likelihood of cold, backward weather. Furthermore, when wool is high in price, the extra weight of wool secured from late shearing is undoubtedly an immense advantage. When it is very low, it is doubtful whether retaining the wool crop at all is of advantage.

CONCLUSIONS

Consumption of Feed.—In a ration composed of corn and alfalfa hay, corn can be made an increasingly larger part of the ration as the feeding period progresses. However, in the experiments herein reported it was not possible at any time to make the proportion of corn in the ration greater than 1 part corn to 0.66 part hay.

As the lambs fed the largest proportion of corn that it was considered possible to feed them, were inclined to go off feed in unfavorable weather, it would seem inadvisable for persons inexperienced in lamb feeding to attempt to feed a maximum amount of corn.

The proportions in which corn and alfalfa hay are fed seem to have practically no influence on the total weight of feed that lambs are able to consume.

Under normal conditions, and within the limits of time over which these experiments extended, it would seem that the power of lambs to consume feed increases gradually with the advance of the feeding period.

Gains and Market Quality.—When corn and alfalfa hay form the ration for fattening lambs, the highest rate of gain is secured when the proportion of corn is as great as it is possible to get the lambs to consume, apparently for the reason that such a ration permits the feeding of a greater amount of digestible nutrients, particularly carbohydrates, and that less of the animal's energy is required to prepare the feed for utilization.

The nature of the gains, that is, whether they are due to growth or to fat, has a bearing on the way lambs grade and sell.

Within certain rather definite limits, different proportions of corn and hay are practically equal in their ability to produce a market finish. The feeder is therefore free to adjust, within these limits, the proportions of corn and hay in the ration.

The total amount of feed required to produce a pound of gain is least when corn forms a comparatively large part of the ration.

In individual cases initial weight is not a sure indication of ability to make gains, but in a given band of typical feeders the 50 per-

cent belonging in the group of heavy lambs will, in general, make a greater average gain than the 50 percent belonging in the group of light lambs.

Financial Aspects.—According to any of the combinations of prices herein used for corn and alfalfa hay, except a combination of comparatively high corn and cheap alfalfa, the larger the proportion of corn that lambs can be induced to consume, the lower is the cost of a pound gain and the greater is the profit per lamb. Should there be a combination of very dear corn and very cheap hay, the profit per lamb would be about the same or slightly greater the larger the amount of hay consumed.

The fact is emphasized that the lamb feeder ought to grow all or part of the feed he uses, near the base of his feeding operations. The significance of this statement can best be comprehended by recalling that with "no margin" it was shown that a fair profit would have been realized if corn had been valued at 35 cents per bushel and hay at $8 per ton, while with corn at 56 cents per bushel and hay at $16 per ton, there would have been a loss in all lots except one.

In determining the particular proportions that will be most profitable to him, the feeder must be guided by the relative prices of corn and hay, and by the efficiency of the proportions in which these feeds are used.

Comparison of Wether and Ewe Lambs.—The difference in the behavior of wether and ewe lambs in the feed lot and at the market is so slight that there is little cause for the feeder to prefer one over the other.

Early and Late Shearing.—Early shearing does not always result in a greater gain in weight. The feeder should study his conditions carefully, and unless he is prepared to keep his lambs comfortable under the most adverse weather conditions, he would do well to see large advantages in the procedure before he decides to shear early.