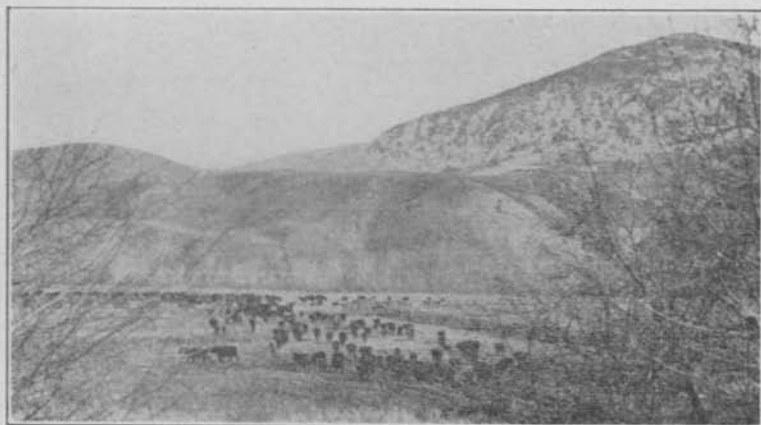


UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION
Department of Animal Husbandry

Fattening Idaho Range Cattle

By

C. W. HICKMAN, E. F. RINEHART, and R. F. JOHNSON



Idaho cattle wintering on the home ranch, with the spring and summer range in the background

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Fattening Idaho Range Cattle

By

C. W. HICKMAN, E. F. RINEHART, and R. F. JOHNSON*

Part I. The Idaho Beef Cattle Industry

The Range Industry

IN EARLY cattle history the Idaho territory lay somewhat remote from the Great Plains, where the southwestern cattle came for finishing before going East to market. The trail to Idaho was long and hard. Winters were treacherous and rustling was common. While Idaho cattle history dates from 1854, the numbers were comparatively small until settlers established sufficient home ranches to winter all the cattle that the summer ranges could carry. Thus, unlike the Great Plains, the coming of the settlers to Idaho increased the number of range cattle by developing farms where winter feed could be produced. The industry developed gradually. The maximum number of beef cattle in the State was reached between 1920 and 1925. The number of cattle other than dairy cows and heifers, two years old and over, as listed by the United States census from 1870 to 1930 is as follows: 1870, 55,303; 1880, 71,292; 1890, 191,807; 1900, 311,605; 1910, 367,588; 1920, 512,512; 1925, 466,836; and 1930, 464,590.

The development of the big irrigation projects was mostly in the valleys and the low-lying plains, the areas of the winter range. This provided plenty of winter feed and changed the method of management from year-long grazing to a combination of ranch and range.

As a general rule the cattle ranches are in the higher mountain valleys, strung out in shoestring form along both sides of the stream. Hay is the main crop, though some ranches produce grain. Irrigation is from the natural flow of the rivers. The land is cheap and the only expense of the irrigation water is the labor. The high altitude is of but very little disadvantage. If the grain is frosted it can still be fed to the cattle. The cattle winter in the underbrush and willows along the streams, where they are fed hay. Deep snow is no handicap. (*See cover page*).

In the spring the gates are opened and the cattle turned onto the sagebrush range of the foothills adjoining the ranch. They can pass through the ranch to water, but this privilege is denied

*Animal Husbandman, Agricultural Experiment Station; Extension Animal Husbandman and Associate Animal Husbandman, Agricultural Experiment Station; and Assistant Animal Husbandman, Agricultural Experiment Station and Superintendent of the Caldwell Substation, respectively.

The steers were fed under the direction of J. E. Nordby during the period of 1919-20; A. W. Johnson, 1920-21; D. A. Stubblefield, 1922-27; and R. F. Johnson since 1927.

to transient stock. In this way good, early, open range can be conserved. The only riding necessary at this time is to prevent the cattle from starting to the summer ranges too early. As the season advances the feed on the lower hills becomes dry. The cattle follow the snow line upward. The trip to the high, forested mountains, which constitute the summer range, is made in this way. (Fig. 1).

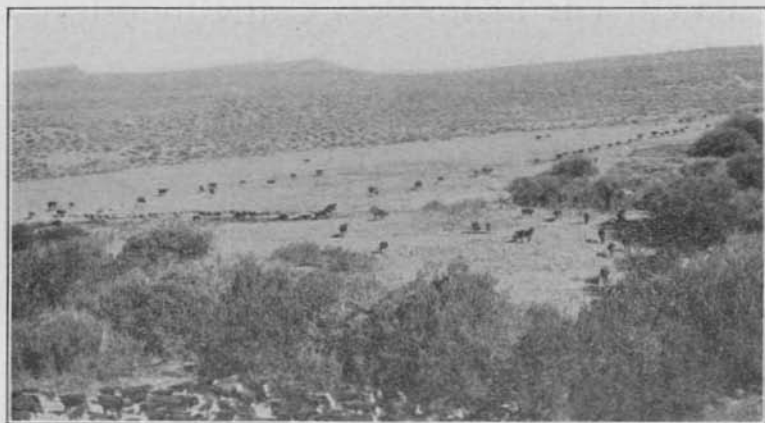


Fig. 1—One type of Idaho range consists of semi-desert sagebrush plain.

Older steers and heifers graze farther out than the bulls and cows with calves, and hence are depended upon to utilize the more remote and steeper parts of the range. Accordingly, if the outfit has been reduced to only cows, calves and bulls (known as a "skeleton" outfit), to get through a hard winter, the range will carry fewer cattle than if the herd is complete. Normally, an average range will fatten the dry cows, three-year-old steers and part of the two-year-old steers. The "beef" is usually gathered by the regular riders, who cut out the dry cows and fat steers intended for market and bring them to fenced holding pastures. In from two to three weeks all market stock will have been gathered and trailed to the railroad for shipment.

If the range feed is failing, so that the cattle are losing weight, those intended for feeders are gathered and brought to good pastures. The breeding herd and the stockers remain on the range as long as there is feed, oftentimes until the first snowfall.

Cost of production records kept with 150 Idaho cattle outfits from 1929 to 1933 showed the average cattle ranch to consist of 1036 acres of deeded land, running 419 cattle, as follows:

Bulls	.....	7
Cows	.....	141
Heifers	.....	51
Calves	.....	99

Steers:

Three-year-olds	16
Two-year-olds	53
Yearlings	52

During the last 20 years, the finishing of feeder cattle for market has become a well-established industry in Idaho. The development of irrigation has resulted in the production of bulky feed crops far in excess of the winter needs of the range cattle and sheep. In the early years of Idaho's agricultural history, the feeder cattle and lambs were shipped to market. Shortly after they were gone, the surplus feed crops were loaded and shipped. To care for the surplus feed it has been necessary to develop a farm livestock industry similar to that of the East and Middle West, with the result that there have been established dairy, swine, farm sheep and cattle and lamb feeding industries.

The development of western cities and the increase of population on the West Coast have resulted in: (1) The establishment of large packing centers in the West, where beef, pork and mutton are processed; (2) A demand from this packing trade for a uniform distribution of livestock throughout the year; (3) A western market for most of the Idaho range cattle, provided they are fattened and distributed evenly to market.

The finishing of feeder cattle on the western farm has meant: (1) A profitable practice of withholding the livestock from the market during the periods of the largest receipts; (2) The utilization of the waste feeds on the farm; (3) A home market for the feed crops; (4) The maintenance of soil fertility; (5) The lengthening of the livestock marketing period; (6) An increase in the number of markets available; (7) The securing of the increased value that usually exists between the prices of feeder and fat stock.

The Feeding Industry

Advisability of Feeding Cattle

Cattle feeding is one of the farm livestock industries selected as a means of disposing of bulky feed crops and improving the fertility of the soil. Beef cattle feeding should be continuous—not an in-and-out program. Advance guesses of the financial aspects of feeding are not reliable.

The age and class of cattle to feed depend upon:

1. Nature of the Feed:

- a. On farms where most of the surplus feed consists of alfalfa hay, beet pulp and corn silage, with only a small amount of grain, the feeding of two-year-old steers and cows will be advantageous.
- b. If the amount of alfalfa and other roughage is limited, but there is an abundance of grain, yearling steers or heifers, and calves, will make more economical use of the feed.

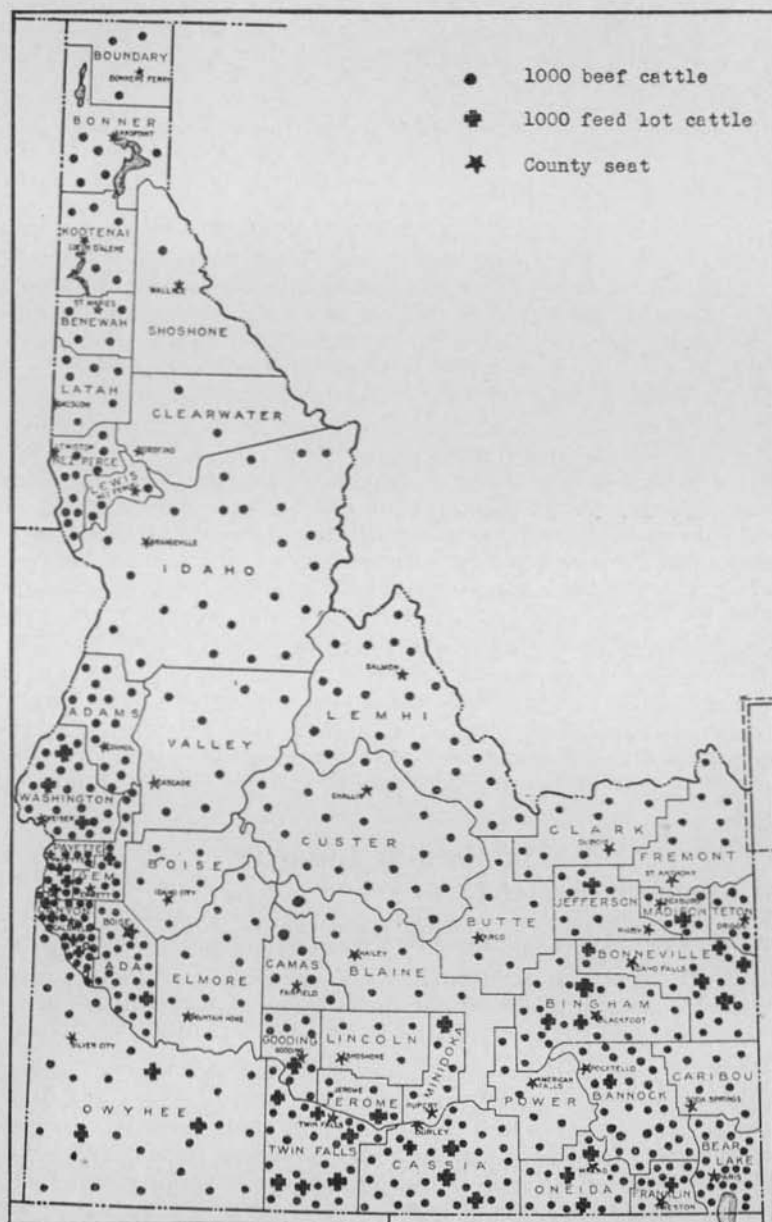


Fig. 2—Distribution of beef cattle and cattle feeding industries in Idaho.

2. Length of the Feeding Period:

- a. Older steers and cows in good flesh will finish in 60 days, while those that are thinner may require 120 days' feeding.
- b. Yearlings require a feeding period of 125 to 150 days, and calves 180 to 250 days.

Available Feeder Cattle

The number of feeder cattle available in Idaho each year depends upon weather conditions. If the feed crop was short the preceding year, a higher percentage of the cattle will be feeders the following fall. Good range conditions, with an abundance of grass, weeds and browse, and an ample water supply, will fatten many of the cattle. The supply of grass fat cattle in other range areas will affect the demand and price. Based upon the conditions of the last eight years, the cattle available as feeders each year are as follows:

Calves. In round numbers there are about 60,000 steer calves available each year, of which only a part can be bought. The majority of cattle outfits refuse to sell calves. The feeder desires calves that will be finished by the first of June. When the feeder calves are bought, only the older, larger and fleshier calves are taken. If all are sold there is so little weight that the cattle grower realizes a loss. The calves that can be bought are limited, usually not exceeding 5,000 head.

Yearling steers. In selecting yearlings, only the larger, fleshier steers will be sorted as feeders. The lighter, thinner steers will be cut back to run until they are two-year-olds.

Two-year-old steers. The supply of two-year-old steers for both short and long feeding averages 32,000 per year. The weight varies from 825 to 1050 pounds, but averages 940 pounds.

Three-year-old steers. Only a limited supply, constituting an 11-per cent sort from grass-fat cattle, or approximately 2000 head annually, has been available. The average weight has been slightly in excess of 1100 pounds.

Cows and heifers. Limited numbers of surplus cows and heifers are sold as feeders every year.

The majority of cattle outfits have a definite calving season, resulting in a spring and early summer crop of calves. In certain sections of the State, and in some outfits in all sections, the bulls are left with the herd the year around. This results in the production of steers of varying sizes and ages, requiring that they be bought in fairly large numbers and sorted according to size and apparent age.

Extension work with range cattle from 1926 to 1933 gave the average weight of the steers from range to market, or to the feed lot, as follows:

Class of Cattle	Number	Average Wt.
Calves	6,157	324 lbs.
Yearling steers	10,728	645 "
Two-year-old steers	44,218	994 "
Three-year-old steers	5,457	1,219 "

The disposal made of the above cattle was as follows:

Calves to feed lot, 2674; average weight 389 pounds.

Calves held over as stockers, 3483; average weight 273 pounds.

Yearling steers to feed lot, 3495; average weight 695 pounds.

Yearling steers, stocker cattle, 7233; average weight 622 pounds.

Two-year-old steers shipped to market, 21,488; average weight 1051 pounds.

Two-year-old steers to feed lot, 22,730; average weight 939 pounds.

Three-year-old steers to market, 4914; average weight 1231 pounds.

Three-year-old steers to feed lot, 543; average weight 1109 pounds.

Breeds. On the Idaho ranges use is made of both Hereford and Shorthorn bulls. Of more than 8,000 purebred bulls in use, 54 per cent are Herefords, 43 per cent Shorthorns and 3 per cent other beef breeds, mostly Aberdeen Angus*. Some outfits change breeds periodically. The majority of feeder cattle are either Herefords or Shorthorns, though brockle faces are common. Choice, good, and medium feeders are found in all sections and among all breeds, the grade of the cattle depending not upon the breed, but upon the individual merit of the breeding herd, as well as the



Fig. 3—A choice lot of Hereford heifers for the breeding herd. This kind of a breeding herd produces good to choice feeder steers.

*U. S. Census, 1930.

nature of the range and the winter management of the cattle. Experienced feeders select cattle by type, conformation, condition and quality rather than by breed. The old saying, "A good beef steer never has a poor color," is true. (Fig. 3).

Grades of Feeder Cattle

Feeder cattle are sorted and classified on the market by grades: fancy selected, choice, good, medium, common, and inferior. On the range feeder cattle will not be found in uniform, graded lots. In the average range herd the top grade of fancy selected, and the two lower grades, common and inferior, are seldom found. Steers from any one outfit usually will range from medium to choice, the majority grading good. However, it is never possible to secure cattle of one grade from the range without sorting. In years when there is but little difference between the prices of grass-fat and feeder cattle, a better grade of feeder cattle will be available.

Seasonal conditions affect the fleshing and thrift of the cattle. If the cattle are poorly wintered, the spring range late and cold and the summer hot and dry, with the feed scanty and the water scarce, they may be thin. The hair may look rough and the cattle have an appearance of being "tight hided." On the other hand, they may have been well wintered and kept on a good range all summer. In this case many of the older cattle will be fat. The feeder cattle will have the mellow, thrifty appearance of "good-doing" cattle. Cattle that are thriving and putting on flesh are a better buy than those that are being held on a poor range and are losing weight.

Cattle in stocker condition are often bought as feeders, but need a preliminary pasturing and feeding period. As a general rule the more flesh cattle carry the better the price that can be paid, as the weight can be bought cheaper than it can be put on in the feed lot. The longer cattle must be kept in the feed lot, the greater must be the spread between the buying and selling prices.

Purchasing Feeder Cattle

The movement of feeder cattle from the range depends upon grazing and weather conditions. In Idaho the movement starts in September and extends into November, with the peak coming during October. A variation of several weeks may be caused by a dry season or by early snows. The western feeder must secure his cattle before they have all been shipped.

To see cattle properly on the range, it is necessary to ride among them on level ground. On the mountain ranges the cattle above the rider will appear larger than they really are, while those below will seem smaller. When viewing cattle towards the sun, the size appears greater. The weight will not be known until after the cattle are purchased and weighed; hence if the

buyers want cattle of a specified weight, they should see them on level ground. The cattle will not be corralled until the sales agreement is made.

All of the steers from one outfit are usually sold at one time. Sorting and grading are necessary in order to make uniform carload lots that will finish evenly and go to market together. For those who desire only one or two carloads, cooperation with other feeders is necessary. One of the most satisfactory ways of securing feeder cattle is for the community to buy the entire supply together. The cattle are then sorted into uniform carload lots and weighed to the individual feeder at the actual delivered cost of cattle of this class and grade. In this way each feeder secures one or more carloads that can be fed together and be ready for market at the same time. Through the Intermountain region the distance from a market is so great that the feeder who does not have an even carload of market stock at one time is handicapped.

The steers from one outfit vary greatly in size and condition, with weight often varying from 600 to 1100 pounds. The larger, fleshier steers will be ready for market in 60 days, while the lighter, thinner steers will require from 150 to 180 days' feeding. Buying in fairly large numbers and sorting is advisable. Sorting of the cattle into even lots, with those of the same size fed together, is an advantage. The feeding of horned and dehorned cattle together is a mistake, lowering the average daily gain and increasing feed requirements.

Purchasing even-sized cattle all of one grade, and in specified numbers, on the range is possible only by paying a premium for the privilege. In sorting on the range a quick decision is necessary, and the buyer has only a glance. However, by taking steers of substance, with short, broad heads and straight backs, but few undesirable individuals will be found in a selected bunch. By starting with the best type steers and working downward a better lot will be selected than by starting at the lower end and cutting out the undesirable types.

It is not as important to secure cattle of a certain type, or that they be of a certain high market standard, as that they be well bought. Losses do not occur, necessarily, in feeding a poor grade of cattle, but in purchasing them at the price of good cattle. There is a profit to be made in feeding any kind of cattle provided they are bought right. An error at this time will be insurmountable.

In the range areas feeder cattle are often purchased through commission men who charge \$1.00 per head for the service. If the dealer is an expert on feeder cattle, and conscientious in buying, sorting and weighing, the commission is worth while, especially if the feeder is not experienced in buying on the range.

Preliminary Feeding or Pasturing

Trailing from the range to the feeding centers should be by easy stages, with ample grazing or night feeding to avoid excessive shrink. Upon arrival of the cattle at the ranch where they are to be fed, they should be allowed a week's rest on pasture or hay. Dehorning, sorting and any vaccination of young cattle may be done the day after arrival, while the cattle are tired and easy to handle.

Satisfactory pasture for feeder cattle needs to be rather abundant so that they may take on a good fill. The clipped aftermath may be so short that feeder cattle will lose rather than gain weight. As long as there are fairly luxuriant pastures available, cheap and satisfactory gains will be made. The pasture gains of good steers average from 1 to 1.5 pounds per head per day. However, as soon as the pastures become so short that the cattle must graze the entire day to satisfy their appetites, they should be removed and the pasture cleaned up with stock cattle or sheep.

Choice of Feeds

There is a variety of feeds for fattening cattle, but the basis for southern Idaho feeding is alfalfa hay. In many cases this forms the entire ration, yet there are feeding principles which should not be overlooked. If there is to be no waste the ration must be balanced; that is, there must be the proper amount of the different nutrients essential for the welfare of cattle. In this section, with alfalfa the main feed, the protein is in excess; hence the supplementary feeds that are of value are those rich in sugar and starches, such as corn, corn silage, beet pulp and barley.

In the Corn Belt, where corn is abundant and cheap, it forms the basic ration. In Idaho alfalfa is the surplus crop, hence is the basic ration. Early feeding in the tests reported in this bulletin was done almost entirely on hay alone, or hay and beet pulp. Western consumers, accustomed to grass or hay fattened beef, were slow to appreciate a high degree of finish, with the result that for many years the western markets paid almost as much for hay-fattened as for grain-fattened cattle. Within the last few years there has been a decided change and a corresponding rise in the market value placed on well-finished cattle. It is no longer necessary to send the well-finished cattle East and the thinner cut-backs and the hay-fattened cattle to the western markets. Some of the western consumers are becoming lovers of prime beef. To meet this demand the western markets are placing the necessary premium on finish to make the feeding of a good ration and a long feeding period profitable.

The cattle feeding rations in Idaho are now of five general classifications:

1. Alfalfa hay.
2. Alfalfa hay and sugar beet by-products.
3. Alfalfa hay and corn silage.

4. Alfalfa hay and grain.

5. Alfalfa hay, pulp or corn silage, and grain.

The hay may be fed long, cut or ground. Each method has its followers, and each has some advantage. Generally, cattle feeders prefer to have the hay processed, as there is less waste and more convenience in feeding a large number of cattle together.

For satisfactory results the hay must be good. Only cows and older steers will fatten on hay alone. The gains range from 1 to 1.3 pounds per day.

The addition of either pulp or corn silage to the ration increases the finish and the rate of daily gain. As pulp is fed in the vicinity of the sugar beet factories, syrup is often fed in connection. The amount of corn silage fed ranges from 15 to 35 pounds per day. Generally the pulp and silage fed cattle gain practically the same, the average daily gain ranging from 1.4 to 1.7 pounds per day.

Ground or rolled barley is the grain most generally used. A standard ration is from 5 to 10 pounds. Corn grown locally or shipped in may be substituted for the barley, and usually has approximately the same value, pound for pound. The cattle fed a good grain ration gain more, ship with less shrink and out-sell those fed on rations consisting only of roughage.

Various combinations of the different feeds are now used. A ration other than hay alone is generally preferred. The practice of adding grain to the silage and pulp ration is generally favored, as is the use of sugar beet syrup.

Equipment for Fattening Cattle in Idaho

Most of the cattle feeding in Idaho is in open corrals. A wind-break of trees, or a fence made of boards or brush, affords con-

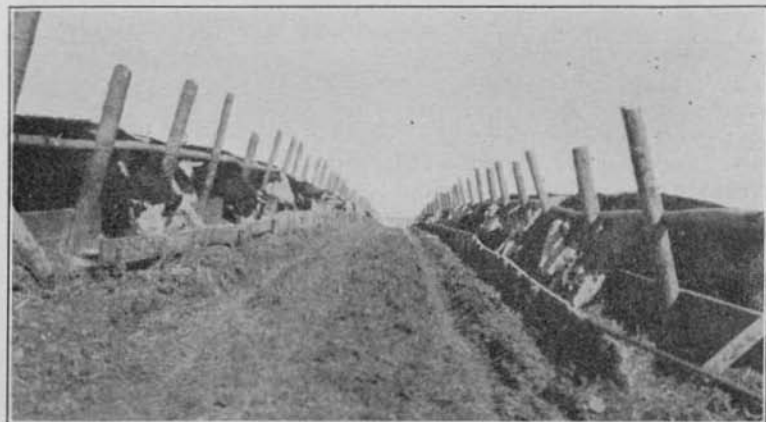


Fig. 4—Arrangement of lots and common method of feeding alfalfa and pulp.

siderable protection from the wind and drifting snow. The corrals are preferably located on a well-drained slope, a southern slope being desirable. Shelter and paved feed lots are not used in Idaho. Practically all of the feed lots are in the open, but the selection of a location with ample drainage is important. Cattle gain slowly in muddy, uncomfortable lots, without a dry, straw-covered bed ground.

Cattle feeding equipment is simple and inexpensive. The majority of the cattle are fed in corrals made of poles, which are cut in the mountains and hauled to the ranch during the summer. Pulp, and often hay, or a mixture of ground hay, syrup and grain, are fed from the outside of pole corrals. The corral fences are built in straight lines, and the feed is fed from a slowly moving wagon. The cattle reach through the opening to obtain the feed (Fig. 4).

Long, chopped or ground hay is usually fed in racks of various designs. Grain is fed in feed bunks placed within the corral. Silage is fed in either the grain bunks or hay racks. (Fig. 5).

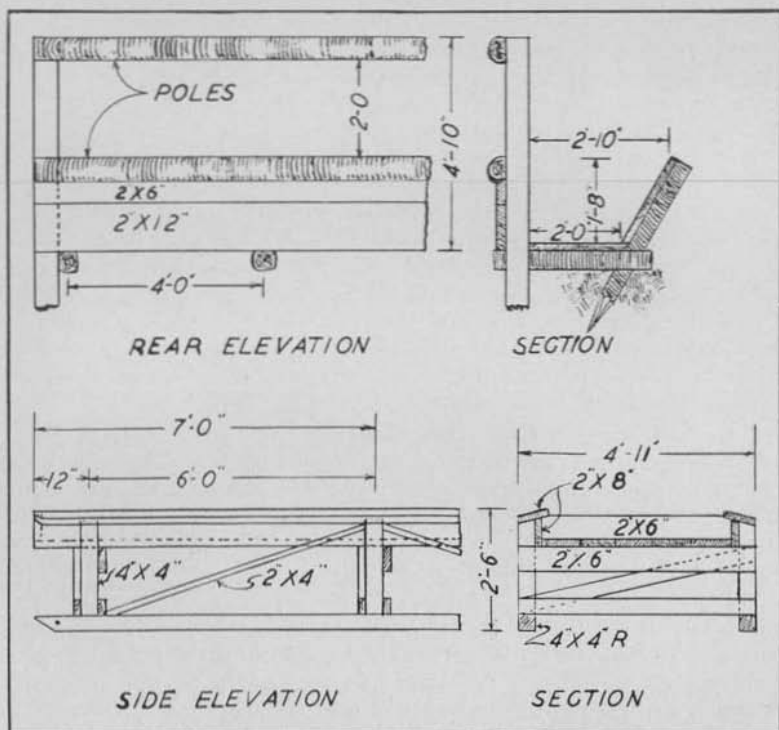


Fig. 5—Plans of a grain bunk and of racks suitable for feeding pulp, silage and hay.

Contract Feeding

Many Idaho cattle are fed on contract. The cattlemen may not desire to sell their feeder cattle at the prevailing price, but may put them out on farms with a surplus of feed on a cooperative agreement. Four forms of contract are in general use.

(a) **Guaranteed Spread:** The cattle are weighed up to the farmer at the market price. The cattle owner immediately contracts the cattle for return delivery in a specified length of time on a fat-cattle basis. The spread varies according to the method of feeding, the length of the feeding period and the price of the feeds. This method has generally proved satisfactory to the feeder but often not to the cattle owner.

(b) **Purchase of Feed Method:** The feed is purchased by the cattleman, who then signs a contract with the farmer to feed the cattle in a satisfactory manner. The consideration for feeding is usually \$1.00 per ton for roughage and \$3.00 per ton for grain. This method has generally proved satisfactory to the feeder, but not always to the cattle owner, as there may be the feeling that cattle fed in this way are not given the best of care.

(c) **Pounds-Gained Basis:** The cattle are weighed up to the farmer, who contracts to finish them for market. Two forms of prices are in use, one a sliding scale based upon the number of pounds gained, and the other a fixed rate. This, in 1921, was 10 cents per pound, in 1922 and 1923, 12½ cents, and since that time has varied from 12½ cents to 16 cents, until 1932-33, when the price was 7 cents. This method has generally proved satisfactory to both parties.

(d) **Cooperative Share Agreement:** The cattle are weighed up to the feeder at the actual market value. The feed is measured and its market value calculated, plus \$1.00 per ton for feeding the hay, silage and pulp, and \$3.00 per ton for feeding the grain. When the cattle are finished they are sold on the market and the cattle owner and feeder share in proportion to the original values of the cattle and the feed. This has been one of the most satisfactory methods of contract feeding.

The following data of the results of feeding 8,944 two-year-old steers on contract on 59 farms are typical of the results of feeding on the common Idaho rations. The minimum number put out on contract to any one farm was two carloads, or 50 head. The maximum number on one farm was 443. The average number to the farm was 152 steers.

All the cattle were weighed by the Extension Animal Husbandman, who was the third party to the contracts. All weights were the shrunk weights, either by weighing after trailing, after standing in a dry corral off water and feed for 12 hours, or weighed full with a 4 per cent shrink. Final weights were secured in the same way by special agreement of the three parties.

Most of the hay was fed chopped. The weights of the hay and the silage were determined by stack measurement and silo

capacity instead of weighing. The weight of the pulp was secured over the scales at the sugar factory as the pulp was hauled from the storage pits to the feed lots. The grain weights were estimated by the feeder, the party of the second part to the contract. As such, the feed data are not as accurate as experimental data where all feeds are weighed.

RESULTS OF CONTRACT STEER FEEDING

All Cattle Weighed. Weights of Hay and Silage Based on Measurement. Pulp Weighed and Grain Estimated.

	Hay	Hay & Corn Silage	Hay & Beet Pulp	Hay & Grain	Hay Suc-culence Grain
Number of steers	2228	2798	1940	736	1242
Av. number of days	115	120	124	120	113
Av. initial wt., lbs.	973	893	962	933	971
Av. final wt., "	1126	1062	1151	1125	1167
Av. daily gain, "	1.33	1.41	1.52	1.60	1.73
Average Daily Ration:					
Alfalfa Hay	33.68	23.70	24.66	24.49	27.91
Corn Silage .....	.....	24.55	.....	.....	13.98
Beet Pulp .....	.....	.....	72.20	.....	.....
Barley .....	.....	.....	.....	7.13	3.63
Feed for 100 lbs. Gain:					
Alfalfa Hay	2532	1683	1618	1531	1609
Corn Silage .....	.....	1743	.....	.....	806
Beet Pulp .....	.....	.....	4737	.....	.....
Barley .....	.....	.....	.....	446	209

Part II. Experimental Cattle Feeding*

Objects of Experiments

The objects of these experiments were to determine: (1) The value of alfalfa hay in different forms when fed alone and in combination with other feeds for fattening two-year-old steers; (2) The efficient use of alfalfa in combination with other feeds for fattening yearling steers and calves; (3) The influence of age upon gains and feed requirements when alfalfa hay is fed in abundance; (4) The value of protein supplements; (5) The influence of mineral (phosphorus) supplements for fattening steer calves; (6) The influence of shelter and warm drinking water upon gains and feed requirements of yearling and two-year-old steers. (Fig. 6).

General Information

The Caldwell Substation is near the center of the Boise valley, at an elevation of 2372 feet. The winters are generally open, with most of the moisture coming in the form of rain during the fall of the year. The farm consists of one-half section of land, of

*A summary of cattle feeding experiments at the Caldwell Substation, from the fall of 1919 to the spring of 1934, is reported in this bulletin.

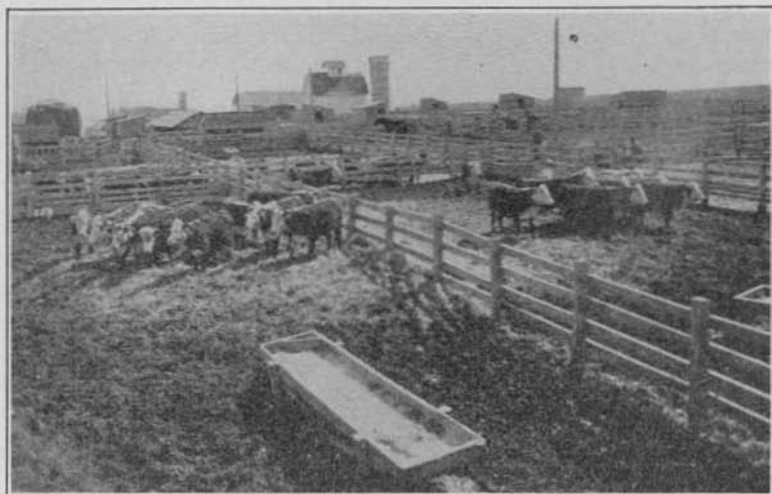


Fig. 6—Two-year-old steers of 1929-30 in the feedlots at the Caldwell Substation. A good straw bed is provided in all lots.

which 267 acres are irrigated. The main crops have been alfalfa hay, corn, barley and oats. The corn crop usually goes into the silo, though it may be grown to maturity.

During the 15 years that this report covers, 1,200 head of cattle, consisting of 786 two-year-old steers, 199 yearling steers, 180 steer calves, 5 heifer calves and 30 cows were fattened. The cattle were all direct from the ranges, from the Owyhee section and from the Payette, Boise and Sawtooth National Forests. The Owyhee ranges are located in the southwestern part of the state, and are of the desert and mountainous type, consisting of public domain and privately owned grazing lands.

As money was not available for the purchase of feeder cattle, the experimental feeding for four years, 1919 to 1923, was with contract cattle. During the years 1919-20 and 1920-21, the cattle were fed on a \$2.00 per cwt. spread, from \$8.00 to \$10.00, and from \$6.00 to \$8.00. In 1921-22 and 1922-23 the feeding was on a pounds-gained basis, \$10.00 and \$12.50 for each hundred pounds put on. At the completion of the feeding experiments the first four years the cattle were turned back to the owner to complete the contract, and marketing data were not secured.

Beginning in 1923-24 and continuing for three years the cattle were purchased on the deferred payment plan with final settlement made from the receipts at time of sale. This procedure permitted the Experiment Station to secure shipping and marketing data. Beginning with 1926-27, a revolving fund derived from an allotment of Purnell funds was established to permit the purchase of steers and lambs for experimental feeding.

Feeder Cattle Used

The grades of cattle used ranged from medium to good. Of the 1,200 cattle fed, 1,000 were of Shorthorn and Hereford breeding, while 200 were Angus. An attempt was made to feed average range cattle, with the exception that during the winters of 1920-21, 1929-30 and since 1931, better grades of cattle were selected. This was done by sorting on the range, paying a premium for the privilege.

The demand for fat cattle on the western market after the close of the grass cattle season starts in December and extends into May or June of the following year. The early months of the fat cattle demand can be filled only with two-year- and three-year-old steers. Fed yearlings start to market in March, while calves are not available until April and May.

A part of the two-year-old steers carry enough finish to sell fat off the grass. Others are in high enough condition that they will finish in 60 days. The two-year-old steers that go into the feed lot for a long feeding period are the smaller, lighter and thinner steers, that sell at a lower price per pound.

The average weight of the 786 two-year-old steers used in the experiments was 947 pounds. They were fed an average of 120 days and gained an average of 201 pounds, an average daily gain of 1.67 pounds.

Although thin yearlings and light calves can be fattened, the necessary feeding period is so long that it extends into the following summer, when the supply of grass-fat cattle is excessive. While the fed and grass-fat cattle do not compete directly, all market prices on Northwest markets are generally lower, giving insufficient spread in price to make a long feeding period profitable.

The 199 yearlings selected averaged 737 pounds off the range. They were fed an average of 134 days, making an average gain of 265 pounds, an average daily gain of 1.98 pounds.

Calves bought for the feed lot must be of good breeding and of good type and conformation. They should be deep-bodied, low-set and carry the milk fat. Calves that are rangy and thin in flesh should be cut back to run as stockers.

The 180 calves used in the experiments were April and May calves. The calves selected averaged 417 pounds off the range. They were fed an average of 198 days, gaining an average of 409 pounds, an average daily gain of 2.07 pounds.

Feeds Used.

Alfalfa hay. The hay in the experiments was grown locally. Usually three crops of hay were harvested. Since 1931 the hay has been chopped directly from the field. This hay was chopped into 1/2- to 1-inch lengths.

Barley. Locally grown Trebi barley, of uniform high quality and weight per bushel, was used. It was plump and well filled, averaging 48 to 52 pounds per bushel. All barley was fed ground.

Corn. Locally grown shelled corn was fed. It graded No. 2 to No. 4 depending on its moisture content.

Corn silage. The silage fed was made from Substation-grown corn which was cut during the denting stage.

Wheat. The wheat fed was soft wheat, grown locally under irrigation, and was fed ground. The average weight per bushel ranged from 57.5 to 60 pounds.

Oats. The oats were produced locally and weighed from 38 to 42.8 pounds per bushel. All oats fed were ground.

Cull beans. The beans (Great Northern variety) were grown in Twin Falls County and consisted of the immature, discolored, small and split beans. They were cleaned after removal from the first grade stock and were free of foreign material.

Cull potatoes. The potatoes were fed during a year of low potato prices and consisted of field run potatoes, with the first grade stock removed. Spoiled potatoes were not used in the experiment.

Cottonseed meal and linseed oil meal. Cottonseed and linseed oil meal are high protein feeds, relatively high in price, and used in limited amounts. The guaranteed protein content of cottonseed meal was 43 per cent, and of linseed oil meal 34 per cent.

Soybeans. The soybeans were of the Minsoy variety, grown on the Caldwell Substation. They were fed ground.

Preparation of Feeds

Chopping and Grinding of Alfalfa Hay. Chopped hay is prepared with a machine equipped with sharp knives. The hay varies in fineness, depending largely on the number and sharpness of the knives, their revolving speed and the rate at which the hay is fed into the machine. The usual machine for grinding hay is equipped with revolving hammers traveling at a high rate of speed which pulverize the material until it is fine enough to go through the openings in a surrounding screen. Screens with variable sized perforations are made for each machine so that the degree of fineness may be regulated. The capacity of a machine is in direct ratio to the screen size, while the cost of preparation increases with the smaller screen sizes.

From the standpoint of fineness, not a great deal of difference can be found between chopped hay prepared under the best of conditions and ground hay prepared with a large sized screen. In the ground hay practically all the stems are split lengthwise, giving it a lighter color and a fluffier appearance. All hay used in the chopped hay experiments reported herein was prepared with some type of ensilage or hay chopping machine. The ground hay used was prepared with a small hammer-type grinder using a screen with 1/4-inch perforations.

Grain Grinding. During the first years of the experiments the grain was prepared with a roller mill. Since 1925 some type of a hammer mill has been used. Some variation in the fineness of ground feed occurred which was due largely to the size of the perforations in the screens used. Screens with 3/16- and 1/4-inch perforations were used entirely for grinding barley and oats, the smaller size being used for barley and the larger size for oats. Fineness modulus determination for barley ground through a 3/16-inch perforation screen was 2.65 and for oats through a 1/4-inch perforation screen was 2.11. Fineness modulus or index system for expressing and comparing feed grinding results was developed by the Rural Electrification Division of the American Society of Agricultural Engineers. Details of feed grinding and forage processing appear in Idaho Experiment Station Bulletin No. 180, *Rural Electrification Development in Idaho*.

Feed Costs

Feed costs of any combination of feeds may be determined from the tables by using the market value of the feed required for 100 pounds gain.

Losses

Of the 1,200 head of cattle fed, 10 steers and 1 cow were lost from bloat. Two calves were lost from hemorrhagic septicemia in 1933, and 1 calf from bloat in 1934. One steer died from an accident.

Bloating occurs to the greatest extent on a ration of alfalfa hay and barley, or alfalfa hay and wheat. On the ration of alfalfa hay and barley 120 steers were fed. Of this number 6 steers died from bloat, a loss of 5 per cent. This loss was heavy, but is typical of cattle fed on this ration. The combinations of alfalfa hay and barley, or alfalfa hay and wheat, tend to produce digestive disorders in certain individuals, resulting in bloating. The greatest difficulty is experienced at the start, but this ration is dangerous at all periods. The addition of any supplementary feed such as silage, oats or cottonseed, alleviates this danger. During the winter of 1930-31 a part of the steers on both barley and hay, and wheat and hay, bloated, resulting in the loss of one steer in each lot. Of the 10 steers and 1 cow lost, 7 head were on a ration of alfalfa hay and barley, 1 on alfalfa hay and wheat, 1 on alfalfa hay and corn and 2 on alfalfa hay, barley and corn silage. Bloating on a ration containing corn silage or beet pulp is rare and is confined to certain individuals that are chronic bloaters and show a mild form of bloating after every feed.

In commercial feeding the danger of bloating can be reduced by the addition of oats, pulp, silage, syrup or cottonseed to the ration, and some feeders make it a practice to include oats in the ration until the cattle have become accustomed to the grain. Mixing bulky feeds, such as chopped hay, silage, pulp or

potatoes with grain, is excellent to prevent too rapid consumption, which is often a fore-runner of bloat. Frozen feeds, such as potatoes, silage or pulp, and wet hay, are injurious, often causing bloat and other digestive disorders. Bloating may be corrected by the use of a purgative in the form of salts or mineral oil. Chronic bloaters should be removed to a separate feed lot and fed a different ration.

Shrink

Shrink to market is based on the difference between the average of three days' final weighings at the Substation, and the selling weight on the market.

Market Value

The market value per head is the selling weight multiplied by the price received per hundredweight. Occasional poorly finished steers naturally lowered the market value in some lots. When the poor finish was due to the unthriftiness of the individual steer, he was removed from the experiment and sold individually.

Carcass Grading

The dressing percentage and market grading were not secured on the cattle of the first four years' feeding, which were fed on contract. The last 10 years the cattle were sold by individual lots on the market, and the carcass grading was given by Swift and Company, who purchased the cattle 9 out of 10 years.

Plan and Procedure

The cattle were purchased in October or November, depending upon the movement of cattle from the range. In the early part of the feeding, use was made of horned cattle, but as a result of comparative trials made in 1923-24, the practice of feeding horned cattle in a small corral was discontinued. Since that time dehorned cattle have been used in the experiments. The cattle are held in the lots on hay until they recover from the trail from the range, and in case of dehorning, until they recover from the shock of the operation.

All the cattle were fed in open corrals, without shelter or windbreak, with the exception that shelter has been provided for one lot since 1929 as an experiment to determine the advisability of shelter for fattening cattle. Straw was used to keep a dry bed. Salt was kept before the cattle at all times. Water, pumped from a well, was supplied in concrete troughs placed at the inter-section of four adjacent lots. During the early years of the experiments no attempt was made to heat the water. During severe weather, difficulty was experienced with the water freezing in the troughs. In 1930 a trial was started and continued for three years, to determine the advisability of heating water for fattening cattle.

Order and Method of Feeding

During the greater part of the period covered in the experiments, the best utilization of cheap alfalfa hay was one of the principal objects in feeding two-year-old steers. The alfalfa hay was fed three times a day in sufficient quantities to satisfy the appetites of the steers, allowing some waste. The amount of waste or refused hay varied from time to time with the quality of hay fed, the better quality hay making less waste. All waste hay was taken from the feed bunks each morning. Variation in the regularity of feeding was slight.

Grain and silage were fed in separate feed bunks about 30 minutes after the feeding of hay. When grain and silage were fed together, the grain was spread evenly over the silage and mixed. Two-year-old steers were raised to a full feed of silage within 10 days and to a full feed of grain in 20 days, or an increase of one-half pound per day. Yearling steers required 25 to 30 days to become accustomed to grain, which in most cases was ground barley, but could be raised to a full feed in a shorter period when the barley was combined with silage. Care was given to the general cleanliness of the feed bunks. All excess feed was removed within a short time after feeding.

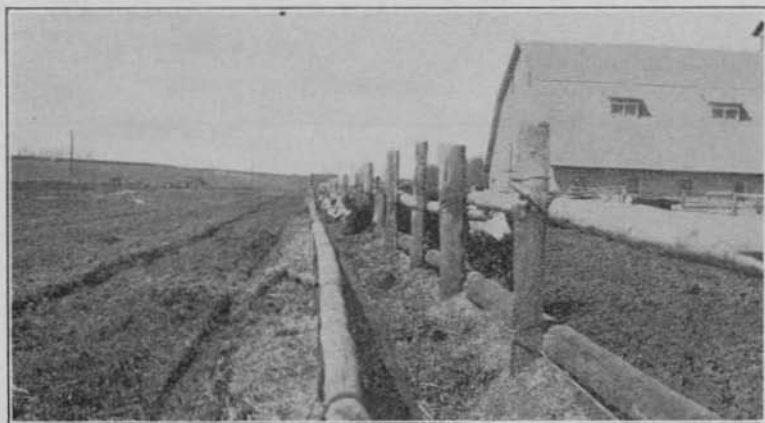


Fig. 7—A good type of manger and arrangement of corrals.

The same order of feeding was followed with chopped and ground hay as with long hay. No difference was made in feeding yearlings and two-year-olds. In feeding calves the grain was fed before the hay, for the purpose of limiting the hay and inducing a larger consumption of grain.

Grain and silage rations were weighed each day. Hay was weighed in load quantities, stored in sheds adjacent to each lot and fed as required. All waste hay was kept in convenient piles and weighed back once or twice a week.

Number of Steers Per Lot

The number of steers per lot ranged from 8 to 15.

Weights

For initial and final weights of the feeding period the cattle were weighed individually for three consecutive days. The average of the three-days' weights without shrink was used for the initial and final weights, respectively. One-day group weighings were made at 28-day intervals, with an individual check weight of any unthrifty steer.

All steers were neck-banded and carried individual numbers. Individual weights were taken on three consecutive days at the beginning and end of the feeding experiments. During the early years of the experiments weights were taken at 14-day intervals with individual weights alternating with group weights, but this system caused so much nervousness and excitement of western range steers that the gains were lowered; hence the practice was discontinued and the weighing confined to group weights at 28-day periods. The practice of three days' individual weighing at the beginning and close of the experiment invariably shrinks the cattle, which are wild and nervous, so that at both the beginning and close the weights the first day are greater than the third day. Taking the cattle from the lot and weighing them individually once a month causes them to be so excited and nervous that gains cease for a period estimated at from three to seven days.

In taking individual weights three days in succession, the average of the second day's weights was 2.96 per cent less than the first day's initial weight. The average of the third day was the same as the second. This makes the average of the three days' initial weights 1.95 per cent less than the first day's initial weight, which would be the commercial weight of the cattle.

In the final three days' weighing, the second day's weight of all the steers averaged 1.80 per cent less than the first day's weight. The third day's weight averaged .59 per cent less than the second day's weight. Thus the average of three days' final weighing is 1.39 per cent less than if the cattle had been weighed only once. Therefore, the initial weight of the various lots of cattle is the full weight less 1.95 per cent. In calculating the actual market shrinkage, 1.39 per cent should be added to the shrinkages given in the tables, which are based on a three days' average individual weight, of which the first day should be taken as the actual full afternoon weight of the cattle. Three days' individual weighing is the standard method of weighing experimental cattle. While undoubtedly of value in weighing farm cattle, or range cattle that have been gentled by a long trip to market, it is detrimental to the quietness and thrift of cattle directly off the range.

Basic Ration

Alfalfa hay has been taken as the basic ration in all experiments, and has been fed liberally.

Discussion of Results*

Comparative Studies of Alfalfa Hay Fed Long, Chopped and Ground, Alone and in Combination With Other Feeds, for Fattening Two-year-old Steers.

Comparing long alfalfa alone with chopped alfalfa alone. Long alfalfa was compared with chopped alfalfa in three trials (Table I). The steers fed long alfalfa gained 1.18 pounds daily, while the steers fed chopped alfalfa gained 1.31 pounds daily. Chopping the alfalfa saved 15.1 per cent of the hay required for 100 pounds gain, and increased the rate of gain 10.8 per cent.

TABLE I
Long Alfalfa Alone vs. Chopped Alfalfa Alone
3 Trials—1919-20*, 1922-23*, 1927-28

	Long Alfalfa	Chopped Alfalfa
Number of steers	30	30
Days fed	113	113
Average initial weight, lbs.	972	967
Average final weight, "	1106	1115
Average total gain, "	134	148
Average daily gain, "	1.18	1.31
Average daily ration:		
Long alfalfa, lbs.	31.45	.....
Chopped alfalfa, " .....	.....	29.78
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	2699	.....
Chopped alfalfa, " .....	.....	2290
Per cent waste hay	9.96	5.89

*Steers in these trials were fed on contract, and market data were not available.

The steers in 1919-20 and 1922-23 were fed on contract, one year at 2 cents spread, and the other at 10 cents per pound gain. In 1927-28 the steers were sold on the open market.

With long alfalfa worth \$8.00 per ton, the chopped alfalfa had a replacement value of \$9.43 per ton. Since chopping the hay cost \$1.50 per ton, the value of the chopped hay lacked 7 cents per ton justifying the chopping.

When the steers were fed on contract, the practice of chopping did not prove profitable. Results of the steers fed in 1927-28 are given separately in Table V.

*All tables in the bulletin are based on the average weight, feed consumption and feed requirements. In the feed for 100 pounds gain the total amount of hay fed is given. To obtain the amount actually consumed, the amount of waste hay must be deducted.



Fig. 8—Arrangement of open lots for feeding hay and pulp.

Comparing long alfalfa and corn silage with chopped alfalfa and corn silage. Long alfalfa and corn silage were compared with chopped alfalfa and corn silage in three trials (*Table II*). Chopping the alfalfa increased the rate of daily gain from 1.3 pounds to 1.5 pounds, an increase of 15.7 per cent. The actual consumption of chopped alfalfa was slightly greater. Chopping the alfalfa saved 13.8 per cent hay and 14.1 per cent corn silage in the feed requirements for 100 pounds gain. Each ton of chopped alfalfa produced as much gain as 2,321 pounds of long hay and 169 pounds of corn silage. With long alfalfa at \$8.00 per ton

TABLE II

Long Alfalfa and Corn Silage vs. Chopped Alfalfa and Corn Silage
3 Trials—1919-20, 1921-22, 1922-23*

	Long Alfalfa Corn Silage	Chopped Alfalfa Corn Silage
Number of steers	32	32
Days fed	100	100
Average initial weight, lbs.	979	987
Average final weight, "	1109	1137
Average total gain, "	130	150
Average daily gain, "	1.3	1.5
Average daily ration:		
Long alfalfa, lbs.	28.39	.....
Chopped alfalfa, " .....	.....	28.02
Corn silage, "	14.75	14.63
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	2191	.....
Chopped alfalfa, " .....	.....	1888
Corn silage, "	1138	978
Per cent waste hay	14.08	7.97

*Steers in these trials were fed on contract, and market data were not available.

and corn silage at \$4.00 per ton, each ton of chopped alfalfa had a value of \$9.62 per ton on the basis of the corn silage and alfalfa replaced, which was 12 cents per ton above cost.

Comparing long alfalfa and barley with chopped alfalfa and barley. Long alfalfa and barley were compared with chopped alfalfa and barley in six trials (Table III). Chopping the alfalfa increased the rate of gain from 1.71 pounds to 1.86 pounds daily, or 8.9 per cent. The actual daily consumption of hay was essentially the same for both lots, 23.37 pounds of long alfalfa and 23.05 pounds of chopped alfalfa. Chopping the alfalfa saved 15.3 per cent alfalfa, and 9.5 per cent barley for 100 pounds gain. Each ton of chopped alfalfa fed produced as much gain as 2,362 pounds of long alfalfa and 56 pounds of barley. With long alfalfa at \$8.00 per ton, and barley at \$20.00 per ton, each ton of chopped hay had a feed replacement value of \$10.01 per ton.

The first three years the steers were fed on contract, and the last three years they were shipped to the open market. The

TABLE III

Long Alfalfa and Ground Barley vs. Chopped Alfalfa and Ground Barley
6 Trials—1919-20*, 1921-22*, 1922-23*, 1923-24, 1926-27, 1928-29

	Long Alfalfa Ground Barley	Chopped Alfalfa Ground Barley
Number of steers	62	62
Days fed	122	122
Average initial weight, lbs.	935	935
Average final weight, "	1144	1163
Average total gain, "	209	228
Average daily gain, "	1.71	1.86
Average daily ration:		
Long alfalfa, lbs.	27.06	.....
Chopped alfalfa, " .....	.....	24.58
Ground barley, "	6.89	6.84
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	1592	.....
Chopped alfalfa, " .....	.....	1348
Ground barley, "	401	363
Per cent waste hay	13.64	6.24
*Marketing data on 59 steers, 1923-24, 1926-27, 1928-29.		
Market weight, lbs.	1102	1127
Shrink to market, per cent	3.52	4.29
Market price per cwt.	\$ 10.36	\$ 10.35
Market value per head	114.18	116.64
**Dressing percentage, 1926-27, 1928-29	60.0	58.8
Carcass grading:		
Choice	7	4
Good	13	11
Medium .....	.....	5

*Steers were fed on contract in 1919-20, 1921-22, 1922-23, and market data were not available.

**Dressing percentage and carcass grading on 40 steers, 1926-27 and 1928-29.

steers fed long alfalfa shipped with less shrink and sold at a slightly higher price per cwt. on the market than the steers fed chopped alfalfa. This increased value and the higher dressing percentage were due to less paunchiness.

Of the three lots of cattle on the market, two were followed through the packing house. On these two lots the finish of the steers, as indicated by shrinkage to market, dressing percentage and carcass grading, was not improved by chopping the alfalfa.

Crediting the feed replacement and market value of the steers reported in Table III, chopped alfalfa had a value of \$9.73 when long alfalfa was worth \$8.00.

Comparing long, chopped and ground alfalfa hay when fed with ground barley. One year (1926-27) chopped alfalfa showed an advantage, while the other year (1928-29) ground alfalfa proved superior (Table IV). This variation was due to the difference in the quality of hay. In 1926-27 the alfalfa was somewhat coarse, with some fibrous, weedy material which was refused and taken out as waste in the lots fed chopped and long alfalfa. When ground, this coarse material was consumed be-

TABLE IV
Comparison of Long, Chopped and Ground Alfalfa
2 Trials—1926-27, 1928-29

	Long Alfalfa Ground Barley	Chopped Alfalfa Ground Barley	Ground Alfalfa Ground Barley
Number of steers	20	20	20
Days fed	145	145	145
Average initial weight, lbs.	879	876	885
Average final weight, "	1125	1167	1174
Average total gain, "	246	291	289
Average daily gain, "	1.71	2.03	1.99
Average daily ration:			
Long alfalfa, lbs.	21.01	.....	.....
Chopped alfalfa, " .....	.....	20.95	.....
Alfalfa meal, " .....	.....	.....	20.77
Ground barley, "	8.52	8.51	8.44
Feed for 100 lbs. gain:			
Long alfalfa, lbs.	1235	.....	.....
Chopped alfalfa, " .....	.....	1036	.....
Alfalfa meal, " .....	.....	.....	1041
Ground barley "	496	419	424
Per cent waste hay	10.75	4.95	0.0
Market weight, lbs.	1094	1124	1134
Shrink to market, per cent	3.18	4.40	3.33
Market price per cwt.	\$ 11.40	\$ 11.29	\$ 10.92
Market value per head	124.70	126.90	123.87
Dressing percentage	60.0	59.0	59.3
Carcass grading:			
Choice	7	3	4
Good	13	11	15
Medium .....	.....	6	1

cause the steers were unable to refuse it. Lacking in digestible nutrients, the woody stems served only as a filler, lowering the average daily gain and increasing the feed requirements. In 1928-29 the hay was of good quality, with the result that the steers on ground alfalfa gained more, with lower feed requirements.

Chopping cost \$1.50 and grinding \$3.00 per ton. Both years the long hay cattle sold at a higher price per cwt. than the steers fed chopped or ground hay. In 1926-27 this was due to their better market appearance. In 1928-29 the long-hay-fed steers had a better market appearance than the chopped-hay-fed steers, but not as good as the ground-hay-fed steers. The steers fed ground hay were discriminated against, however, because their weight put them in the class above "1100-pound steers" at a time when lighter weights were desired.

TABLE V
A—Comparison of Long, Chopped, and Ground Alfalfa Fed Alone.
B—The Value of Barley and Corn Silage Added to Long Alfalfa.

1 Trial—1927-28

	Long Alfalfa	Chopped Alfalfa	Ground Alfalfa	Long Alfalfa Ground Barley	Long Alfalfa Ground Barley Silage
Number of steers	8	8	8	8	8
Days fed	147	147	147	147	147
Average initial wt., lbs.	898	889	889	899	885
Average final wt., "	1082	1095	1126	1158	1156
Average total gain, "	184	206	237	259	271
Average daily gain, "	1.25	1.40	1.62	1.76	1.85
Average daily ration:					
Long alfalfa, lbs.	28.35	.....	.....	22.99	14.53
Chopped alfalfa " .....	.....	27.26	.....	.....	.....
Ground alfalfa, " .....	.....	.....	29.25	.....	.....
Ground barley, " .....	.....	.....	.....	9.08	9.03
Corn silage, " .....	.....	.....	.....	.....	14.91
Feed for 100 lbs. gain:					
Long alfalfa, lbs.	2370	.....	.....	1309	787
Chopped alfalfa, " .....	.....	1945	.....	.....	.....
Ground alfalfa, " .....	.....	.....	1827	.....	.....
Ground barley, " .....	.....	.....	.....	517	490
Corn silage, " .....	.....	.....	.....	.....	808
Per cent waste hay	9.3	3.9	0.0	14.03	13.90
Market weight, lbs.	1006	1012	1061	1104	1109
Shrink to market, per ct.	7.15	6.90	4.61	4.86	4.54
Market price per cwt.	\$ 11.10	\$ 11.50	\$ 11.75	\$ 12.25	\$ 12.50
Market value per head	112.34	116.44	124.70	135.21	138.59
Dressing percentage	56.7	57.9	56.7	60.9	62.5
Carcass grading:					
Choice .....	.....	.....	.....	.....	2
Good	3	8	5	8	6
Medium	5	.....	3*	.....	.....

*Graded down because of dark color.

Comparing long, chopped and ground alfalfa fed alone, and the value of barley and barley and silage added to a long hay ration. One trial with five lots of cattle was made on alfalfa in different forms compared with hay and barley, and hay, silage and barley (Table V). The purpose of the trial was to determine the value of good quality alfalfa hay fed long, chopped and ground as the sole ration for cattle; also to determine the result of improving the hay alone ration by adding various other feeds. The results indicate an improvement in the long alfalfa ration, both by preparation of the hay and by addition of other feeds. Gains on chopped alfalfa were 12.1 per cent greater than on long alfalfa, while the gains on ground alfalfa were 15.3 per cent greater than on chopped alfalfa, and 29.3 per cent greater than on long alfalfa. This order of gains corresponds to the relative amounts of hay eaten daily, the ground hay being consumed in the largest and the long hay in the smallest amounts.

Hay required for 100 pounds gain was reduced 17.9 per cent by chopping. The steers fed ground hay required 6.1 per cent less than those fed chopped hay and 22.9 per cent less than those fed long hay to produce 100 pounds gain. With long alfalfa at \$8.00 per ton, chopping increased its value to \$9.75 and grinding to \$10.38 per ton, but as the cost of chopping was \$1.50 per ton, and the grinding \$3.00 per ton, chopping returned only 25 cents per ton margin, while grinding lost 62 cents per ton, on the basis of feed replacement values. The value of processing was due to the increased weight and value of the finished cattle.

Summary of long, chopped and ground alfalfa for fattening two-year-old steers. Table VI gives the summary of all results from feeding long, chopped and ground alfalfa in comparative

TABLE VI
Summary of Long, Chopped and Ground Hay for Fattening Two-Year-Old Steers.

	No. Trials	No. Steers	Av. Daily Gain	Per Cent Waste Hay	Feed for 100 lb. gain			Feed Cost 100 lb. Gain*
					Alfalfa	Silage	Grain	
Hay alone:								
Long	4	42	1.19	9.96	2450	.....	.....	\$ 9.80
Chopped	4	42	1.32	5.93	2142	.....	.....	10.17
Ground	2	19	1.57	0.0	1993	.....	.....	10.96
Hay & Silage:								
Long hay	6	62	1.39	15.25	1973	1429	.....	\$10.75
Chop'd hay	6	67	1.60	6.14	1732	889	.....	10.01
Hay & Barley:								
Long hay	6	62	1.72	19.64	1529	.....	423	\$10.35
Chop'ed hay	6	62	1.89	9.91	1272	.....	382	9.86
Hay, bly. & sil.:								
Long hay	8	82	1.78	19.0	1114	1102	427	\$10.93
Chop'ed hay	7	74	1.90	6.13	1065	803	364	10.31

Feed Prices: Long alfalfa, \$8.00 a ton; chopped alfalfa, \$9.50; ground alfalfa, \$11.00; corn silage, \$4.00 per ton; all grain charged at \$20.00 a ton.

tests. In general, the practice of chopping or grinding the hay has been profitable. The rate of daily gain has been increased, feed requirements for 100 pounds gain lowered, and the finish of the cattle improved. Generally the cattle have eaten more chopped hay than long hay, and more ground hay than chopped hay; consequently gaining more, though this has been true only when the hay was of good quality. If the hay is of poor quality, the reverse may be true. There is, however, a great variation in the amount of hay different lots of cattle consume. In five years' trials, where three lots of cattle were fed the same ration, with the amounts of silage and barley fixed, there has been as great a variation as 3.5 pounds per head per day.

The variable amounts of waste hay, ranging from 4.32 to 23.16 per cent for long hay, and from 1.06 to 11.38 per cent for chopped hay, were largely due to variation in the quality of the hay. Stormy weather increases the percentage of waste hay.

Alfalfa hay, fed alone or in combination with other feeds, is the basis of Idaho's cattle fattening rations. When constituting a large proportion of the fattening ration, the alfalfa should be harvested while fairly green, only partially in bloom, and should be leafy and not coarse and stemmy. Variation in the quality of the hay is great. Gains are slow and expensive on coarse, over-ripe and stemmy hay. When the alfalfa is cut too green the tonnage is decreased and the hay is somewhat washy, though it is palatable and fed with little waste. In all the experimental trials, 1808 pounds of the choicest alfalfa hay was the minimum amount required for 100 pounds gain, while with the coarsest, over-ripe, poor quality hay the maximum was 3900 pounds.

Alfalfa hay may be fed long, chopped or ground. Each method has some advantages. Processing changes only the form and not the composition of the hay; it does not make a concentrate out of a bulky feed crop. However, it results in more complete utilization.

The advantage of processing depends upon the quality of the hay. In poor quality hay the portions low in palatability and nutritive value may constitute so large a part of the whole that the feed value will be reduced. When used only to add bulk to the ration, or as a filler to a concentrated ration, hay may be processed to prevent waste. However, when used for fattening steers, poor quality alfalfa hay is not improved by chopping or grinding. If the poor quality is due to large, coarse stems and weedy, fibrous material, cattle to be fattened will do better if fed alfalfa in a form which permits them to refuse the coarser, indigestible portions. On the other hand, the average of all the trials on chopped and ground alfalfa fed to steers shows an advantage in processing good quality alfalfa hay.

Poor quality alfalfa is generally fed whole, permitting the cattle to pick out the more palatable and desirable portions. The refused hay has sufficient feeding value to satisfactorily winter

stock cattle and horses. In the winter of 1919-20, 24 head of yearling steers were wintered on waste hay from the feed lot, supplemented by damaged hay from the tops and bottoms of the stacks. During the wintering period the yearlings made an average daily gain of .65 pound. They were successfully fattened as two-year-olds by the Station the following winter.

Ground hay is completely consumed by steers. Finely chopping the hay results in a small amount of waste, but with coarsely chopped hay the waste may be as great as with long hay. Feed requirements for 100 pounds gain decrease with the increasing fineness of the prepared alfalfa, both when fed alone and in combination with other feeds. The proportion of waste hay increases with the addition of other feeds.

The amount of chopped hay consumed daily has ranged as high as 3.4 pounds per head more than long hay of the same quality. The amount of ground hay has ranged from 1.3 to 3.0 pounds more per head daily than chopped hay. If the hay is of poor quality and contains a high proportion of coarse stems and unpalatable weeds, more long hay than either chopped or ground hay will be consumed.

Chopped or ground hay is handled with more convenience than long hay. The amount of storage space is materially reduced when the hay is processed. Chopping costs vary, but are lower when chopping is done as a part of the harvesting operation. Hay chopped directly from the field should be well cured and thoroughly dry before chopping. Grinding hay for small feeding units is expensive, though the increased daily gains and reduced feed requirements may offset the actual expense. The final decision of whether to chop or grind the hay depends upon the supply and price of hay, the cost of processing and the use that may be made of the waste hay.

The following table shows the composition of long, chopped and ground hay fed in the experiments and the analysis of the refused hay. Figures calculated on a moisture-free basis are included.

Chemical Analyses of Alfalfa Hay in Various Forms*

Feed	No. of Anal.	Water	Ash	Crude Protein	Crude Fat	Crude Fiber	Nitrogen free Extract
Long alfalfa	14	15.54	7.76	13.33	1.39	28.78	33.19
(fed)		0	9.18	15.76	1.65	34.63	40.02
Long alfalfa	7	21.38	5.35	6.90	0.82	36.81	28.75
(refused)		0	6.79	8.70	1.02	47.12	36.37
Chopped alfalfa	5	11.99	7.43	12.36	1.58	30.36	36.28
(fed)		0	8.45	14.06	1.79	34.79	40.92
Chopped alfalfa	2	16.27	4.89	8.79	1.17	35.25	33.63
(refused)		0	5.85	10.49	1.39	42.08	40.18
Ground alfalfa	3	8.79	7.45	12.89	1.48	31.02	38.38
(fed)		0	8.14	14.08	1.61	34.09	42.08

*Determinations made by the Department of Agricultural Chemistry, Idaho Experiment Station.

Comparative Studies With Corn Silage as a Supplement to Alfalfa and Alfalfa and Grain When Fed to Two-year-old Steers.

Alfalfa alone compared with long alfalfa and corn silage. Long alfalfa alone was compared with long alfalfa and corn silage in two trials (Table VII). The addition of corn silage in-

TABLE VII
Comparison of Long Alfalfa Alone vs. Long Alfalfa and Corn Silage
2 Trials—1919-20, 1922-23*

	Long Alfalfa	Long Alfalfa Corn Silage
Number of steers	22	21
Days fed	100	100
Average initial weight, lbs.	999	991
Average final weight, "	1115	1114
Average total gain, "	116	123
Average daily gain, "	1.16	1.23
Average daily ration:		
Long alfalfa, lbs.	32.57	27.03
Corn silage, " .....	.....	18.09
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	2819	2188
Corn silage, " .....	.....	1465
Per cent waste hay	10.2	18.58

*These steers were fed on contract and market data were not available.

creased the rate of gain from 1.16 to 1.23 pounds per head daily, or 6.7 per cent. Each ton of corn silage replaced 862 pounds of alfalfa hay. The amount of waste hay was increased from 10.2 per cent on hay alone to 18.5 per cent when silage was added to the ration.

With alfalfa at \$8.00 per ton, corn silage had a feed replacement value of \$3.45 per ton.

TABLE VIII
Chopped Alfalfa Alone vs. Chopped Alfalfa and Corn Silage
3 Trials—1919-20, 1920-21, 1922-23*

	Chopped Alfalfa	Chopped Alfalfa Corn Silage
Number of steers	34	34
Days fed	100	100
Average initial weight, lbs.	977	996
Average final weight, "	1121	1149
Average total gain, "	144	153
Average daily gain, "	1.43	1.53
Average daily ration:		
Chopped alfalfa, lbs.	30.87	27.39
Corn silage, " .....	.....	13.75
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	2201	1793
Corn silage, " .....	.....	900
Per cent waste hay	5.92	7.03

*Steers in these trials were fed on contract, and market data were not available.

Comparing chopped alfalfa alone with chopped alfalfa and corn silage. Chopped alfalfa alone was compared with chopped alfalfa and corn silage in three trials (*Table VIII*). By adding corn silage to the chopped alfalfa alone ration, the rate of daily gain was increased from 1.43 pounds daily to 1.53 pounds, or 6.7 per cent. One ton of corn silage replaced 907 pounds of chopped alfalfa. With chopped alfalfa at \$9.50 per ton, corn silage was worth \$4.31 per ton. The increased replacement value of corn silage fed with chopped alfalfa hay over that fed with long alfalfa hay (*Table VII*) is chiefly due to the higher cost per ton of the chopped hay.

Comparing different amounts of corn silage. Varying amounts of corn silage were compared in three trials (*Table IX*). The

TABLE IX
Comparing Different Amounts of Corn Silage
3 Trials—1920-21, 1921-22, 1922-23*

	Alfalfa Light Silage	Alfalfa Heavy Silage
Number of steers	33	32
Days fed	100	100
Average initial weight, lbs.	979	983
Average final weight, "	1125	1156
Average total gain, "	146	173
Average daily gain, "	1.47	1.73
Average daily ration:		
**Alfalfa hay, lbs.	27.20	25.15
Corn silage, "	14.87	24.71
Feed for 100 lbs. gain:		
Alfalfa hay, lbs.	1889	1544
Corn silage, "	1036	1525
Per cent waste hay	8.04	10.62

*These steers were fed on contract and market data were not available.

**Two lots fed long alfalfa and one lot fed chopped alfalfa in each group.

feeding of a larger amount of silage decreased the alfalfa requirement 18.3 per cent, but required 47.2 per cent more silage. On the heavier silage ration 7.9 per cent less total nutrients were required to produce 100 pounds gain, indicating that a larger amount of silage improved the balance of the silage and alfalfa ration, securing more complete utilization of the feed nutrients. The increased gain on the heavier silage allowance was 18.2 per cent.

The main advantage of the heavier silage feeding was the increased gain, which in these trials amounted to 18.2 per cent.

All the cattle in these trials were fed on contract. With hay at \$8.57* per ton, silage that was figured at \$4.00 per ton when fed in light amounts had a value of \$4.60 per ton when fed in sufficient quantity to more nearly balance the ration.

*Part fed long and part chopped.

Comparing long alfalfa hay and barley with long alfalfa, barley and corn silage. Corn silage was added to a ration of long alfalfa and barley in five trials (Table X). Silage increased the

TABLE X
Value of Corn Silage Added to a Ration of Long Alfalfa and Ground Barley.
5 Trials—1921-22,* 1923-24, 1926-27, 1927-28, 1928-29

	Long Alfalfa Ground Barley	Long Alfalfa Ground Barley Corn Silage
Number of steers	48	48
Days fed	137	137
Average initial weight, lbs.	896	896
Average final weight, "	1131	1156
Average total gain, "	235	260
Average daily gain, "	1.72	1.90
Average daily ration:		
Long alfalfa, lbs.	25.52	19.26
Corn silage, "		18.49
Ground barley, "	8.89	8.76
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	1485	1015
Corn silage, "		975
Ground barley, "	518	462
Per cent waste hay	10.71	14.50
Market data on 76 steers, 1923-24, 1926-27, 1927-28 and 1928-29.		
Market weight, lbs.	1103	1115
Shrink to market, per cent	3.63	4.23
Market price per cwt.	\$ 10.84	\$ 10.71
Market value per head	119.38	119.39
Dressing percentage	60.2	60.6
**Carcass grading:		
Choice	7	6
Good	21	20
Medium	0	2

*Steers in these trials were fed on contract, and market data were not available.

**56 steers—1926-27, 1927-28 and 1928-29.

rate of daily gain from 1.72 pounds to 1.90 pounds per head per day, an increase of 10.4 per cent. The addition of corn silage increased the waste hay from 10.7 to 14.5 per cent.

Each ton of silage fed replaced 964 pounds of hay and 115 pounds of ground barley. Figuring long alfalfa at \$8.00 per ton and ground barley at \$1.00 per cwt., each ton of corn silage had a feed replacement value of \$5.01 per ton.

In 1921-22 the steers were fed on contract. Of the 76 steers shipped to market, the silage-fed cattle shrank an average of 4.7 per cent against 3.8 per cent on the no silage lots. The differential in shrinkage and the market price received gave both groups of cattle the same value.

In these trials silage increased the gains of the cattle, but caused more shrinkage to market and increased the percentage

of waste hay. The advantage in the dressing percentage of the silage-fed cattle was due to the higher shrinkage to market. The carcass grading was slightly in favor of the hay- and grain-fed cattle.

Comparing chopped alfalfa hay and barley with chopped alfalfa, barley and corn silage. Corn silage was added to a ration of chopped alfalfa hay and ground barley in five trials (Table XI). The addition of corn silage increased the average

TABLE XI
Chopped Alfalfa and Ground Barley vs. Chopped Alfalfa,
Ground Barley and Silage.
4 Trials—1919-20, 1920-21, 1929-30, 1930-31

	Chopped Alfalfa Ground Barley	Chopped Alfalfa Ground Barley Corn Silage
Number of steers	55	57
Days fed	120	120
Average initial weight, lbs.	945	949
Average final weight, "	1155	1192
Average total gain, "	210	243
Average daily gain, "	1.75	2.02
Average daily ration:		
Chopped alfalfa, lbs.	25.62	20.82
Corn silage, "	—	16.05
Ground barley, "	6.57	6.73
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	1462	1031
Corn silage, "	—	795
Ground barley, "	375	333
Per cent waste hay	6.91	9.59
*Market weight, lbs.	1098.37	1130.95
Shrink to market, per cent	1.24	2.90
Market price per cwt.	\$ 9.69	\$ 9.87
Market value per head	106.44	111.63
Dressing percentage	60.26	60.91
Carcass grading		
Choice	2	1
Good	10	16
Medium	7	4

*Market data for 2 years, 1929-30 and 1930-31.

daily gain from 1.75 to 2.02 pounds, or 15.6 per cent. Each ton of corn silage replaced 1084 pounds of chopped alfalfa, and 106 pounds of barley. With chopped alfalfa at \$9.50 per ton and ground barley at \$1.00 per cwt., each ton of silage had a feed replacement value of \$6.21 per ton.

The steers were fed on contract two years and sold on the market two years. On those shipped to market the shrinkage was very light, due to shrinkage of the cattle by three days' individual weighing. Counting the cost of the cattle and the cost of the feed, the silage-fed cattle returned the most profit.

Silage added to a chopped alfalfa and barley ration replaces fairly high priced feeds. An additional value is the element of safety. No steers were lost in the silage fed lots, while two steers were lost from bloat on the ration of chopped alfalfa and ground barley. The value of the steers lost was not considered in the comparison.

Comparative value of potatoes and corn silage fed with alfalfa and barley. Potatoes were fed one year to two-year-old steers, (*Table XII*). The potatoes used were sound, somewhat

TABLE XII
Comparative Value of Potatoes and Corn Silage Fed With
Alfalfa and Barley.
1 Trial—1928-29

	Long Alfalfa Ground Barley	Long Alfalfa Ground Barley Potatoes	Long Alfalfa Ground Barley Corn Silage
Number of steers	10	10	10
Days fed	159	159	159
Average initial wt., lbs. ...	876	882	867
Average final wt., "	1129	1186	1156
Average total gain, "	253	304	289
Average daily gain, "	1.59	1.91	1.82
Average daily ration:			
Long alfalfa, lbs.	21.30	18.10	16.20
Ground barley, "	7.77	7.77	7.77
Cull potatoes, " .....	.....	16.90	.....
Corn silage, " .....	.....	.....	18.5
Feed for 100 lbs. gain:			
Long alfalfa, lbs.	1345	945	894
Ground barley, "	489	407	427
Cull potatoes, " .....	.....	883	.....
Corn silage, " .....	.....	.....	1018
Per cent waste hay	12.5	18.1	16.8
Market weight, lbs.	1074	1138	1098
Shrink to mkt., per cent	4.9	4.1	5.0
Market price per cwt.	\$ 12.85	\$ 12.38	\$ 13.00
Market value per head	138.01	140.88	142.74
Dressing percentage	61.1	60.9	62.0
Carcass grading:			
Choice	1	2	1
Good	9	8	8
Medium .....	.....	.....	1

mis-shapen, and would grade mostly No. 2. They were fed raw, coarsely chopped with a spade. The amount fed ranged from 15 to 20 pounds per head daily. When fed in larger amounts there were some digestive disorders, resulting in scouring.

When added to long alfalfa and ground barley, each ton of potatoes replaced 906 pounds of alfalfa and 186 pounds of barley. With alfalfa at \$8.00 per ton and ground barley at \$1.00 per cwt., each ton of potatoes had a feed replacement value of \$5.48. When silage was substituted for the potatoes each ton of silage replaced

886 pounds of alfalfa and 122 pounds of barley, having a feed replacement value of \$4.76 per ton. The addition of silage increased the gains 14.6 per cent, while the addition of potatoes increased the gain 20.3 per cent.

When fed in limited amounts the potatoes increased gains and, apparently, the finish of the cattle, though the dressing percentage and carcass grading were not changed materially in the different lots. Owing to a lighter shrinkage, the potato-fed steers dressed lower, but taking the home weight as the basis for calculating dressing percentage, the potato-fed steers dressed 58.4 against 58.1 per cent for the steers fed hay and barley, and 58.9 per cent for the silage-fed steers. The lower price received for the potato-fed steers was due to their weight coming in the classification of "steers over 1100 pounds", which were discriminated against on the market at that time. Fed in limited amounts, potatoes have a feed value fully equal to corn silage.

Summary of silage experiments with two-year-old steers. As a general summary the addition of silage to a ration of hay alone, or hay and grain has been beneficial. The cattle receiving silage have been thrifty and have finished uniformly. Much of the danger of bloat and trouble from digestive disorders was eliminated by the addition of silage to the ration.

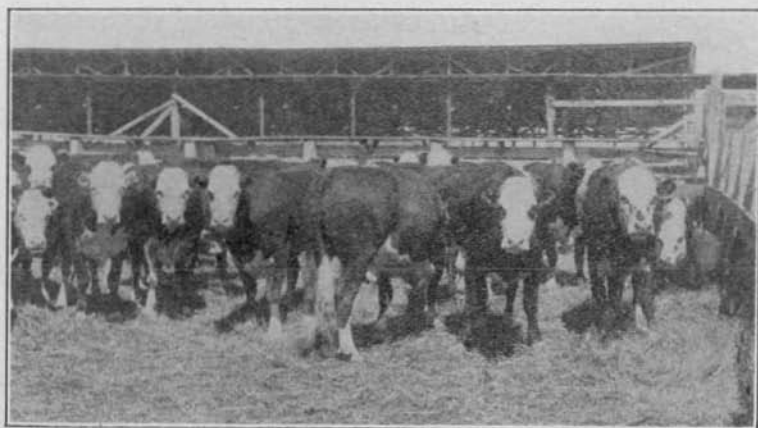


Fig. 9—The 1929-30 two-year-old steers at the end of the feeding period.

With long alfalfa hay at \$8.00 per ton, chopped hay at \$9.50 per ton and ground barley at \$1.00 per cwt., silage had a feed replacement value ranging from \$3.45 to \$6.21 per ton. It had the least value when fed in light amounts as a supplement to a hay alone ration, and the greatest value when fed as a supplement to the hay and barley ration. A general summary of silage fed to two-year-old steers as a supplement to long or chopped alfalfa

shows corn silage to have a value of approximately half the value of alfalfa.

Results of nine lots of experimental steers shipped to market showed a somewhat heavier shrinkage on the silage-fed cattle. The average shrink of the steers fed hay and grain was 3.68 per cent, while the cattle fed hay, grain and silage shrank an average of 4.61 per cent.

The silage-fed cattle brought a higher return in all cases. In eight lots of contract steers fed silage the average price received for feeding each head was \$1.70 more than when no silage was fed. Of eight lots of steers shipped and sold on the open market, the silage fed steers brought an average of 98 cents per head more than cattle fed no silage.

In feeding 340 cattle, half of them on hay alone or hay and grain, and the other half on hay and silage or hay, grain and silage, the silage-fed steers returned an average of \$1.44 per head more than those that received no silage. Of the 170 head that were fed silage 169 were delivered or marketed, one having been lost from bloat, while of the 170 steers receiving no silage 4 died of bloat.

TABLE XIII
Long Alfalfa Alone vs. Long Alfalfa and Ground Barley.
3 Trials—1919-20*, 1922-23*, 1927-28

	Long Alfalfa	Long Alfalfa Ground Barley
Number of steers	30	30
Days fed	113	113
Average initial weight, lbs.	972	978
Average final weight, "	1106	1172
Average total gain, "	134	194
Average daily gain, "	1.18	1.72
Average daily ration:		
Long alfalfa, lbs.	31.45	29.20
Ground barley "		5.99
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	2699	1703
Ground barley, "		348
Per cent waste hay	9.96	14.29
** Marketing data for 1927-28:		
Market weight, lbs.	1006	1104
Shrink to market, per cent	7.15	4.85
Market price per cwt.	\$ 11.16	\$ 12.25
Market value per head	105.90	128.15
Dressing percentage	56.7	60.9
Carcass grading:		
Choice	0	0
Good	5	8
Medium	3	0

*These cattle were fed on contract and market data were not available.

**Marketing data on 8 steers per lot.

Comparative Studies of Barley and Other Grains When Fed With Hay Alone and When Added to a Ration of Hay and Corn Silage, Fed to Two-year-old Steers.

Comparing long alfalfa alone with long alfalfa and barley. Alfalfa alone was compared with alfalfa and barley in three trials (*Table XIII*). The addition of six pounds of barley per head per day increased the average daily gain from 1.18 to 1.72 pounds, an increase of 44.8 per cent. Each ton of barley replaced 5,724 pounds of alfalfa hay. With alfalfa hay at \$8.00 per ton, each ton of barley had a feed replacement value of \$22.90 per ton.

The addition of barley to the ration improved the finish of the cattle, as indicated by increased gains and lighter shrinkage to market, higher dressing percentage and better carcass grading. When barley was added the percentage of hay refused increased from 10 per cent to 14.3 per cent.

Comparing chopped alfalfa alone with chopped alfalfa and barley. Chopped alfalfa alone was compared with chopped alfalfa and ground barley in three trials (*Table XIV*). The addition of ground barley at the rate of slightly more than 6 pounds per head per day increased the average daily gain from 1.43 pounds to 1.85 pounds, or 29.4 per cent.

Each ton of ground barley replaced 4,386 pounds of chopped hay. Counting the value of chopped hay at \$9.50 per ton, each ton of ground barley was worth \$20.83.

All the cattle in these trials were fed on contract. The contract allowed no additional value for improved finish; hence all were delivered at the same price. The only advantage with the barley-fed cattle was that there was an increased weight to deliver, which, in this case, did not offset the extra cost of the feed. On the uniform contract price received barley was worth only 93 cents per cwt.

TABLE XIV
Chopped Alfalfa Alone vs. Chopped Alfalfa and Ground Barley.
3 Trials—1919-20, 1920-21, 1922-23*

	Chop'd Alfalfa	Chop'ed Alfalfa Ground Barley
Number of steers	34	34
Days fed	100	100
Average initial weight, lbs.	977	982
Average final weight, "	1121	1168
Average total gain, "	144	186
Average daily gain, "	1.43	1.85
Average daily ration:		
Chopped alfalfa, lbs.	30.9	27.30
Ground barley, " .....	.....	6.15
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	2201	1473
Ground barley, " .....	.....	332
Per cent waste hay	5.92	7.06

*These cattle were fed on contract and market data were not available.

Comparing long alfalfa and corn silage with long alfalfa, corn silage and ground barley. The value of barley added to a ration of long alfalfa and corn silage was investigated in three trials (*Table XV*). The addition of barley increased the average

TABLE XV
Value of Barley Added to a Ration of Long Alfalfa and Corn Silage.
3 Trials—1919-20, 1921-22*, 1923-24

	Long Alfalfa Corn Silage	Long Alfalfa Corn Silage Ground Barley
Number of steers	42	43
Days fed	112	111
Average initial weight, lbs.	952	948
Average final weight, "	1111	1153
Average total gain, "	159	205
Average daily gain, "	1.41	1.83
Average daily ration:		
Long alfalfa, lbs.	27.35	22.97
Corn silage, "	19.63	16.45
Ground barley, " .....	.....	7 18
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	1959	1322
Corn silage, "	1371	898
Ground barley, " .....	.....	378
Per cent waste hay	16.05	23.31
Market data for 1923-24:		
Market weight, lbs.	1054	1127
Shrink to market, per cent	5.56	6.61
Market price per cwt.	\$ 7.65	\$ 8.28
Market value per head	80.63	93.33

*These cattle were fed on contract and market data were not available.

daily gain from 1.41 to 1.83 pounds, or 29.4 per cent. Each ton of ground barley replaced 3,370 pounds of hay and 2,503 pounds of silage. With long alfalfa at \$8.00 per ton, and corn silage at \$4.00 per ton, the ground barley had a feed replacement value of \$18.49 per ton.

Three lots were fed on contract and sold at the same price regardless of finish. Charging the long alfalfa at \$8.00 per ton, the silage at \$4.00 per ton and the ground barley at \$1.00 per cwt., the margin over the cost of the cattle and the feed was \$6.49 per steer in both cases, regardless of ration, giving barley a value of 93 cents per cwt. When the cattle were delivered at the same price, barley had no particular value other than to reduce the amount of hay and silage fed.

In 1923-24 the cattle were sold on the market, the barley-fed cattle bringing a premium above the cattle that received no grain. The steers fed hay and silage returned \$49.10, or \$4.91 per head, above feed lot costs. The steers fed barley in addition to hay and silage returned \$81.10, or \$8.11 per head above feed lot costs. This increased return on the barley ration amounted to \$3.20 per steer, or 23 cents per cwt. on the barley above its cost.

Combining the feed replacement value of the barley with its market value on the steers gave it a total value of \$1.16 per cwt.

Comparing chopped alfalfa and corn silage with chopped alfalfa, corn silage, and ground barley. Ground barley fed with chopped alfalfa hay and corn silage was compared with hay and silage alone in four trials (*Table XVI*). The addition of ground

TABLE XVI
Value of Barley Added to a Ration of Chopped Alfalfa and Corn Silage.
3 Trials—1919-20*, 1920-21*, 1929-30

	Chop'd Alfalfa Corn Silage	Chop'd Alfalfa Corn Silage Ground Barley
Number of steers	47	47
Days fed	112	112
Average initial weight, lbs.	983	978
Average final weight, "	1169	1208
Average total gain, "	186	230
Average daily gain, "	1.71	2.10
Average daily ration:		
Chopped alfalfa, lbs.	26.17	22.88
Corn silage, "	17.64	16.65
Ground barley, " .....	.....	6.68
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	1609	1113
Corn silage, "	1061	795
Ground barley " .....	.....	327
Per cent waste hay	5.96	10.02
**Market weight, lbs.	1695	1172
Shrink to market, per cent	3.07	3.22
Market price per cwt.	\$ 11.50	\$ 11.87
Market value per head	125.98	139.13
Dressing percentage	59.9	61.2
Carcass grading:		
Choice	0	0
Good	7	9
Medium	4	2

*These cattle were fed on contract and market data were not available.

**Market data on 22 steers, 1929-30.

barley at the rate of 6.68 pounds per head per day increased the average daily gain from 1.71 to 2.10 pounds, or 24.1 per cent.

Each ton of ground barley replaced 3034 pounds of chopped hay and 1627 pounds of corn silage. With chopped hay at \$9.50 per ton, and corn silage at \$4.00 per ton, each ton of ground barley had a replacement value of \$17.67.

Three lots of cattle were fed on contract and one sold on the open market. When fed on contract and delivered at the same price, the steers brought essentially the same returns on both rations. When sold on the open market, the barley-fed steers brought a higher price and returned \$3.22 per head more than the steers fed hay and silage. Crediting the increased returns to the barley gave it a value of 39 cents per cwt. above cost. The

combined feed replacement value and increased selling value of the barley fed steers gave barley a value of \$1.14 per cwt.

Comparing long alfalfa alone with long alfalfa and ground corn. One year's trial was made to determine the value of ground corn added to the long alfalfa alone ration for contract cattle (Table XVII). The addition of 5.15 pounds of ground corn in-

TABLE XVII
Long Alfalfa Alone vs. Long Alfalfa and Ground Corn
1 Trial—1922-23*

	Long Alfalfa	Long Alfalfa Ground Corn
Number of steers	10	10
Days fed	100	100
Average initial weight, lbs.	985	1025
Average final weight, "	1103	1187
Average total gain, "	118	162
Average daily gain, "	1.18	1.62
Average daily ration:		
Long alfalfa, lbs.	31.95	28.91
Ground corn, "		5.15
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	2718	1788
Ground corn, "		319
Per cent waste hay	12.12	9.69

*These steers were fed on contract and market data were not available.

creased the average daily gain from 1.18 to 1.62 pounds, or 37.5 per cent. Each ton of corn replaced 5,831 pounds of alfalfa. With long alfalfa at \$8.00 per ton, the value of each ton of ground corn was \$23.32.

The cattle in these trials were fed on contract on a pounds-gain basis. For each pound put on 12 cents was received. For the hay-alone cattle the feed cost of each hundred pounds gain was \$10.87, leaving a margin of \$1.13 per cwt. above feed costs. With the cattle fed long alfalfa and ground corn, the cost of the hay required for 100 pounds gain was \$7.16. Deducting this amount from the cost of the hay when hay alone was fed left a margin of \$3.71 to pay for the 319 pounds of ground corn required for 100 pounds gain. This gave the corn a value of \$1.16 per cwt.

Comparing long alfalfa and ground barley with long alfalfa and ground corn. The results of two years' comparison of ground barley with ground corn are given in Table XVIII. The results show each to have practically the same value. The variations in the amounts of feed consumed, the feed requirements, for 100 pounds gain, the percentage of waste hay, the shrinkage to market and the variation in market price are no greater than are found on two lots of cattle fed on identical rations. For all practical purposes barley and corn may be considered to have the same value.

TABLE XVIII
Alfalfa and Barley vs. Alfalfa and Corn
2 Trials— 1922-23*, 1923-24

	Long Alfalfa Ground Barley	Long Alfalfa Ground Corn
Number of steers	20	20
Days fed	125	125
Average initial weight, lbs.	955	961
Average final weight, "	1174	1181
Average total gain, "	219	220
Average daily gain, "	1.75	1.76
Average daily ration:		
Long alfalfa, lbs.	25.70	26.50
Ground barley, "	7.82	.....
Ground corn, " .....	.....	7.86
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	1465	1508
Ground barley, "	446	.....
Ground corn, " .....	.....	447
Per cent waste hay	15.87	12.12
Market weight, lbs.	1120	1126
Shrink to market, per cent	4.11	4.15
Market price per cwt.	\$ 8.32	\$ 8.30
Market value per head	93.12	93.46

*These steers were fed on contract and market data were not available.

Comparing wheat and oats fed with chopped alfalfa hay. One trial was made to determine the value of ground wheat alone, and combined with 25 per cent oats (*Table XIX*). While the trial was made in a different year than the barley and corn tests, the results checked closely with those of the barley and corn trials shown in *Table XVIII*. A smaller amount of hay was wasted and the feed requirements for 100 pounds gain were lowered, but this was due more to the superior quality of the alfalfa than to the wheat.

The results show ground wheat to be a valuable grain supplement in fattening cattle, practically equal to corn or barley. The only difficulty experienced was the tendency of part of the cattle to bloat, one steer in this trial having been lost in the wheat-alone lot.

When a mixture of 25 per cent oats and 75 per cent wheat was fed, the tendency to bloat was overcome. However, from the standpoint of gains, market price, finish and dressing percentage, the combination of wheat and oats did not prove as valuable as the wheat-alone ration.

Summary of grain vs. no grain when fed to two-year-old steers. The addition of grain to the hay alone and the hay and silage rations increased the rate of daily gain and the finish of the cattle, but also increased the feed cost. When the cattle were fed on contract and the same price received for the finished steers regardless of condition, there was a loss in feeding grain.

TABLE XIX
Comparison of Chopped Alfalfa and Ground Wheat vs.
Chopped Alfalfa, Ground Wheat and Ground Oats
1 Trial—1930-31

	Chop'd Alfalfa Ground Wheat	Chop'd Alfalfa Ground Wheat 75% Ground Oats 25%
Number of steers	9	10
Days fed	155	155
Average initial weight, lbs.	829	825
Average final weight, "	1094	1079
Average total gain, "	265	254
Average daily gain, "	1.71	1.64
Average daily ration:		
Chopped alfalfa, lbs.	22.95	18.44
Ground wheat, "	6.11	4.59
Ground oats, " .....	.....	1.53
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	1342	1127
Ground wheat, "	357	281
Ground oats, " .....	.....	94
Per cent waste hay	5.24	7.05
Market weight, lbs.	1080	1071
Shrink to market, per cent	3.49	3.30
Market price per cwt.	\$ 7.50	\$ 7.44
Market value per head	81.00	79.73
Dressing percentage	60.1	58.2
Carcass grading:		
Choice	1	.....
Good	7	7
Medium	1	3

When 137 contract steers were fed long hay at \$8.00 per ton, chopped hay at \$9.50 per ton, corn silage at \$4.00 per ton and ground barley at \$1.00 per cwt., the addition of barley to the ration did not prove profitable. While the gains were increased, the margin for feeding averaged \$1.10 per head more when no barley was fed. The barley added to the silage and hay ration had a feed value of only 83 cents per cwt.

When shipped and sold on the open market, the grain-fed steers brought sufficient premium over the steers fed hay alone or hay and silage to make the feeding of grain profitable. The grain-fed steers shrank less and sold at higher prices than the steers receiving no grain. The grain-fed steers returned an average of \$3.44 more than the steers fattened without grain. When the increased gains, lighter shrinkage and higher price are considered, the value of each cwt. of barley ranged from \$1.14 to \$1.74, averaging \$1.25.

The comparisons of feeding grain to steers show that when fed on contract and the same price per cwt. was paid for steers weighed up at home, one ton of barley was worth \$16.60 when

hay was worth \$8.00 per ton. When the cattle were shipped and sold on the open market, the barley had a value of \$25.00 per ton when alfalfa had a value of \$8.00 per ton.

Value of Protein Supplements Added to a Ration for Two-year-old Steers.

Comparing barley and beans with barley. One trial was made with cull beans, ground barley and alfalfa hay, compared with alfalfa hay and barley (*Table XX*). The beans were fed in vary-

TABLE XX
Long Alfalfa and Barley vs. Long Alfalfa, Barley and Beans
I Trial—1928-29

	Long Alfalfa Ground Barley	Long Alfalfa Ground Barley Ground Beans
Number of steers	10	7
Days fed	159	159
Average initial weight, lbs.	876	878
Average final weight, "	1129	1127
Average total gain, "	253	249
Average daily gain, "	1.59	1.56
Average daily ration:		
Long alfalfa, lbs.	21.3	19.5
Ground barley, "	7.77	6.55
Ground beans, "		1.27
Feed for 100 lbs. gain:		
Long alfalfa, lbs.	1345	1249
Ground barley, "	489	419
Ground beans, "		82
Per cent waste hay	11.3	14.2
Market weight, lbs.	1074	1080
Shrink to market, per cent	4.9	4.2
Market price per cwt.	\$ 12.85	\$ 12.75
Market value per head	138.01	137.70
Dressing percentage	61.1	60.3
Carcass grading:		
Choice	1	
Good	9	7
Medium		

ing amounts, ranging from 15 to 20 per cent of the grain ration, averaging 16 per cent. When fed in larger amounts there were some digestive disorders, resulting in scouring. The rate of gain was practically the same, being slightly in favor of the barley lot.

Each ton of cull beans replaced 2,341 pounds of alfalfa and 1,707 pounds of barley.

The beans fed consisted of the discolored and cracked beans discarded from the first grade, re-cleaned and with all dirt removed. The results of this trial show that cull beans may be used successfully as approximately 15 per cent of the grain ration.

Comparing alfalfa and barley with alfalfa, barley and cottonseed meal. Cottonseed meal was added to the alfalfa-barley ration in one trial (*Table XXI*). Cottonseed meal, constituting

TABLE XXI
Chopped Alfalfa and Barley vs. Chopped Alfalfa, Barley
and Cottonseed Meal
1 Trial—1930-31

	Chop'd Alfalfa Ground Barley	Chop'd Alfalfa Ground Barley Cottonseed Meal
Number of steers	9	10
Days fed	155	155
Average initial weight, lbs.	831	827
Average final weight, "	1054	1068
Average total gain, "	223	241
Average daily gain, "	1.44	1.56
Average daily ration:		
Chopped alfalfa, lbs.	18.32	20.75
Ground barley, "	6.26	5.51
Cottonseed meal, " .....		.61
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	1314	1331
Ground barley, "	435	354
Cottonseed meal, "		39
Per cent waste hay	7.40	8.52
Market weight, lbs.	1031	1051
Shrink to market, per cent	3.63	4.65
Market price per cwt.	\$ 7.35	\$ 7.46
Market value per head	75.74	78.39
Dressing percentage	58.3	59.5
Carcass grading:		
Choice	1	.....
Good	5	10
Medium	3	.....

10 per cent of the grain ration, proved beneficial, improving the gains and finish of the cattle. The rate of daily gain was increased from 1.41 to 1.56 pounds, or 8.5 per cent.

Each ton of cottonseed meal fed required 872 pounds more hay, but 4154 pounds less barley in producing 100 pounds gain. With chopped alfalfa at \$9.50 a ton, and ground barley at \$1.00 per cwt., the feed replacement value of the cottonseed meal was \$37.40 per ton.

Value of cottonseed meal as a supplement to alfalfa, corn, silage and barley. Cottonseed meal was added to chopped alfalfa, silage and barley in two trials (*Table XXII*). From the standpoint of gains and shrinkage to market, the addition of cottonseed meal was not profitable.

Each ton of cottonseed meal replaced 558 pounds of chopped hay and 1674 pounds of barley, but made it necessary to use 698 pounds more silage. With chopped alfalfa at \$9.50 per ton,

TABLE XXII

Value of Cottonseed Meal added to a Ration of Chopped Alfalfa,
Corn Silage and Barley

2 Trials—1929-30, 1930-31

	Chop'd Alfalfa Corn Silage Ground Barley	Chop'd Alfalfa Corn Silage Ground Barley Cottonseed Meal
Number of steers	21	21
Days fed	153	153
Average initial weight, lbs.	889	882
Average final weight, "	1165	1154
Average total gain, "	276	272
Average daily gain, "	1.80	1.77
Average daily ration:		
Chopped alfalfa, lbs.	16.63	16.15
Corn silage, "	15.99	15.94
Ground barley, "	7.52	6.75
Cottonseed meal, " .....		.75
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	930	918
Corn silage, "	899	914
Ground barley, "	424	388
Cottonseed meal, "		43
Per cent waste hay	9.56	8.00
Market weight, lbs.	1075	1063
Shrink to market, per cent	3.85	3.95
Market price per cwt.	\$ 10.38	\$ 10.47
Market value per head	111.63	111.28
Dressing percentage	60.9	62.1
Carcass grading:		
Choice	1	1
Good	16	15
Medium	4	5

corn silage at \$4.00 per ton and ground barley at \$1.00 per cwt., the meal had a feed replacement value of \$18.00 per ton, while it had cost \$30.00. The steers fed cottonseed meal had a little better market appearance and sold at 9 cents per cwt. premium over the steers receiving no cottonseed meal.

Comparing ground alfalfa and barley with ground wheat-and-pea hay and barley. In one year part of the alfalfa fields had been winter-killed. An emergency hay crop consisting of wheat and peas was grown. It was ground and fed to one lot of steers compared with one lot on alfalfa meal (*Table XXIII*). The wheat-and-pea hay was fairly mature when harvested, containing some wheat and some mature peas; hence the grain ration was materially increased, though the definite amount was not determined. Average daily gains were increased from 1.93 pounds on alfalfa meal and ground barley to 2.62 pounds on wheat-and-pea hay and ground barley, or 35.5 per cent.

TABLE XXIII
Ground Alfalfa vs. Ground Wheat-and-Pea Hay
1 Trial—1926-27

	Ground Alfalfa Ground Barley	Ground Wheat- and-Pea Hay Ground Barley
Number of steers	10	7
Days fed	130	130
Average initial weight, lbs.	886	886
Average final weight, "	1137	1226
Average total gain, "	251	340
Average daily gain, "	1.93	2.62
Average daily ration:		
Ground alfalfa, lbs.	19.74	.....
Ground barley, "	9.09	9.12
Ground wheat-and-pea hay, " .....	.....	22.14
Feed for 100 lbs. gain:		
Ground alfalfa, lbs.	1020	.....
Ground barley, "	470	348
Ground wheat-and-pea-hay, " .....	.....	844
Per cent waste hay	0.0	0.0
Market weight, lbs.	1119	1209
Shrink to market, per cent	3.99	3.51
Market price per cwt.	\$ 9.50	\$ 9.75
Market value per head	106.31	117.84
Dressing percentage	57.3	56.3
Carcass grading:		
Choice	4	5
Good	5	2
Medium	1	0

Each ton of the ground wheat-and-pea hay was equal to 2,417 pounds of alfalfa meal supplemented with 289 pounds of barley. With alfalfa meal at \$11.00 per ton and ground barley at \$1.00 per cwt., this gave a feed replacement value of \$16.18 per ton to the ground wheat-and-pea hay.

While well finished, the steers on wheat-and-pea hay were somewhat paunchy, which lowered their dressing percentage below that of the steers fed alfalfa meal and barley. Because of their superior finish, the steers fed wheat-and-pea hay out-sold the steers fed alfalfa meal and barley 25 cents per cwt.

Summary of Feeding Work With Two-year-old Steers

During the 12 years that experiments were conducted with two-year-old cattle, western markets underwent a decided change. In the early years of the experiments cattle finished on good quality alfalfa hay produced beef of good enough quality to supply the western trade. The demand of the consuming public underwent a change, with the result that during the later years of the experimental feeding period grain-fed cattle sold at sufficient premium to make the feeding of grain profitable.

When hay alone was fed, chopping and grinding did not save sufficient feed to pay for the processing. However, as the hay-

fed cattle gained more and had better finish when fed chopped or ground hay, the increased market value was sufficient to pay for processing the hay.

Chopped hay had the greatest value when fed with other feeds, lowering the feed costs though not improving the finish.

In contract feeding where the same price was paid for the cattle regardless of finish, grain feeding did not prove profitable. With long alfalfa hay at \$8.00 per ton, grain fed to the contract cattle was worth 83 cents per cwt. However, when the cattle were shipped and sold on the open market, the grain-fed cattle sold at sufficient premium to give grain a value of \$1.25 per cwt.

In most trials the addition of a protein supplement to a ration of alfalfa hay and barley, or of alfalfa hay, barley and corn silage, did not prove profitable.

Comparative trials with barley, wheat and corn showed all to have approximately the same value for producing gains on two-year-old steers.

With long hay at \$8.00 per ton, chopped hay at \$9.50 and ground hay at \$11.00, corn silage at \$4.00 and grain at \$20.00, feed requirements and cost of 100 pounds gain were as follows:

Feed Requirements for 100 Pounds Gain

	No. of Trials	No. of Steers	Av. Daily Grain	Feed for 100 lbs. Gain			Feed Cost 100 lb. Gain
				Hay*	Silage	Grain	
Hay alone	10	103	1.31	2240			10.16
Hay and silage	12	129	1.50	1848	1149		10.37
Hay and grain	12	124	1.81	1401		402	10.10
Hay, barley, silage	15	156	1.85	1091	960	397	10.64

*Part of hay fed long and part chopped.

Comparative Feeding Trials with Yearling Steers

Comparing yearlings with two-year-olds. In the fall of 1927 20 large selected yearlings were compared with two-year-olds. As 50 per cent of the two-year-old steers had gone to market as grass-fat cattle, the comparison was between top yearlings and cut-back two-year-olds (*Table XXIV*).

The two-year-old steers consumed more feed and made 7.4 per cent larger gains than the yearlings. The older cattle required 21 per cent more hay and 12 per cent more silage, but 5 per cent less grain for 100 pounds gain. With the cost of long alfalfa hay at \$8.00 per ton, ground barley at \$1.00 per cwt. and corn silage at \$4.00 per ton, the cost of 100 pounds gain on the yearlings was \$9.54, compared with \$10.24 on the two-year-olds. All the cattle on experiment were two-year-olds except 20 yearlings. They were all shipped to market together. The finish of the yearlings was not as good as that of the two-year-olds, resulting in a lower price, a lower dressing percentage and poorer carcass grading. To have finished the yearlings as well as the two-year-olds would have required an additional 30 days' feeding.

TABLE XXIV

Yearling vs. Two-Year-Old Steers on Alfalfa and Ground Barley, and Alfalfa, Ground Barley and Corn Silage
1 Trial—1927-28

	Yearlings	2-Year-Olds	Yearlings	2-Year-Olds
	Alfalfa Ground Barley	Alfalfa Ground Barley	Alfalfa Ground Barley Silage	Alfalfa Ground Barley Silage
Number of steers	10	8	10	8
Days fed	147	147	147	147
Average initial wt., lbs.	779	899	782	885
Average final wt., "	1019	1158	1034	1156
Average total gain, "	240	259	252	271
Average daily gain, "	1.63	1.76	1.72	1.85
Average daily ration:				
Long alfalfa, lbs.	17.00	22.99	11.91	14.53
Ground barley, "	9.08	9.08	8.77	9.03
Corn silage, "			13.03	14.91
Feed for 100 lbs. gain:				
Long alfalfa, lbs.	1042	1309	696	787
Ground barley, "	557	517	510	490
Corn silage, "			758	808
Per cent waste hay	11.20	14.70	16.5	15.1
Market weight, lbs.	973	1104	995	1109
Shrink to mkt., per cent	5.63	4.85	4.78	4.52
Market price per cwt.	\$ 11.85	\$ 12.25	\$ 11.85	\$ 12.50
Market value per head	115.30	135.21	117.91	138.59
Dressing percentage	58.1	60.9	58.7	62.5
Carcass grading:				
Choice	0	0	0	2
Good	8	8	7	6
Medium	2	0	3	0

The two-year-old cattle were purchased at \$7.50 and the yearlings at \$7.85 per cwt. Each two-year-old returned \$4.20 more per head over the cost of the cattle and the feed than the yearlings. This was largely due to the difference in value of well finished two-year-olds over partially finished yearlings.

Comparing yearlings with two-year-old steers on long alfalfa, ground barley and corn silage. Selected yearlings were compared with cut-back two-year-olds in two years' trials (Table XXV). The yearlings made 4.1 per cent more gains than the two-year-olds. Feed requirements for 100 pounds gain on the yearlings were 21.2 per cent less hay, 10.6 per cent less silage and 4.5 per cent less grain than for the two-year-olds. Charging long alfalfa at \$8.00 per ton, corn silage at \$4.00 per ton and ground barley at \$1.00 per cwt., the feed cost of each 100 pounds gain was \$8.61 for the yearlings and \$9.67 for the two-year-olds.

Owing to the fact that there were not enough yearlings to ship separately, they were shipped with the two-year-olds. There was much variation in the way the yearlings finished. In 1926-27 the yearlings were as well finished as the two-year-olds, dressing

TABLE XXV

Yearlings vs. Two-Year-Old Steers on Whole Alfalfa, Barley and Silage
2 Trials—1926-27, 1927-28

	Yearlings		2-Year-Olds	
	Long Alfalfa Ground Barley Corn Silage		Long Alfalfa Ground Barley Corn Silage	
Number of steers	20		18	
Days fed	139		139	
Average initial weight, lbs.	753		886	
Average final weight, "	1022		1144	
Average total gain, "	269		258	
Average daily gain, "	1.96		1.88	
Average daily ration:				
Long alfalfa, lbs.	12.29		15.19	
Ground barley, "	13.67		14.81	
Corn silage, "	9.01		9.16	
Feed for 100 lbs. gain:				
Long alfalfa, lbs.	636		807	
Ground barley, "	704		787	
Corn silage, "	465		487	
Per cent waste hay	17.10		16.21	
Market weight, lbs.	971		1117	
Shrink to market, per cent	4.16		3.41	
Market price per cwt.	\$ 10.81		\$ 10.82	
Market value per head	104.98		120.90	
Dressing percentage	58.2		59.8	
Carcass grading:				
Choice	3		5	
Good	13		12	
Medium	4		1	

and grading exactly the same. Because of their lighter weight they sold at a premium of 75 cents per cwt. In 1927-28 the yearlings were not well finished and sold at a discount of 65 cents per cwt.

Comparing yearlings with two-year-old steers on chopped alfalfa, barley and silage. In the fall of 1930 a trial with yearling and two-year-old steers was started, with the intention of feeding each load of cattle until they were finished (*Table XXVI*). The yearlings consisted of 60 head, the heavy end out of 300 head, while the two-year-olds consisted of cut-back steers from a range which had been too dry to fatten cattle that year. The two-year-olds finished in 125 days, and the yearlings in 155 days. While not sold on the market at the same time, each brought the same price per cwt.

The two-year-olds gained slightly faster than the yearlings, but required 18.5 per cent more alfalfa, 11.9 per cent more corn silage and 24.6 per cent more grain for 100 pounds gain. With chopped alfalfa at \$9.50 per ton, corn silage at \$4.00 per ton and ground barley at \$1.00 per cwt., the cost of each 100 pounds gain was \$8.57 for the yearlings and \$10.26 for the two-year-olds.

TABLE XXVI

Yearlings vs. Two-Year-Old Steers on Chopped Alfalfa, Ground Barley and Corn Silage
1 Trial—1930-31

	Yearlings	2-Year-Olds
	Chopped Alfalfa Ground Barley Corn Silage	Chopped Alfalfa Ground Barley Corn Silage
Number of steers	10	9
Days fed	155	125
Average initial weight, lbs.	817	1001
Average final weight, "	1113	1248
Average total gain, "	296	247
Average daily gain, "	1.91	1.97
Average daily ration:		
Chopped alfalfa, lbs.	15.87	19.48
Ground barley, "	6.12	7.91
Corn silage, "	13.43	15.57
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	832	986
Ground barley, "	321	400
Corn silage, "	704	788
Per cent waste hay	7.56	6.27
Market weight, lbs.	1085	1198
Shrink to market, per cent	4.55	4.05
Market price per cwt.	\$ 7.50	\$ 7.50
Market value per head	81.38	89.84
Dressing percentage	60.6	59.9
Carcass grading:		
Choice	1	1
Good	7	7
Medium	2	1

The finish of the yearlings at 155 days was very close to the finish of the two-year-olds at 125 days.

Comparing chopped alfalfa and barley with chopped alfalfa, barley and corn silage for yearling steers. In two trials with yearling steers the alfalfa and barley ration was supplemented with corn silage (*Table XXVII*).

The addition of corn silage increased the average daily gain from 1.53 to 1.82 pounds, or 18.9 per cent.

Each ton of corn silage fed replaced 1,097 pounds of chopped alfalfa and 259 pounds of ground barley. With chopped alfalfa at \$9.50 per ton and ground barley at \$1.00 per cwt., each ton of corn silage had a feed replacement value of \$7.80 a ton.

Both lots sold at the same price, except one slightly inferior steer in the silage lot. The dressing percentage of the barley and silage-fed cattle was higher than the barley-fed cattle, though the carcass grading was practically the same.

An additional value of silage not shown in this table was the thrift of the steers. In the winter of 1930-31 there was serious

bloating in the alfalfa and barley lot, resulting in the loss of one steer which was figured out of the experiment.

TABLE XXVII
Chopped Alfalfa and Barley vs. Chopped Alfalfa, Barley and Silage for
Yearling Steers
2 Trials—1927-28, 1930-31

	Chopped Alfalfa Ground Barley	Chopped Alfalfa Ground Barley Corn Silage
Number of steers	19	20
Days fed	151	151
Average initial weight, lbs.	804	799
Average final weight, "	1035	1074
Average total gain, "	231	275
Average daily gain, "	1.53	1.82
Average daily ration:		
Chopped alfalfa, lbs.	19.3	12.9
Ground barley, "	7.70	7.41
Corn silage, "		13.24
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	1168	768
Ground barley, "	502	408
Corn silage, "		729
Per cent waste hay	8.85	11.58
Market weight, lbs.	1000	1040
Shrink to market, per cent	4.71	4.66
Market price per cwt.	\$ 9.65	\$ 9.58
Market value per head	96.56	99.65
Dressing percentage	58.2	59.7
Carcass grading:		
Choice	1	1
Good	13	14
Medium	5	5

Determining the value of cottonseed meal when added to a ration of alfalfa and barley, and alfalfa, barley and silage. Cottonseed meal was added to the alfalfa and barley ration, and to a ration consisting of alfalfa, barley and corn silage in one trial (*Table XXVIII*). When added to the hay and barley ration, cottonseed meal increased the rate of daily gain from 1.44 to 1.56 pounds, or 8.3 per cent. The finish of the steers was improved. However, when added to the alfalfa, barley and silage ration, there was no improvement either in the rate of daily gain or the finish of the steers.

Fed with chopped alfalfa and barley each ton of cottonseed meal replaced 4,154 pounds of barley but required the use of 872 pounds more hay. With chopped alfalfa at \$9.50 per ton and ground barley at \$1.00 per cwt., cottonseed meal had a feed replacement value of \$37.40 per ton. When added to the alfalfa, barley and silage ration, each ton of cottonseed meal replaced 750 pounds of hay, 250 pounds of silage and 1,875 pounds of ground barley. With corn silage at \$4.00 a ton, each ton of cottonseed meal had a feed replacement value of \$22.81.

TABLE XXVIII
Comparison of Cottonseed Meal Added to Alfalfa and Ground Barley and
Alfalfa, Ground Barley and Silage
1 Trial—1930-31

	Alfalfa Gr. Barley	Alfalfa Gr. Barley Cottonseed Meal	Alfalfa Gr. Barley Silage	Alfalfa Gr. Barley Silage Cottonseed Meal
Number of steers	9	10	10	10
Days fed	155	155	155	155
Average initial wt., lbs.	831	827	817	816
Average final wt., "	1054	1068	1113	1110
Average total gain, "	223	241	296	294
Average daily gain, "	1.44	1.56	1.91	1.90
Average daily ration:				
Chopped alfalfa, lbs.	18.92	20.75	15.87	15.55
Ground barley, "	6.26	5.51	6.12	5.51
Corn silage, " ....	.....	.....	13.43	13.27
Cottonseed meal, " ....	.....	.61	.....	.61
Feed for 100 lbs. gain:				
Chopped alfalfa, lbs.	1314	1331	832	820
Ground barley, "	435	354	321	291
Corn silage, " ....	.....	.....	704	700
Cottonseed meal, " ....	.....	39	.....	32
Per cent waste hay	7.40	8.52	7.56	7.41
Market weight, lbs.	1031	1051	1085	1084
Shrink to mkt., per cent	3.63	4.65	4.55	4.03
Market price per cwt.	\$ 7.35	\$ 7.46	\$ 7.50	\$ 7.60
Market value per head	75.74	78.39	81.38	82.13
Dressing percentage	58.3	59.5	60.6	60.4
Carcass grading:				
Choice	1	0	1	2
Good	5	10	7	7
Medium	3	0	2	1

Corn silage in different amounts for yearling steers. From the results of the experiments previously reported, the combination of chopped alfalfa hay, corn silage and ground barley was adopted as a standard ration for fattening yearling steers. During the last three years a carload of yearling steers was fattened on this ration each year (*Table XXIX*).

The steers in 1931-32 were selected and were uniform. Prior to the experiment they had been pastured and fed hay for 60 days. In 1932-33 the steers ranged in age from short to long yearlings. They came from an outfit where the bulls run with the cows the year around. They had been cut out from the herd and brought in to pasture early in the fall. In 1933-34 the steers were of uniform age and quality, in only fairly good condition. The 85 steers reported in *Table XXIX* graded mostly good. When finished they graded from good to choice on the Portland market, all bringing the top price.

At the uniform rate charged for the feed of \$9.50 a ton for chopped hay, \$4.00 per ton for corn silage and \$1.00 per cwt. for ground barley, the feeding of an increased amount of silage

TABLE XXIX
Corn Silage in Different Amounts for Yearling Steers
3 Trials—1931-32, 1932-33, 1933-34

	1931-32 Chopped Alfalfa Gr. Barley Corn Silage	1932-33 Chopped Alfalfa Gr. Barley Corn Silage	1933-34 Chopped Alfalfa Gr. Barley Corn Silage
Number of steers	30	33	22
Days fed	95	131	141
Average initial weight, lbs.	841	784	732
Average final weight, "	1041	1067	1065
Average total gain, "	200	283	333
Average daily gain, "	2.11	2.16	2.36
Average daily ration:			
Chopped alfalfa, lbs.	15.07	14.89	13.67
Ground barley, "	9.13	7.28	8.30
Corn silage, "	5.0	9.62	12.10
Feed for 100 lbs. gain:			
Chopped alfalfa, lbs.	719	689	581
Ground barley, "	441	337	354
Corn silage, "	254	445	514
Per cent waste hay	2.53	2.22	3.47
Market weight, lbs.	963	1012	1006
Shrink to market, per cent	7.52*	5.13	5.48
Market price per cwt.	\$ 7.25	\$ 6.01	\$ 6.15
Market value per head	69.82	60.87	61.87
Dressing percentage	58.8	59.8	60.1
Carcass grading:			
Choice	**	12	9
Good .....	.....	20	13
Medium .....	.....	1	.....

*On cars 48 hours on account of floods.

**Carcass grading not available.

proved profitable. When five pounds per head per day were fed, the feed cost for 100 pounds gain was \$8.34, which was lowered to \$7.53 when the average daily ration consisted of 9.6 pounds, and to \$7.31 when 12 pounds of silage were fed per day.

The addition of silage proved more valuable in a ration for yearling than for two-year-old steers. All steers were thrifty throughout the experiment with no digestive disorders.

Summary of yearling steers. Until recent years the fattening of yearling steers has not been extensively practiced in Idaho. A majority of the feed-lot cattle consists of two-year-old steers and dry cows. The system of ranch and range management has been for the production of grass-fat cattle. The shortage of fat cattle in the west has occurred during the period between the close of the ranch pasturing season in December and the beginning of the grass-fat cattle season in May or June. The general practice has been to finish the thinner and lighter cut-back two- and three-year-old steers and cows in the feed lot during the winter.

Most of the cattle feeding has been done to dispose of bulky feed crops such as hay, beet pulp and corn silage. Until recent years, grain has been comparatively scarce and so high in price that it was not profitable in a cattle fattening ration. Only cows and older steers would fatten on the bulky feed crops which constituted the surplus.

The majority of yearling steers from the ranges are in stocker condition. In all cases the yearlings used in experimental trials were the larger, fleshier animals.

Yearlings require a longer period in the feed lot and more grain than older cattle. The early part of the fed cattle marketing season can be supplied only by the larger, fleshier range cattle that are "short-fed". The demand for a lighter carcass and the popularity of the smaller cuts of beef gives an outlet for the yearlings from the feed lot to be marketed during the late winter and early spring months.

The yearlings make more economical use of feed and put on gains at a lower cost. If long-fed and properly finished, a premium may be expected, allowing more spread or permitting a higher price per pound on purchasing the feeders. The purchasing of thin yearlings in stocker condition for feeding for market is precarious, for they may not be well finished in time to get to the market before there is a surplus of grass-fat cattle.

All yearlings were fed grain. Unlike older cattle, yearlings will not fatten on hay alone. At the start of the experiments with yearlings the ration adopted as a base was hay and barley, which was later changed to hay, barley and silage as a safety factor against bloat. A comparison of feed requirements, costs and gains of yearlings compared with two-year-olds is given in the following table:

Hay and Grain	No. Steers	Av. Daily Gain lbs.	Feed for 100 Pounds Gain			Feed Cost 100 lbs. Gain
			Hay lbs.	Barley lbs.	Silage lbs.	
Yearlings	31	1.73	1037	461	.....	\$ 9.54
Two-year-olds	62	1.79	1400	403	.....	10.11
Hay, Silage & Grain						
Yearlings	113	2.12	680	389	476	8.07
Two-year-olds	74	2.02	1065	364	803	10.31

Determining the Value of Shelter and Warm Water for Fattening Steers.

Comparing shed with open lot. A five years' comparison of the value of the shed was made from 1929 to 1934 (*Table XXX*). In 1929-30 and 1930-31 the trials were made with two-year-old steers, while in the last three years yearlings were used. The use of an open shed increased the gains but slightly. The steers having access to the shed made an average daily gain of 2.05 compared with an average daily gain of 1.98 pounds for the steers in the open lot. This resulted in a difference of 8.5 pounds in favor of the shed during the entire period.

TABLE XXX
 Determining the Value of Shelter and Warm Water for Fattening
 Yearling and Two-Year-Old Steers
 5 Trials—1929-30 to 1933-34

	2-Year-Olds		Yearlings		Summary	
	Open lot Chopped Alfalfa Ground Barley Silage	Shed Chopped Alfalfa Ground Barley Silage	Open lot Chopped Alfalfa Ground Barley Silage	Shed Chopped Alfalfa Ground Barley Silage	Open lot Chopped Alfalfa Ground Barley Silage	Shed Chopped Alfalfa Ground Barley Silage
Number of steers	19	19	32	31	51	50
Days fed	139	139	118	118	126	126
Ave. initial wt., lbs.	974	970	783	783	854	854
Ave. final wt., "	1203	1211	1045	1051	1104	1112
Ave. total gain, "	229	241	262	268	250	258
Ave. daily gain, "	1.65	1.73	2.22	2.27	1.98	2.05
Average daily ration:						
Chop'd alfalfa, lbs.	22.33	20.73	14.59	14.68	17.77	17.26
Ground barley, "	7.63	7.57	8.15	8.12	7.93	7.91
Corn silage, "	6.52	6.66	9.48	9.59	8.29	8.38
Feed for 100 lbs. gain:						
Chop'd alfalfa, lbs.	1362	1197	656	649	895	844
Ground barley, "	465	437	366	359	399	387
Corn silage, "	404	384	426	424	418	410
Per cent waste hay	7.59	7.69	4.05	3.59	5.88	5.66
Market weight, lbs.	1168	1175	984	987	1053	1058
Shrink to mkt., per ct.	2.89	3.03	5.77	6.07	4.62	4.86
Market price per cwt. \$..	\$ 9.80	\$ 9.80	\$ 6.39	\$ 6.30	\$ 7.80	\$ 7.78
Market value per head ..	114.46	115.13	62.93	62.19	82.13	82.31
Dressing percentage .....	.....	.....	.....	.....	59.8	60.1
*Carcass grading:						
Choice .....	.....	.....	.....	.....	10	9
Good .....	.....	.....	.....	.....	25	28
Medium .....	.....	.....	.....	.....	6	4

*82 steers. Not available on 19 steers slaughtered in Seattle 1931-32.

The feed consumption was slightly greater in the open lot. Feed requirements for 100 pounds gain were 61 pounds, or 7.2 per cent more hay; 15 pounds, or 3.9 per cent more barley; and 10 pounds, or 2.4 per cent more corn silage than when the cattle had no protection from the weather.

Charging chopped hay at \$9.50 per ton, corn silage at \$4.00 per ton and ground barley at \$1.00 per cwt., the use of the shelter saved \$41.79 worth of feed during the five years, amounting to 84 cents for each steer fed. The difference in gains during the entire period was an average of 8.5 pounds in favor of the shed.

The cattle of the different lots fed on the same ration had practically the same finish, all selling at the same price on the market, with dressing percentage and carcass grading practically the same.

Open lot feeding is satisfactory under conditions prevailing in the Boise Valley.

Comparing warm water with cold water. Three years' trials, started in 1930 and completed in 1933, were made to determine the value of heating the water for fattening cattle in cold weather (Table XXXI). The steers receiving warm water made an average daily gain of 2.08, compared with 2.01 pounds where the water was cold.

TABLE XXXI
Comparing Warm Water with Cold Water For Fattening Yearling and Two-Year-Old Steers
3 Trials—1930-31, 1931-32, 1932-33

	2-Year-Olds		Yearlings		Summary	
	Warm Water	Cold Water	Warm Water	Cold Water	Warm Water	Cold Water
	Chopped Alfalfa Ground Barley Silage	Chopped Alfalfa Ground Barley Silage	Chopped Alfalfa Ground Barley Silage	Chopped Alfalfa Ground Barley Silage	Chopped Alfalfa Ground Barley Silage	Chopped Alfalfa Ground Barley Silage
Number of steers	9	9	21	21	30	30
Days fed	125	125	106	106	111	111
Ave. initial wt., lbs.	1002	1002	809	811	867	868
Ave. final wt., "	1248	1225	1034	1035	1098	1092
Ave. total gain, "	246	223	225	224	231	224
Ave. daily gain, "	1.97	1.79	2.12	2.11	2.08	2.02
Average daily ration:						
Chop'd alfalfa, lbs.	19.48	20.00	15.63	15.35	16.93	16.91
Ground barley, "	7.91	7.96	8.04	7.82	7.99	7.87
Corn silage, "	15.57	15.73	7.62	7.71	10.29	10.41
Feed for 100 lbs. gain:						
Chop'd alfalfa, lbs.	986	1118	734	722	815	842
Ground barley, "	400	445	378	368	385	391
Corn silage, "	788	879	358	363	496	518
Per cent waste hay	6.27	7.27	4.15	4.57	4.98	5.65
Market wt., lbs.	1198	1172	974	975	1041	1035
Shrink to mkt., per ct.	4.17	4.33	5.84	5.81	5.23	5.22
Market price per cwt.	\$ 7.50	\$ 7.50	\$ 6.60	\$ 6.60	\$ 6.90	\$ 6.90
Market price per head	\$9.83	\$7.92	\$4.28	\$4.35	\$7.95	\$7.42
Dressing percentage	59.9	60.1	59.5	59.0	59.1	59.4
*Carcass grading:						
Choice	1	0	3	3	4	3
Good	7	7	7	7	14	14
Medium	1	2	1	1	2	3

*Carcass grading on 1930-31 and 1932-33 steers only.

Feed requirements for 100 pounds gain in the cold water lot were greater by 57 pounds, or 7 per cent hay; 7 pounds, or 1.7 per cent barley; and 23 pounds, or 4.4 per cent silage. Charging chopped hay at \$9.50 per ton, corn silage at \$4.00 per ton, and ground barley at \$1.00 per cwt., the use of warm water saved \$26.18 worth of feed in three years. This amounted to 87 cents per steer. The difference in gains during the entire period was an average of 7.7 pounds in favor of the warm water.

The finish of the cattle was the same in both lots, all selling at the same price, dressing and grading the same.

These trials were made in cooperation with the Department of Agricultural Engineering and the Idaho Power Company. Details appear in Idaho Experiment Bulletin No. 80, *Rural Electrification Development in Idaho*.

Comparative Feeding Trials with Calves

Comparing early and late spring calves, fall calves and yearlings. The growing demand for lightweight cattle on western markets has created interest in the fattening of calves. Calf fattening experiments were started at the Caldwell Substation in 1931-32 to determine the size of young cattle best suited to this demand. Feed requirements and economy gains on steers of different ages were studied in this trial. Four lots of steers were fed on alfalfa, barley, oats and cottonseed meal (*Table XXXII*). The oats were added to reduce the danger of bloat.

The early spring calves were dropped in April and the early part of May, and the late spring calves in the latter part of May and in June. The fall calves had been dropped from July to October. The yearlings were dropped the preceding spring. All the calves were of the same breeding and type and from one outfit. The yearlings were from different outfits. (*Fig. 10*).



Fig. 10—The calves fed in 1931-32 as they appeared on shipping day.

The calves were put into the feed lot on November 1st, while the yearlings were held on pasture and hay until December. The spring calves were fed 186 days, the fall calves 180, and the yearlings 148 days, all going to market at the same time.

The younger calves made the more economical gains. Figuring chopped alfalfa at \$9.50 per ton, ground barley at \$1.00 per cwt., and cottonseed meal at \$30.00 per ton, the feed cost of each 100 pounds gain was \$6.24 for the little calves, \$6.47 for the big calves, \$8.41 for the fall calves and \$8.86 for the yearlings (*Table XXXII*).

TABLE XXXII
Comparison of Late Spring Calves, Early Spring Calves, Fall Calves
and Yearlings
1 Trial—1931-32

	Late Spring Calves	Early Spring Calves	Fall Calves	Yearlings
	Alfalfa Barley Oats Cottonseed Meal	Alfalfa Barley Oats Cottonseed Meal	Alfalfa Barley Oats Cottonseed Meal	Alfalfa Barley Oats Cottonseed Meal
Number of steers	12	15	10	12
Days fed	186	186	180	148
Average initial weight, lbs.	376	454	586	694
Average final weight, "	730	837	910	977
Average total gain, "	354	383	324	283
Average daily gain, "	1.90	2.06	1.80	1.91
Average daily ration:				
Chopped alfalfa, lbs.	9.25	11.55	13.20	16.42
Ground barley, "	4.63	4.92	5.66	6.29
Ground oats, "	1.53	1.88	1.92	1.64
Cottonseed meal, " .....	.68	.72	.86	.94
Feed for 100 lbs. gain:				
Chopped alfalfa, lbs.	487	561	734	859
Ground barley, "	243	239	315	329
Ground oats "	80	91	107	86
Cottonseed meal, "	36	35	48	49
Per cent waste hay	1.28	1.04	1.56	1.06
Market weight, lbs.	685	793	867	941
Shrink to market, per cent	6.18	5.28	4.70	3.71
Market price per cwt.	\$ 6.75	\$ 7.00	\$ 7.00	\$ 7.00
Market value per head	46.23	55.52	60.69	65.86
Dressing percentage	60.0	*	61.0	58.5
Carcass grading	*	*	*	*

*Sold to city butchers.

The steers in this trial were marketed just before the run of grass-fat cattle, being sold during the last week of the good market for fed cattle. The early spring calves, the fall calves and the yearlings carried sufficient finish to top the market, while the little calves should have been fed for a longer period. As a result, the financial returns varied. The yearlings took on a good fill on the market, which decreased their shrinkage and lowered their dressing percentage.

This trial, made to determine the size of calves to buy for finishing for the western market, demonstrated the necessity of securing calves of good size and condition in order that they may be finished and sold on the market before the heavy run of grass-fat cattle.

Comparing cottonseed meal with linseed oil meal. Linseed oil meal was compared with cottonseed meal as a supplement to the ration of alfalfa hay, barley and oats fed to calves in one trial (*Table XXXIII*). Cottonseed meal proved superior in this trial. Fed in combination with alfalfa hay, barley and oats, the

linseed oil meal proved to be somewhat laxative, necessitating a slight reduction in the amount fed. Other than this difficulty, the results checked closely. (Fig. 11).



Fig. 11—A pen of calves fattened on alfalfa, barley, oats and cottonseed meal (1931-32).

TABLE XXXIII
Comparison of Cottonseed Meal and Linseed Oil Meal
1 Trial—1931-32

	Chopped Alfalfa Ground Barley Ground Oats Cottonseed Meal	Chopped Alfalfa Ground Barley Ground Oats Linseed Oil Meal
Number of Steers	15	15
Days fed	186	186
Average initial weight, lbs.	454	454
Average final weight, "	837	821
Average total gain, "	383	367
Average daily gain, "	2.06	1.97
Average daily ration:		
Chopped alfalfa, lbs.	11.55	11.49
Ground barley, "	4.92	5.03
Ground oats, "	1.88	1.88
Cottonseed meal, " .....	.72	.....
Linseed oil meal, " .....	.....	.59
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	561	582
Ground barley, "	239	255
Ground oats, "	91	95
Cottonseed meal, "	35	.....
Linseed oil meal, " .....	.....	30
Per cent waste hay	1.04	1.38
Market weight, lbs.	793	779
Shrink to market, per cent	5.28	5.19
Market price per cwt.	\$ 7.00	\$ 7.00
Market value per head	55.53	54.51
Dressing percentage	57.9	57.0

With cottonseed meal and linseed oil meal at the same price, the gains with cottonseed meal were more economical than when oil meal was used. Both were judged to have the same degree of finish, though owing to the fact that both lots were sold to city butchers on the market, the carcass grading could not be secured.

The value of cottonseed meal or soybeans fed with alfalfa, barley and oats, with and without corn silage. Cottonseed meal and soybean meal were compared in two trials. In one trial the cottonseed meal and soybeans were added to a ration of chopped alfalfa, ground barley and oats. (Table XXXIV). The second trial

TABLE XXXIV
The value of Cottonseed Meal or Soybeans when fed with Alfalfa, Barley and Oats
1 Trial—1932-33

	Chopped Alfalfa Ground Barley Ground Oats	Chopped Alfalfa Ground Barley Ground Oats Cottonseed Meal	Chopped Alfalfa Ground Barley Ground Oats Soybeans
Number of steers	12	11	11
Days fed	190	190	190
Average initial weight, lbs.	449	454	446
Average final weight, "	845	866	840
Average total gain, "	396	412	394
Average daily gain, "	2.09	2.17	2.07
Average daily ration:			
Chopped alfalfa, lbs.	11.33	12.71	11.69
Ground barley, "	4.64	4.23	4.16
Ground oats, "	2.19	2.31	2.30
Cottonseed meal, " .....	.....	.60	.....
Ground soybeans, " .....	.....	.....	.53
Feed for 100 lbs. gain:			
Chopped alfalfa, lbs.	543	586	565
Ground barley, "	222	195	201
Ground oats, "	105	107	111
Cottonseed meal, " .....	.....	28	.....
Ground soybeans, " .....	.....	.....	26
Per cent waste hay .....	.91	1.26	1.61
Market weight, lbs.	806	823	796
Shrink to market, per cent	4.67	5.02	5.18
Market price per cwt.	\$ 6.85	\$ 6.85	\$ 6.85
Market value per head	55.20	56.36	54.55
Dressing percentage	57.5	59.8	58.8
Carcass grading:			
Choice	9	10	9
Good	2	1	2
Medium	1	0	0

was made with the same ration, supplemented with 4.7 pounds of silage per day (Table XXXV).

The addition of a protein supplement improved the finish of the steers, though the difference was not great. In 1932-33, the

TABLE XXXV
Value of Cottonseed Meal or Soybeans when fed with Alfalfa,
Barley, Oats and Corn Silage
1 Trial—1933-34

	Chopped Alfalfa Ground Barley Ground Oats Corn Silage	Chopped Alfalfa Ground Barley Ground Oats Corn Silage Soybeans	Chopped Alfalfa Ground Barley Ground Oats Corn Silage Cottonseed Meal
Number of steers	10	11	12
Number of days	211	211	211
Average initial weight, lbs.	436	432	429
Average final weight, "	878	896	881
Average total gain, "	442	464	452
Average daily gain, "	2.09	2.20	2.14
Average daily ration:			
Chopped alfalfa, lbs.	10.18	10.21	9.50
Ground barley, "	5.35	4.83	4.69
Ground oats, "	2.19	2.13	2.11
Corn silage, "	4.77	4.69	4.72
Cottonseed meal, " .....	.....	.....	.64
Ground soybeans, " .....	.....	.50	.....
Feed for 100 lbs. gain:			
Chopped alfalfa, lbs.	486	465	443
Ground barley, "	255	219	219
Ground oats, "	105	97	99
Corn silage, "	228	213	220
Cottonseed meal, " .....	.....	.....	30
Ground soybeans, " .....	.....	23	.....
Per cent waste hay	5.82	3.78	3.94
Market weight, lbs.	831	831	832
Shrink to market, per cent	5.35	7.26	5.67
Market price per cwt.	\$ 6.60	\$ 6.60	\$ 6.60
Market value per head	54.85	54.85	54.91
Dressing percentage	59.8	60.4	59.9
Carcass grading:			
Choice to prime	10	11	10
Good	0	0	0
Medium	0	0	0

steers suffered an attack of hemorrhagic septicemia, the soybean fed calves being more affected than the cottonseed meal fed calves, which may have accounted for the better showing made by the cottonseed meal. While recovering completely after vaccination, the gains for the period of infection were unsatisfactory.

In 1933-34 cottonseed meal increased the average daily gain from 2.09 pounds to 2.14 pounds, or 2.39 per cent. Each ton of cottonseed meal saved 2,866 pounds of alfalfa, 2,400 pounds of barley, 400 pounds of oats and 533 pounds of silage. The average daily gain was increased from 2.09 to 2.20 pounds, or 5.26 per cent, by the addition of soybeans. Each ton of soybeans fed replaced 1,826 pounds of alfalfa, 3,130 pounds of barley, 695 pounds of oats and 1,304 pounds of silage.

The value of corn silage and cottonseed meal added to alfalfa barley and oats. Corn silage was added to the ration of alfalfa hay, barley and oats in two trials (*Table XXXVI*). The addition

TABLE XXXVI

The value of Corn Silage and Cottonseed Meal added to Alfalfa, Barley and Oats

2 Trials—1932-33, 1933-34

	Chopped Alfalfa Ground Barley Ground Oats	Chopped Alfalfa Ground Barley Ground Oats Corn Silage	Chopped Alfalfa Ground Barley Ground Oats Cottonseed Meal
Number of steers	24	20	24
Number of Days	200	200	200
Average initial weight, lbs.	442	446	440
Average final weight, "	851	883	867
Average total gain, "	409	437	427
Average daily gain, "	2.04	2.18	2.13
Average daily ration:			
Chopped alfalfa, lbs.	11.45	10.31	9.98
Ground barley, "	5.10	5.03	4.41
Ground oats, "	2.15	2.20	2.14
Corn silage, " .....	.....	4.81	4.77
Cottonseed meal, " .....	.....	.....	.62
Feed for 100 lbs. gain:			
Chopped alfalfa, lbs.	560	473	467
Ground barley, "	250	231	208
Ground oats, "	105	101	100
Corn silage, " .....	.....	221	223
Cottonseed meal, " .....	.....	.....	29
Per cent waste hay	1.66	3.69	2.58
Market weight, lbs.	813	837	818
Shrink to market, per cent	4.47	5.21	5.60
Market price per cwt.	\$ 6.67	\$ 6.67	\$ 6.67
Market value per head	54.23	55.85	54.57
*Dressing percentage	58.8	59.8	59.9
*Carcass grading:			
Choice to prime	11	10	12
Good	1	0	0
Medium	0	0	0

*34 steers, 1933-34.

of corn silage increased the daily gain from 2.04 to 2.18 pounds, or 6.85 per cent. With chopped alfalfa at \$9.50 per ton and ground barley and oats at \$1.00 per cwt., each ton of corn silage had a feed replacement value of \$5.82 per ton.

Cottonseed meal was added to the ration of alfalfa, barley, oats and silage in two trials. In 1932-33 the calves suffered from an attack of hemorrhagic septicemia, from which they completely recovered after vaccination. However, during the period of infection the cottonseed meal fed calves were retarded to such an extent that the other two lots, which were not seriously affected, made better gains.

In 1933-34, the lot on cottonseed meal made an average daily gain of 2.14 pounds, compared with 2.09 pounds on the lot receiving no cottonseed, an increase of 2.39 per cent. Each ton of cottonseed meal saved 2,867 pounds of alfalfa, 2,400 pounds of barley, 400 pounds of oats and 533 pounds of corn silage.

Bone meal, mono-calcium phosphate and cottonseed meal were added as sources of phosphorus to the ration of alfalfa, barley, oats, and corn silage for fattening calves for a period of 211 days (*Table XXXVII*). Bone meal was fed at the rate of .95

TABLE XXXVII
Comparison of Minerals with no Minerals
1 Trial—1933-34

	Chopped Alfalfa Ground Barley Ground Oats Corn Silage	Chopped Alfalfa Ground Barley Ground Oats Corn Silage Bone Meal	Chopped Alfalfa Ground Barley Ground Oats Corn Silage Mono-Cal. Phos.	Chopped Alfalfa Ground Barley Ground Oats Corn Silage Cottonseed Meal
Number of steers	10	11	11	12
Number of days	211	211	211	211
Average initial wt., lbs.	436	434	434	429
Average final wt., "	878	865	841	881
Average total gain, "	442	431	407	452
Average daily gain, "	2.09	2.04	1.93	2.14
Average daily ration:				
Chopped alfalfa, lbs.	10.18	10.26	9.80	9.50
Ground barley, "	5.35	5.36	5.36	4.69
Ground oats, "	2.19	2.13	2.13	2.11
Corn silage, "	4.77	4.69	4.69	4.72
Cottonseed meal, " .....	.....	.....	.....	.64
Bone meal, oz. ....	.....	.95	.....	.....
Mono-Cal. Phos. " .....	.....	.....	.95	.....
Feed for 100 lbs. gain:				
Chopped alfalfa, lbs.	486	503	509	443
Ground barley, "	255	262	278	219
Ground oats, "	105	104	111	99
Corn silage, "	228	230	243	220
Cottonseed meal " .....	.....	.....	.....	30
Bone meal, oz. ....	.....	46	.....	.....
Mono-Cal. Phos., " .....	.....	.....	49	.....
Per cent waste hay	5.82	3.21	4.26	3.94
Market weight, lbs.	831	825	792	832
Shrink to mkt., per cent	5.35	4.57	5.85	5.67
Market price per cwt.	\$ 6.60	\$ 6.60	\$ 6.60	\$ 6.60
Market value per head	54.85	54.45	52.27	54.91
Dressing percentage	59.8	59.1	60.4	59.9
Carcass grading:				
Choice to prime	10	10	11	12
Good	0	1	0	0
Medium	0	0	0	0

ounce per head daily. The addition of bone meal decreased the daily gain from 2.09 to 2.04 pounds, or 2.39 per cent. When the bone meal was added the feed requirements were increased as

follows: alfalfa hay, 3.38 per cent; barley, 2.67 per cent; and corn silage, .87 per cent.

Mono-calcium phosphate was fed at the rate of .95 ounce per head daily. The addition of mono-calcium phosphate decreased the daily gain from 2.09 to 1.93 pounds, or 8.13 per cent. The feed requirements were increased when the mono-calcium phosphate was added, as follows: alfalfa hay, 4.52 per cent; barley, 8.28 per cent; oats, 5.41 per cent; and corn silage, 6.17 per cent.

The addition of the phosphorus supplements, bone meal and mono-calcium phosphate, to the ration of alfalfa hay, barley, oats and corn silage decreased gains and increased feed requirements. Apparently this ration as grown on the soil of the Caldwell Substation farm was not deficient in phosphorus.

Experiments were made at the Aberdeen and Caldwell Substations to determine whether or not additional phosphorus was necessary for fattening lambs and steers. At Aberdeen in 1932-33, three lots of 115 lambs each were fed alfalfa, barley and beet pulp. At Caldwell in 1933-34, four lots of 65 lambs each were fed alfalfa, barley and corn silage. Bone meal and mono-calcium phosphate were added as sources of phosphorus. In each experiment the check lot, receiving no mineral supplement, made greater gains with lower feed requirements and graded higher on the market than the mineral fed lots.

The value of minerals for fattening calves. Minerals are essential for normal plant and animal life; while usually present in small amounts they are essential. Of the 90 or more elements known to the chemist, only 14 are commonly present in plants. If the soil is deficient in one or more essential minerals, the crops may be decreased in yield and their composition modified. Animals receive their supply of minerals, other than salt, from their feed. Animals fed on forage and grains deficient in minerals show lack of thrift, normal growth and development. Indications of lack of minerals are unthrifty appearance, hard, rough hair, and a depraved appetite, when the animals chew bones and rags or lick soil.

Feeds are most often deficient in phosphorus and calcium. In some regions feeds are deficient to the extent that it is necessary to supply mineral supplements to both breeding and feed-lot stock. Phosphorus is one mineral that is lacking in the soils of certain sections of Idaho. The Idaho Agricultural Experiment Station has conducted experiments with various field crops and soil analysis showing that there are certain crops in particular regions which respond to phosphorus fertilizer.

The addition of cottonseed meal to the ration of alfalfa, barley, oats, and corn silage increased the daily gain from 2.09 to 2.14 pounds, or 2.39 per cent. The feed requirements were decreased when the cottonseed meal was added, as follows: alfalfa, 9.7 per cent; barley, 16.4 per cent; oats, 6.1 per cent; and corn silage 3.7 per cent.

The addition of cottonseed meal, which is relatively high in phosphorus, to the ration of alfalfa, barley, oats and silage improved the average daily gains and decreased the feed requirements. From the results of mineral feeding noted above, the positive results from feeding cottonseed meal were probably due to the additional protein rather than the phosphorus content.

Comparing calves with yearlings on alfalfa, barley, oats and cottonseed meal. Calves and yearlings of the same breeding and from the same outfit were compared in two trials (*Table XXXVIII*). The calves averaged 402 pounds and were fed 198

TABLE XXXVIII
Comparison of Yearlings with Calves
2 Trials—1931-32, 1933-34

	Calves Chopped Alfalfa Ground Barley Ground Oats Cottonseed Meal*	Yearlings Chopped Alfalfa Ground Barley Ground Oats Cottonseed Meal*
Number of steers	24	21
Days fed	198	158
Average initial weight, lbs.	402	654
Average final weight, "	794	946
Average total gain, "	388	292
Average daily gain, "	1.96	1.85
Average daily ration:		
Chopped alfalfa, lbs.	10.41	16.55
Ground barley, "	5.10	5.66
Ground oats, "	1.82	1.91
Cottonseed meal, " .....	.32	.47
Feed for 100 lbs. gain:		
Chopped alfalfa, lbs.	532	895
Ground barley, "	261	307
Ground oats, "	93	104
Cottonseed meal, "	16	25
Per cent waste hay	1.82	2.33
Market weight, lbs.	752	898
Shrink to market, per cent	5.29	4.98
Market price per cwt.	\$ 6.67	\$ 6.48
Market value per head	50.19	58.17
Dressing percentage	60.0	61.0
**Carcass grading:		
Choice to prime	12	8
Good	0	3
Medium	0	0

*Fed in 1931-32 only.

**Carcass grading not available on 1931-32 steers.

days. The yearlings averaged 654 pounds and were fed 158 days. The yearling steers made 5.6 per cent less gain than the calves. The feed requirements for 100 pounds gain on the calves were 40.55 per cent less alfalfa, 14.98 per cent less barley, 10.57 per cent less oats, and 36.0 per cent less cottonseed meal than for the yearlings. Charging chopped alfalfa at \$9.50 per ton, ground barley and oats at \$1.00 per cwt., and cottonseed meal at \$30.00

per ton, the feed cost per 100 pounds gain was \$6.31 for the calves and \$8.72 for the yearlings.

The yearlings, on a ration containing a relatively higher proportion of roughage were as well finished in 158 days as were the calves in 198 days.

Summary on fattening calves. Under Idaho conditions calves to be fattened and marketed before the heavy run of grass-fat cattle should be the large calves of good beef type and in good condition when they are put into the fed lot. Calves that have lost their milk fat are stocker rather than feeder calves, consequently require a longer feeding period.

A ration of alfalfa hay, barley and oats is satisfactory for fattening calves. Oats are added to reduce the danger of bloat.

The alfalfa allowance must be limited so that the calves will consume sufficient grain to fatten.

The addition of a limited amount of corn silage to a ration of alfalfa, barley and oats increased the rate of gain and saved enough feed to make it profitable.

The addition of cottonseed meal to a ration of alfalfa, barley, oats and corn silage saved sufficient feed to justify the use of a limited amount.

Cottonseed meal and linseed oil meal were fed with a ration of alfalfa, barley and oats. The cottonseed meal was slightly superior because of the increased gains and lower feed requirements.

Cottonseed meal and ground soybeans were fed with the ration of alfalfa, barley and oats, with and without corn silage. The protein supplements had a higher value when corn silage was included in the ration. In general, cottonseed meal and soybean meal have approximately the same value.

Minerals in the form of bone meal and mono-calcium phosphate were not necessary when fed with alfalfa, barley, oats and corn silage grown on the Substation farm.

Calves require a longer feeding period and higher proportion of grain than yearlings. In two trials with yearlings and calves of the same breeding, and from the same outfit, the yearlings finished in 158 days, while 198 days were required to finish the calves.

**Comparison of Gains and Feed Requirements of Calves
Yearlings and Two-Year-Old Steers**

	No. Trials	No. Steers	Av. Daily Gain	Feed for 100 Pounds Gain		
				Hay	Silage	Grain
Calves	8	88	2.10	477	350	226
Yearlings	10	113	2.12	680	476	389
Two-Year-Olds	7	74	2.02	1065	803	364
Calves	6	76	2.05	569	.....	356
Yearlings	3	31	1.73	1037	.....	461
Two-Year-Olds	6	62	1.79	1400	.....	403

Shipping and Marketing

The shrinkage of cattle from feed lot to market varies so greatly that it differs on each individual lot of cattle. Feed lot results may be somewhat deceptive because of variations in weighing conditions. Variation in shrinkage is due to a number of factors:

1. Condition of the cattle, whether thin, half-fat or well finished.
2. Nature of the feed, influenced by bulk of the ration and softness of the feed.
3. Weighing conditions, whether weighed full at the home yards, or trailed before the weights are taken: Immediately upon moving the cattle some weight is lost. When turning out of the corral, if the cattle are not restrained and prevented from running, the first shrink will be heavy. Cattle weighed on tested scales have shrunk as much as 4 per cent on trailing four miles, though the average shrink for this distance is 2 per cent to 2½ per cent. The common method of weighing cattle, if they must be taken from the feed lot and trailed one to two miles, is to shrink them 3 per cent, but if the distance is from two to four miles, the shrink is 2 per cent. When weighed full at home the common practice is to allow 4 per cent.
4. Condition of cattle upon arrival on the market; a long, hard, 36-hour run is hard on cattle. Some shipments arrive in good shape, while in others the cattle become so foot-sore from standing in the cars that they take but little fill on the market. The greatest shrink experienced with grain fed cattle was with the yearlings in the spring of 1932, when, owing to flood waters and a submerged track, the cattle were held in the cars 48 hours, resulting in 7.52 per cent shrink, while a later shipment of the remaining yearlings cut back from this same bunch, with an excellent 26-hour run, shrank an average of only 3.71 per cent.
5. The loading of the cattle: Cattle under-loaded move around too much and may be thrown by the jerking of the train. Cattle over-loaded are not comfortable. An over-loaded car must be carefully watched, for once a steer gets down he cannot get up without assistance.
6. Fill on the market: The fill on the market depends upon the condition of the cattle upon arrival, and weather conditions. If the cattle are tired out and foot-sore, they will desire rest more than feed and water. If the weather is stormy, or there is a cold wind, they may drink but little water.

At the close of the experiments the cattle were shipped to market. During the first four years, when the cattle were fed on contract, they were slaughtered in Boise, to which point they were trailed from the station, a distance of 32 miles. The cattle

fed in 1923-24 were marketed in Salt Lake City. All other cattle were marketed in Portland, Oregon, which involved four miles' trail and 462 miles by rail.

On shipping day the cattle are fed their usual ration of hay, but no silage or grain. They are trailed to Caldwell in the morning, a distance of 4.2 miles. The stock train for Portland leaves Caldwell at from 2 to 5 o'clock in the afternoon. The run to market is made without unloading, usually in from 28 to 32 hours.

The two-year-olds were loaded 27 to the car, with a full loading weight of 30,790 pounds. The market weight per car was 29,665 pounds. All stock cars used in Idaho are the standard 36-foot length.

The yearlings were loaded on an average of 30 to the car, with a full loading weight, without shrink, of 30,390 pounds, and a market weight of 28,720 pounds.

Calves were loaded 34 to the car, with a full weight of 27,900 pounds and a market weight of 26,450 pounds.

The actual cost of shipping and selling of all shipments was \$172.80 per car. Based on the full weight at home and the market weight, this gives an average cost per cwt. of shipping and marketing cattle of the different ages as follows:

SHIPPING EXPENSE PER CWT.

	Home Wt.	Market Wt.
Two-year old steers	\$.56	\$.58
Yearling steers .....	.57	.60
Calves .....	.63	.67

The variation in shrinkage of two-year-old steers is shown in the following table:

No.		Av. Home	Av. Market	Shrinkage	
Steers	Ration	Weight	Weight	Lbs.	Per Cent
24	Hay	1101.04	1126.67	74.37	6.75
20	Hay and Silage	1136.15	1076.00	60.15	5.29
119	Hay, Silage, Grain	1165.85	1116.36	49.49	4.24
224	Hay and Grain	1138.85	1092.35	46.50	4.08

Financial Aspects of Cattle Feeding

The financial statement shown in Table XXXIX is calculated on the actual prices paid for the cattle and feed. Most of the hay, silage, barley, corn and oats were raised on the Substation farm, but as the Substation was paid for the feed out of the net proceeds, there is no distinction between money paid the Caldwell Substation and money paid for commercial feed or for hay and grain produced on adjoining farms; the disbursements are the same in all cases.

The price of long hay ranged from \$4.00 in the winter of 1932-33 to \$16.25 in the winter of 1919-20. The average price of the hay for the 15 years was \$8.25. Chopped hay fed averaged \$10.00 per ton, with ground hay at \$12.00 per ton. The average price of corn silage was \$5.60.

TABLE XXXIX

Year	Cattle	Purchase Price per Cwt.	Cost of Cattle	Cost of Feed	Home Value	Return over cost of cattle & feed	
						Profit	Loss
1919-20	120*	\$ 8.00	\$7,778.08	\$3,317.88	\$10,641.48	\$	\$454.48
1920-21	118*	6.00	6,846.72	3,015.65	10,602.18	739.81	.....
1921-22	75*	4.50	3,119.11	1,543.85	4,689.42	26.46	.....
1922-23	88*	5.50	4,457.31	1,411.18	6,328.81	460.32	.....
1922-23	30 (cows)	4.00	1,276.24	428.23	1,505.59	.....	198.88
1923-24	51	5.50	2,394.48	1,552.10	4,162.44	215.86	.....
1924-25	52	5.50	2,575.10	1,360.99	3,932.03	.....	4.06
1925-26	56	6.50	3,204.50	1,637.46	4,848.47	6.51	.....
1926-27	47	6.60	2,742.43	1,697.06	4,903.63	464.14	.....
1926-27	10 (yrigs.)	6.60	478.50	345.63	1,022.70	198.57	.....
1927-28	40 (twos)	7.50	2,703.00	1,091.44	4,747.28	952.84	.....
1927-28	21 (yrigs.)	7.85	1,163.21	675.80	2,206.10	367.09	.....
1928-29	57 (twos)	10.50	5,258.81	2,417.71	7,581.57	.....	94.95
1929-30	55	10.00	5,020.29	1,981.76	6,796.04	.....	206.01
1930-31	27 (twos)	6.50	1,637.35	699.01	2,243.55	.....	92.81
1930-31	60 (yrigs.)	6.00	2,810.40	1,578.65	4,277.29	.....	111.76
1931-32	42 (yrigs.)	5.00	1,587.10	796.01	2,641.44	258.33	.....
1931-32	52 (calv.)	5.25	1,201.98	1,209.45	2,561.20	149.77	.....
1932-33	33 (yrigs.)	4.00	983.00	447.20	1,813.73	383.53	.....
1932-33	59 (calv.)	4.25	1,166.56	862.86	2,877.44	848.02	.....
1933-34	33 (yrigs.)	3.40	818.25	662.38	771.96	291.33	.....
1933-34	69 (calv.)	4.00	1,162.15	1,850.54	3,339.85	327.16	.....
1933-34	5 (heif.)	3.75	78.37	101.29	233.10	53.40	.....

*Steers fed on contract.

Like the hay, the grain was charged at the actual market price. Both the roughage and concentrate feeds are paid for on the basis of delivering in town, on the assumption that the labor of delivering to a market or feeding cattle on the farm would offset each other. Thus, while no allowance is made for labor, the prices allowed are similar to those when the feed is fed to contract cattle and the agreement of feed prices includes the cost of feeding.

Ground barley ranged from \$12.00 per ton in the winter of 1932-33 to \$55.50 per ton in 1919-20. The average price of the barley is \$26.82 per ton. The average price of the ground corn was \$32.40 per ton. Ground oats, which were fed in the later years of the experiments, were \$20.25 per ton. Cottonseed meal, which was purchased, averaged \$38.50 at the farm.

The highest price paid for cattle was in the year of 1928-29, when good feeder steers sold off the range at \$10.50 per cwt. The lowest prices paid were in the fall of 1933, when the yearling steers were bought at \$3.25 per cwt. The average price paid for steers over the 15-year period was \$6.36.

The financial aspects of cattle feeding, as shown in Table XXXIX, are typical of Idaho as a whole. Profits have not been large, yet have been reasonably safe and sure. In all cases the cattle have paid a fair price for their feed, usually more than the market value. The feed prices include the estimated extra

labor in feeding. The farm which has adopted cattle feeding as a means of marketing the crop has been able to realize higher prices than could have been realized by selling their feed on the market.

Summary

Winter fattening of range steers is a practical method of marketing the home grown grains, roughage and various by-products produced on the Idaho ranch. The combination of feeds that will produce maximum gains at minimum cost is an important factor within the control of the feeder. Quality of feeds, regularity of feeding, adequate watering facilities and dry, comfortable lots, all add to the rapidity and economy of gains.

The buying of feeder cattle is one of the important phases of successful operation. "Cattle well bought are half sold." The value of feeder cattle depends upon type, conformation, condition and quality. The size and condition of the cattle purchased depend upon the length of the feeding period and kind and amount of feed.

Alfalfa hay forms the basis for cattle fattening rations in Idaho. It may be fed whole, chopped or ground. The choice of the form in which the hay is to be fed depends upon the supply and price of hay, the cost of processing and the use that may be made of the waste hay.

When the hay is of good quality, chopping or grinding increases the consumption, consequently the gains. When the hay is of good quality, cattle will eat more ground hay than chopped hay, and more chopped hay than long hay, consequently will gain more. When the hay is of poor quality, containing coarse, woody stems, and unpalatable weeds, which the cattle cannot refuse in the processed hay, the reverse is true.

When hay alone was fed, 2450 pounds of long hay, 2142 pounds of chopped hay, or 1993 pounds of ground hay produced 100 pound gain on two-year-old steers.

When fed in combination with other feeds, principally silage and grain, chopped hay proved more economical than long hay, both from the standpoint of feed costs and gain of the cattle. When hay is fed long, the percentage of hay wasted increases with the amount of silage and grain added, being less when hay alone is fed.

The relative value of barley, corn and wheat is not materially different. When fed with alfalfa hay, either wheat or barley may cause bloating. The danger of bloat may be alleviated by the addition of a supplementary feed such as oats, bran or corn silage.

Each ton of grain fed to two-year-old steers replaced 4160 pounds of hay. When the increased value of the grain-fed cattle is considered, each ton of grain had a value equal to 6260 pounds of hay.

Corn silage added to a ration of hay valued at \$8.00 per ton had a feed replacement value ranging from \$3.45 to \$6.21 per ton. It had the least value when fed in light amounts as a supplement to a hay alone ration, and the greatest value as a supplement to a hay and grain ration. Silage proved to be a more valuable addition to the ration of yearlings than of two-year-olds.

Sound potatoes, fed at the rate of 17 pounds per head per day, had a value equal to corn silage.

Cull beans may be fed to advantage as 15 per cent of the grain ration. While valuable when fed in a limited amount, when fed in excess they may cause digestive disorders.

Cottonseed meal and linseed oil meal are rich protein supplements which are comparatively high in price. While the gains and finish were slightly improved, the protein supplements did not prove profitable when fed with comparatively low priced feeds. When local feeds are high in price and cottonseed meal is cheap, it may be included in the ration at a profit, but it is not indispensable.

The age of cattle to feed depends largely upon the supply and kind of feed. When the surplus feed consists mostly of roughage, two- or three-year-old steers, or cows, will make most economical use of the feed. When the roughage is limited and the surplus feed consists mostly of grain, yearlings or calves may be advantageous.

Two-year-old steers finish in from 60 to 120 days. Yearlings require from 120 to 150 days, and calves from 180 to 250 days.

In feeding two-year-olds the largest item of expense is the purchase of the cattle, while in calves the feed costs represent the highest item of expense.

The younger the cattle, the less the amount of feed required for 100 pounds gain. When fed the same ration, calves produced gain on 31 per cent less hay and 13 per cent less grain than the yearlings. Feed requirements for 100 pounds gain on the yearlings were 38 per cent less hay and 14 per cent less silage, but 6 per cent more grain than the two-year-olds. With long hay at \$8.00 and chopped hay at \$9.50 per ton, corn silage at \$4.00 and grain at \$20.00 per ton, the feed cost of 100 pounds gain was \$10.31 for the two-year-olds, \$8.07 for the yearlings and \$5.23 for the calves. When the ration consisted of only hay and grain at the above prices, feed costs for 100 pounds gain were \$10.68 for the two-year-olds, \$9.54 for the yearlings and \$6.26 for the calves.