

CALIFORNIA
AGRICULTURAL EXTENSION SERVICE

CIRCULAR 49

November, 1930

SHEEP PRODUCTION
IN CALIFORNIA

ROBERT F. MILLER

Cooperative Extension work in Agriculture and Home Economics, College of Agriculture, University of California, and United States Department of Agriculture cooperating. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. B. H. Crocheron, Director, California Agricultural Extension Service.

THE COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA

1930



Digitized by the Internet Archive
in 2011 with funding from
University of California, Davis Libraries

SHEEP PRODUCTION IN CALIFORNIA

ROBERT F. MILLER¹

Sheep raising has been an important branch of the livestock industry in California for many years. It was formerly conducted primarily under range conditions, but during recent years farmers have become greatly interested in sheep owing to the favorable returns from the sale of lambs and wool.

The College of Agriculture, University of California, has received many requests during recent years for information, general and specific, relative to sheep production, not only from farmers, but from prospective settlers and others wanting to engage in sheep raising in this state. This circular has been prepared with a view to supplying this information.

The circular includes a brief statistical review, a discussion of the most prominent breeds, practical suggestions in the feeding, care and management of the flock, and a word about common parasitic infestations.

LEADING SHEEP AND WOOL COUNTRIES

There are about 617,800,000 head of sheep in the world according to the January 1, 1925,² estimate. The leading sheep producing countries are Australia, Russia, Argentine-Uruguay, United States; Union of South Africa, New Zealand, and Great Britain.

The United States ranks fourth in the number of sheep, having 48,913,000 head, according to January 1, 1930, estimate. The annual receipts of sheep and lambs at public stockyards amount to about 23,000,000 head, the leading markets being Chicago, Omaha, Denver, Kansas City, and Jersey City. Some importations of frozen mutton and lamb have been made from time to time, principally from New Zealand. This product, however, has not met with ready sale in this country.

The United States ranks third in the production of wool and the average for the last twenty years has been about 300,000,000 pounds a year. This country, however, does not produce sufficient quantity of wool to meet its needs, and its imports annually amount to about 275,000,000 pounds. About 150,000,000 pounds of this is carpet wool,

¹ Associate Professor of Animal Husbandry and Associate Animal Husbandman in the Experiment Station.

² U. S. Dept. Agr. Yearbook 1928:942. 1929.

a very small quantity of which is produced in this country. Wool is a non-perishable product, readily transported, and enters into world trade, and its price is determined by world conditions of supply and demand. Boston is the second largest wool market in the world and in some years handles 75 per cent of the domestic wool and occasionally as high as 70 per cent of the imported wool.

The ten leading states in numbers of sheep are Texas, California, Montana, Wyoming, Utah, Colorado, Oregon, New Mexico, Idaho, and Ohio. Texas is a very large state and is credited with 5,052,000³ head of sheep, and California stands second with nearly 4,000,000 head. In density of sheep population the order is somewhat reversed: Ohio stands first, with 52.8 head per square mile; Wyoming, 35.3; Utah, 34.8; etc. California and Texas rank eighth and ninth, having only 24.7 and 19.2 sheep per square mile respectively.

The sheep population is centered in the thirteen western states which are credited with 67 per cent of the total sheep in the United States.

TABLE 1
ESTIMATED NUMBER OF SHEEP ON FARMS AND RANGES IN CALIFORNIA
JANUARY 1, 1920-1930

Year	Number in California	Yearly increase or decrease	Increase or decrease, per cent
1920.....	2,900,000
1921.....	2,750,000	-150,000	- 5.2
1922.....	2,475,000	-275,000	-10.0
1923.....	2,600,000	125,000	5.1
1924.....	2,890,000	290,000	11.2
1925.....	3,045,000	155,000	5.4
1926.....	3,200,000	155,000	5.1
1927.....	3,392,000	192,000	6.0
1928.....	3,528,000	136,000	4.0
1929.....	3,846,000	318,000	9.0
1930.....	3,923,000	77,000	2.0

Since 1922, the low year in point of numbers following the World War, sheep have steadily increased in this state, and on January 1, 1930, the figures indicate an increase of 58.5 per cent as compared to January 1, 1922.

This heavy increase can be accounted for by the replacement of cattle on many California ranges and by the general farm flock movement throughout the state. It may be said, however, that California ranges have reached the saturation point, many areas are already overstocked, and further expansion of the industry would be unwise.

³ U. S. Dept. Agr. Yearbook 1928:940. 1929.

LAND AREAS IN CALIFORNIA

There are approximately 100 million acres of land in California, classified as indicated in table 2.

The land classification changes from year to year, although the above table may serve as a satisfactory guide as to land areas of the state. All the classified lands are used more or less for grazing purposes except the improved farm land, which constitutes only 12 per cent of the total area. On this basis it is safe to conclude that 80 to 85 per cent may be considered as grazing land, although a large portion of it is rough and mountainous.

TABLE 2
CLASSIFICATION OF LAND AREAS IN CALIFORNIA⁴

	Acres	Per cent
Farm land.....	29,365,667	29.5
National Forest.....	19,334,865	19.4
Unappropriated lands (public domain).....	19,000,000	19.1
School land.....	8,389,053	8.4
Timber, coal, desert.....	4,926,000	4.9
Indian.....	913,621	0.9
Homestead, railway, lands patented.....	1,349,678	1.4
Other classifications.....	16,338,396	16.4
Total.....	99,617,280	100.0

EARLY HISTORY AND DISTRIBUTION OF SHEEP IN CALIFORNIA

The first domestic sheep were brought into California in 1769 by the Franciscan padres on their mission-founding enterprise. These sheep were of a very low grade and were probably descendants of the coarse-wooled sheep kept in the lowlands of Spain. They were used as an agency in the missionary work of Christianizing and civilizing the native race by teaching the care of sheep to the men and the manufacture of clothing to the women, as well as contributing toward a food supply for the colonists. It is estimated that in 1825 there were 1,003,970 head of sheep kept at the seventeen missions extending from San Francisco to San Diego and about as many more were kept by the ranchers outside of the missions. This would indicate that in early days the coast district of California had been a very great sheep country. Spinning and weaving were two of the chief occupations of the women and girls at the larger missions, providing coarse blankets

⁴ Statistical Report California State Board of Agriculture 1921:11-27. 1923.

and clothing for the inhabitants. Vast numbers of pelts and much tallow were also produced for sale to coast trading ships for Atlantic seaports. During the Secularization Period the law placed the disposal of the livestock in the hands of the government officers and under them the property was generally scattered by sale. From 1832, when the process began, to 1848, little mention is made of sheep in California. When gold was discovered there was great demand for fresh meat by miners; lambs sold for \$12.00 and wethers for \$15.00 per head. Few of the old mission sheep survived pelt killing, neglect, and feeding the gold seekers. The first census, which was taken in 1850, records only 17,514 head of sheep, or less than 1 per cent of the number said to have existed twenty-five years before. To supply the demand for fresh meat, there was a great influx of sheep from neighboring states and from 1852 until 1857 it is estimated that 551,000 sheep were driven into California from New Mexico.

Recognizing the importance of the industry and the adaptability of sheep to our mild and equable climate, enterprising sheep raisers made extensive importations of purebred sheep from Vermont and New York, Ohio and Pennsylvania, to improve the native stock. In 1854, Curtis and McConnell of Sacramento, brought the first Spanish Merinos from Vermont. Large numbers of Australian sheep were imported at extreme prices. These were followed by Cotswolds, Leicestershires, and Southdowns. At the state fairs during the period of 1856 to 1860 as many as 200 purebred sheep were exhibited at a single exhibition. On September 24, 1860, the first California Sheep and Wool Growers Association was organized "to foster and promote the enterprise of sheep breeding and wool growing in all its branches; and to provide a remedy against a repetition of such efforts to establish a monopoly in the wool market of this state as characterize the operations of the wool buyers this year."

Sheep rapidly increased in number from 1860 to 1870 and reached the peak in 1876, when the state was credited with over 6,000,000 head, and a total wool clip of 56,550,970 pounds. During the decade from 1880 to 1890 there was a gradual decrease due to low prices of wool and a gradual utilization of valley and foothill range for fruit planting. During this period thousands of sheep were driven from California to intermountain states, thus reducing the number of sheep in California and assisting materially in the rapid increase in intermountain states. It was claimed by one writer⁵ that 150,000 sheep

⁵ Wickson, E. J. Rural California (The Macmillan Co., New York), pp. 247-260. 1923.

were driven eastward from southern California, and 75,000 from northern California, in 1881.

The decade from 1890 to 1900 was a critical period for flockmasters. The census for 1900 showed further decrease in numbers, and the lowest point in valuation of sheep was reached in 1897, when the farm value was placed at \$1.50 per head for all sheep reported in that year.

From 1900 to 1910, conditions for grazing sheep in California remained adverse and public policy discriminated against the wool producer. The Department of Agriculture at Washington, D. C., placed a grazing tax on sheep and cattle in the National Forests in 1903. Sheep continued to decrease in numbers, and the low point was reached in 1910. About this time a new interest was awakened in mutton sheep and Shropshires became popular.

In 1912, the National Wool Growers Association made a determined stand, followed by a strong plea for consideration by Congress in 1913, for a tariff revision which would give American wool growers proper protection by a fairer classification of wools. However, all efforts failed and wool was again placed on the free list in the tariff of 1913. The advance in prices of both wool and mutton caused by the outbreak of the World War in 1914 greatly increased the value of sheep, but did not increase the number of sheep, as shown by the census of 1920. Following the war there was a period of national depression, and sheep and wool declined greatly in value; however, the industry recovered more rapidly than some other branches of agriculture, and since 1922 there has been not only a decided increase in numbers of sheep, but also a proportionate increase in values of wool and lambs.

Accompanying these cycles in sheep production there has been a gradual change from the three and four-year-old wether, kept primarily for the wool clip, to the present four-months-old milk lamb, and while the American people do not favor mutton they have learned to like lamb. In California the returns from the sale of lamb at present is estimated at about 65 per cent, and from the sale of wool only about 35 per cent; and statistics show that 90 to 95 per cent of the total receipts at the principal markets are lambs, and only 5 to 10 per cent mature sheep.

Sheep raising is conducted in practically all sections of the state; however, the industry is more highly developed in the great interior valleys, Sacramento and San Joaquin, as shown by figure 1 and tables 3 and 4.

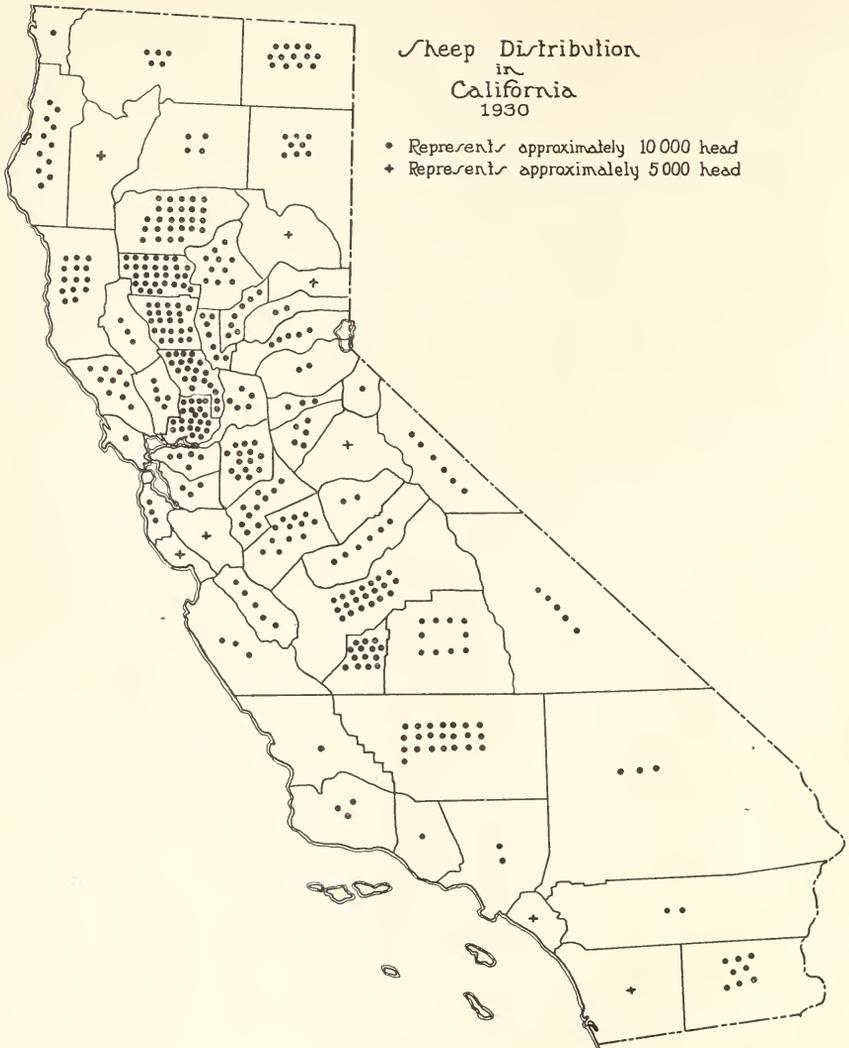


Fig. 1.—The largest number of sheep is found in the Sacramento Valley. There is considerable concentration in the San Joaquin Valley, the north coast counties, and the northeastern counties, Modoc and Lassen.

The Sacramento Valley.—This is the leading sheep section, including over 40 per cent of the total sheep population in the state. The foothill region of the great Sacramento Valley, with the Coast Range on the west and the Sierra-Nevada Range on the east, provides winter grazing and lambing ground for thousands of range sheep. These low, rolling hills furnish green feed from about November 15 to May 1.

After May 1 most of the sheepmen in the upper part of the valley resort to the National Forests for summer grazing. Those located in the central or lower part depend on privately owned or leased pasture land and on leased barley and wheat stubble during the summer and fall. In former years these vast grain stubble fields were burned over to prepare the land for fall plowing. In recent years, however, these stubble fields have been eagerly sought by sheepmen.

TABLE 3

LEADING COUNTIES IN NUMBER OF SHEEP, AND IN SHEEP PER UNIT AREA, IN CALIFORNIA; JANUARY 1, 1930

Rank	Number of sheep	Rank	Sheep per square mile
Glenn.....	290,000	Solano.....	249.4
Tehama.....	245,000	Glenn.....	209.4
Colusa.....	220,000	Colusa.....	193.0
Kern.....	220,000	Yolo.....	192.3
Solano.....	205,000	Kings.....	116.5
Fresno.....	205,000	San Joaquin.....	93.2
Yolo.....	195,000	Tehama.....	83.7
Mendocino.....	143,000	Mendocino.....	40.4
San Joaquin.....	135,000	Fresno.....	34.4
Kings.....	135,000	Kern.....	27.5

TABLE 4

DISTRIBUTION OF SHEEP IN CALIFORNIA BY DISTRICTS, JANUARY 1, 1930

District	Number of sheep	Per cent of total number
Sacramento Valley.....	1,597,000	40.71
San Joaquin Valley.....	1,148,000	29.28
Mountain counties.....	337,000	8.59
North coast.....	440,000	11.21
South coast.....	205,000	5.21
Southern California.....	196,000	5.00
Total.....	3,923,000	100.00

In addition to this foothill range a great many lambs are produced within the valley on native pasture land, volunteer grain fields, and Sacramento River basin lands, where forage is plentiful. Alfalfa hay is usually fed at lambing time and also some concentrates, such as shelled corn or cottonseed cake.

Commercial and purebred farm flocks are also found extensively throughout the valley in conjunction with grain and fruit farming. The purebred industry is rather highly developed in the counties of Yolo, Colusa, Solano, and Sacramento.

The San Joaquin Valley.—This is the second largest sheep section in the state, with 30 per cent of the total sheep population. It is similar in topography and climate to the Sacramento Valley, being bordered on the east by the Sierra Nevada Range and on the west by the Coast Range. The average rainfall, however, is lower than in the Sacramento Valley, especially in the southern part of the valley and in certain seasons sheepmen have suffered severely from drought. Feed conditions are similar to those of the Sacramento Valley, some men trailing to the National Forests, while others remain in the valley for summer feed. The Sacramento River Delta region below Stockton furnishes an abundance of grain stubble and beet tops. The Bakersfield district, located in the southern part of the valley, is noted for a superior type of Rambouillet ewe, and this section supplies many breeding ewes to range men in other parts of the state.

The Mountain Counties.—The principal sheep counties in this district are Shasta, Modoc, Lassen, Inyo, and Mono. In the mountain counties there are 8 per cent of the sheep of the state. This section is characterized by extensive mountain ranges and the sheep are wintered in the small valleys on hay put up in large stacks on the home ranches. The lambing period is usually during February and March, and the sheep are driven to the National Forests in May and June. Grazing lands are cheaper and rentals more reasonable than in the valleys, although sheepmen are usually compelled to feed hay for three or four months during the winter. Shelled corn and cottonseed cake are commonly fed during severe winters. In Lassen and Modoc counties, there is considerable desert land in the public domain where many sheep are wintered on sagebrush, browse and other forage. The Rambouillet is the prevailing type of sheep in these counties, although crossbreeding to a mutton sire is becoming common practice.

The North Coast.—In this district there are 11 per cent of the sheep and Mendocino and Humboldt are among the leading sheep counties of the state. The sheep range of these counties is generally rugged and mountainous and in some sections is heavily timbered. Sheep raising is generally conducted in large fenced pastures, allowing the sheep to graze at will throughout the year, although many of the range sheepmen resort to adjacent National Forests for summer feed. There is also some open range bordering on the Pacific Ocean and the long-wool breeds, Cotswold and Romney, as well as Dorsets, are favored for these conditions. The Ferndale section in Humboldt County is noted for high grade farm flocks, as well as for a number of breeders of purebred Shropshires, Romneys, and Dorsets. .

Land values and rental fees are more reasonable in Mendocino County than in some other sections. The carrying capacity of the range is only fair, and the forage is not as nutritious as in the interior valleys. The Delaine Merino is the prevailing type of sheep in Mendocino County and these north coast wools are noted for superior fineness, length of staple and light shrinkage. In this district rainfall is rather heavy, varying from 40 to 60 inches per season. The winters are rather cold and early lambing is impractical unless proper barns or sheds and supplementary winter feeds are provided. Lambing usually takes place during February and March on the open range, and lambs are marketed in August and September. A large percentage of the lambs are usually sold as feeder lambs, shipped into the Sacramento Valley and fattened on barley stubble, beet stubble, or placed directly into feed lots.

Sonoma, Napa, and Marin counties are characterized by a rolling topography affording excellent sheep range. Farm flocks are common and early lambing is practiced to meet the spring lamb market.

The South Coast.—This district includes 5 per cent of the sheep in the state; however, there are large numbers of sheep in Imperial and Los Angeles counties.

Due to the mild climate and the abundance of alfalfa pasture in Imperial Valley, conditions are ideal for the production of very early spring lambs. Large numbers of old range ewes bred to lamb in November and December are purchased in Central California and Arizona during the early fall and shipped into the valley. Alfalfa is usually interplanted with barley and this makes excellent winter pasture for lambing. The lambs are grown and fattened on this green feed, and after the lambs are marketed the ewes are usually fattened and sold. Because of the hot weather and scarcity of summer range, conditions are not favorable for carrying over large numbers of breeding ewes.

In certain parts of Imperial Valley the fattening of lambs for market is an important industry. Feeder lambs are purchased in neighboring states during early fall, shipped into the valley and fattened on grain stubble fields and alfalfa pasture. Some concentrates, namely barley, milo maize, and cracked corn, are also usually fed, in addition to alfalfa pasture.

POSSIBILITIES IN SHEEP RAISING

Sheep raising has been profitable for many years and with the successful development of the early lamb industry in recent years, sheep production in California has attracted considerable attention. Many people, however, overestimate the profits in this industry and the beginner should study his farm resources and make certain that he has conditions favorable for the production of lambs and wool.

The shipment of early lambs in California to eastern markets has increased from 265,000 in 1922 to 579,000 in 1929.⁶ In addition to those shipped east, approximately the same number of spring lambs are slaughtered locally, principally in San Francisco and Los Angeles. Local markets have been greatly stabilized by exporting the surplus during the spring months, which has proven an advantage to those shipping lambs, as well as to the smaller producers and others who market at California points.

Because of the mild winters, California growers are able to finish and market lambs during the spring months of April, May, and June, thus evading the competition from the bulk of lambs originating in the western states, which are usually not ready for market until August, September, and October. This gives California producers a decided advantage, although more or less competition is developing in the southern and corn belt states where growers are also striving for the spring market.

The large fertile valleys of California provide an abundance of feed in the form of natural forage for winter and spring grazing. The extensive barley and wheat fields after harvest afford excellent feed for breeding ewes and feeder lambs. Sugar beet tops, after harvest, are well adapted for fattening lambs. Rice stubble is utilized to some extent, although rather severe losses have been caused by turning sheep into heavy rice stubble, probably due to an overconsumption of rice causing severe indigestion. Sheep are often turned into vineyards or orchards in the fall of the year to clean up the cull fruit, grass, and weeds.

Parasitic infestations are less serious in California than in the states east of the Rocky Mountains due to the dry arid climate and hot summers. However, where sheep are grazed on natural pastures year after year, internal parasites are found and with a more concentrated sheep population these infestations are becoming more

⁶ Voorhies, Edwin C., and W. E. Schneider. Economic aspects of the sheep industry. California Agr. Exp. Sta. Bul. 473:92-115. 1929.

serious. Liver fluke and stomach worm infestations exist in some of the north coast counties, but within the large interior valleys these have not become a serious menace.

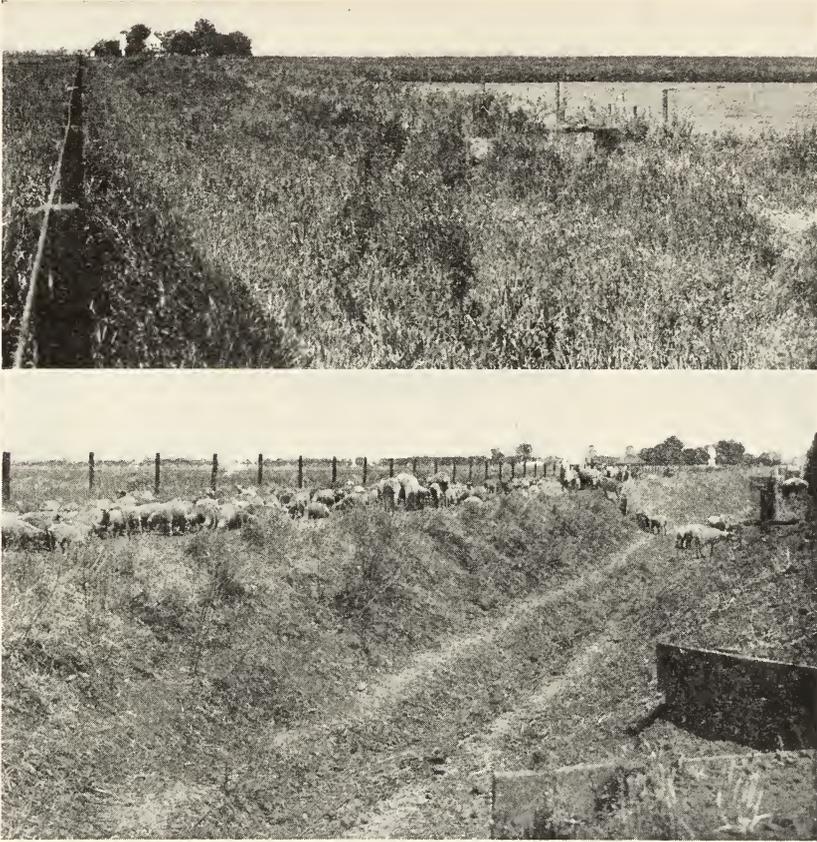


Fig. 2.—Pasturing sheep on the main irrigation ditch at University Farm; before and after sheep were turned in. In addition to keeping the ditch clean and saving labor and expense, sheep keep the banks well tramped and gophers are less troublesome.

FARMER AND FLOCK

In view of the recent years of prosperity among sheepmen, due to favorable prices for lambs and wool, there is a special interest in farm sheep production. The average layman, however, is also likely to overestimate the returns from sheep and forget that the sheepman is not without his troubles. Sheep are in no sense a “get-rich-quick” proposition, but will usually return a satisfactory profit under farm conditions. Success depends very largely upon the shepherd, as there are many details in the management, feeding and sanitation of sheep

that the beginner should understand. The only way to become familiar with these is through experience in the actual handling of sheep. Proper feed is the first consideration; however, fresh water, salt, shelter, and routine care are important essentials. Parasitic control has become an important problem in California in recent years. "A stitch in time saves nine" is particularly true in the care of a flock of sheep.

There are many reasons why the average farmer in California might consider keeping a flock of sheep along with other types of livestock. Sheep return two cash crops, namely, lambs and wool.



Fig. 3.—The wool type. American Merino ewe (B-type), noted for density, weight, and fineness of fleece.

Returns come quickly in that lambs are ready for market when only four to five months of age. Sheep may be cheaply kept, subsisting largely on grass and forage crops, and the lambs are largely fattened on grass, not requiring expensive grain feeds. They have been found useful in keeping down weeds about the farmstead, in irrigation ditches (fig. 2), and on summer fallow ground. They are noted for improving the soil, as sheep manure is a highly prized fertilizer and is evenly distributed over the fields without undue tramping. Sheep are easily handled and driven, especially by the aid of a dog, and do not need the regular daily routine required by most other livestock.

THE QUESTION OF BREEDS

The breeds of sheep are classified into the wool type and the mutton type. The wool type is characterized by a dense, fine, oily fleece, and heavy folds of skin, or wrinkles, around the neck, which may extend on the body (fig. 3). The body is of medium size, round rather than rectangular in build. The mutton type is square, broad and compact in conformation, with a wide chest, well sprung ribs, wide loin, and



Fig. 4.—The mutton type. Grand Champion wether (purebred Southdown) at the International Livestock Exposition, Chicago, Illinois, 1925. Bred and exhibited by the University of California.

full hindquarters (fig. 4). These types have been developed by careful selection for either wool or mutton and for that reason the type which is efficient in the production of wool is usually lacking in the desirable qualities favorable for mutton. In successful sheep farming, it is impossible to ignore either wool or mutton and while in recent years the production of lambs has been greatly emphasized, the average sheepman looks well toward an added income from his wool clip.

There are about thirty-nine breeds of improved sheep, of which twelve are well established in the United States. The beginner often inquires as to which is the "best" breed, although there is no one breed that is best for all conditions. Each breed has been developed and improved to meet certain requirements and the beginner should acquaint himself with the special merits and usefulness of each breed and then select one that best meets his conditions.

In the following brief discussion of breeds it is aimed to point out the merits and adaptability of each breed.

CLASSIFICATION OF BREEDS OF SHEEP IN THE UNITED STATES

Wool type	{	Fine-wool	{	American and Delaine Merino, types A, B, and C Rambouillet, types B and C
Mutton type	{	Medium-wool	{	Southdown Shropshire Hampshire Suffolk Oxford Dorset Cheviot Corriedale
	{	Long-wool	{	Lincoln Cotswold Leicester Romney Karakul (fur bearing)
Miscellaneous types	{	Medium-wool	{	Romeldale Columbia

FINE-WOOL BREEDS

The American Merino.—The American Merino is generally characterized as a short-legged, compact, small-bodied sheep with heavy folds or wrinkles and a superior quality of fine white wool, grading Strictly Fine Combing when of twelve months' growth. There are three types, referred to as A, B, and C, and segregated on the basis of skin folds and body size as follows:

A-type, heavily folded over all parts of the body; small in size.
(This type is not favored generally in the west, and is found mainly in Ohio and Michigan.)

B-type, folds on the neck, forequarters and thighs; medium size.

C-type, two or three folds around the neck, while the body is usually smooth; medium to large in size. This type is referred to as the Delaine Merino.

For illustration of B-type, see figure 3.

The American Merino was at one time very common throughout the western states. It was the principal range sheep, but during the last fifteen years has been replaced by the Rambouillet, due to the latter having greater scale, and superior mutton conformation. They are, however, still fairly common in this state, in some sections of Mendocino County.



Fig. 5.—Rambouillet ram. The size, and broad, deep conformation is characteristic of the Rambouillet. (Courtesy, International Livestock Exposition.)

The Rambouillet.—The Rambouillet (fig. 5) is the all-important fine-wool breed of the western range states. There are two types recognized by the American Rambouillet Record Association, namely B and C. The B-type is heavily folded around the neck, with some folds on the body and over the hindquarters. The C-type is smooth over the body and usually has only two or three folds around the neck. The latter type is preferred by western sheepmen, while the B-type is found principally in Ohio, Michigan, and Vermont. Rambouillet wool usually grades Fine Combing or French Combing.⁷

It is commonly stated that 75 or 80 per cent of the western range ewes are of Rambouillet breeding. They make excellent range sheep due to their hardiness, longevity, herding or flocking instinct, heavy

⁷ For definition of market grades of wool see: Wilson, J. F. Wool production in California. California Agr. Ext. Cir. 12:14-18. 1930.

shearing qualities and adaptability to range conditions. Ewes do not produce as large a percentage of twins as the mutton breeds and lack somewhat in milking qualities. Furthermore, Rambouillet ewes possess the early mating habit, breeding readily in July and August, and for that reason are well adapted for the production of early lambs by mating with a mutton sire.

THE MUTTON BREEDS

The mutton types are divided into medium-wool and long-wool breeds. The medium-wool breeds are often referred to as the "down breeds," the name referring to an open rolling country known as the "Downs" in the south of England where most of these breeds



Fig. 6.—Southdown ram. Very compact, blocky and low-set in appearance with short, wide head. (Courtesy, International Livestock Exposition.)

originated. These breeds are characterized by brown or black face and leg markings, with the exception of the Dorset and Cheviot, which have white markings. These are of ideal mutton conformation and produce a coarse type of wool as compared to the Merino.

The long-wool breeds are larger, more upstanding than the medium-wool breeds. They have white markings and are characterized by coarse wool which hangs in ringlets six to eight inches long. As a class these breeds are well adapted to coast conditions where rainfall is plentiful and the summer comparatively cool.

The Southdown.—The Southdown (fig. 6) is easily recognized by its compact, low-set, broad conformation, with wide chest and extremely full hindquarters. It is often referred to as the "model"

of the mutton type. Face and legs are gray or light brown, ears small and wool extending down to the eyes. They shear rather light, mature ewes producing 5 to 6 pounds of wool per year, and the wool grades One-half Blood Combing and Clothing.

The breed is often criticized by commercial sheepmen for lack of size, although with the demand for a light 65 to 75 pound lamb, there is considerable interest at present in the possibilities of the Southdown as a sire of California market lambs.

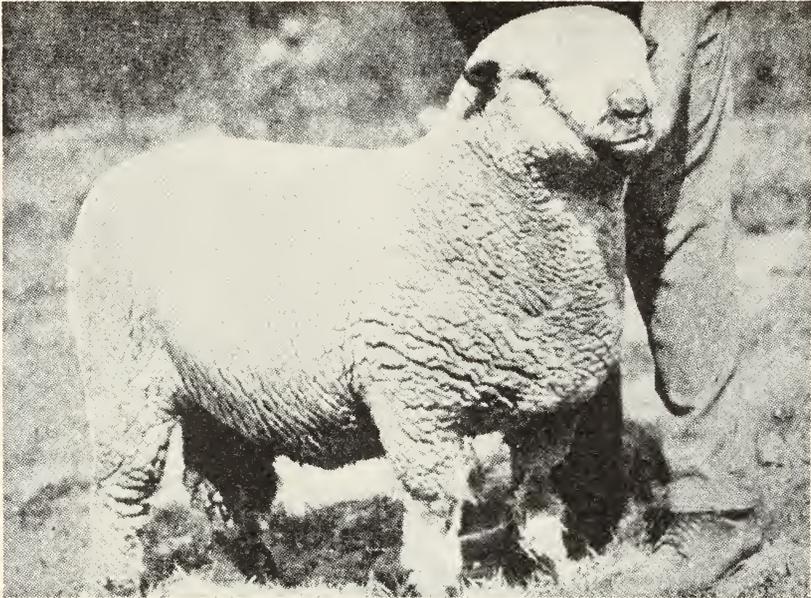


Fig. 7.—Shropshire ram. Medium in size; square in form with a characteristic hood or face covering.

The Shropshire.—The Shropshire (fig. 7) ranks next to the Southdown in typical mutton conformation. It is medium in size, very well proportioned, and the lambs are of early maturity. This breed somewhat combines wool and mutton production. Mature ewes shear from 8 to 10 pounds of wool a year, grading Three-eighths Blood Combing. For this reason the Shropshire is admirably adapted as a farm sheep and they are very popular throughout the farming states of the middle west. They are also favored by many sheepmen in California for crossing with range ewes in the production of early market lambs.

The distinguishing feature of the Shropshire is the characteristic hood, or wool-covered head and face. The wool usually extends down to the nose, although commercially this feature is not looked upon with

favor, as it causes wool blindness. Furthermore, grass seeds readily adhere to the wool and frequently drop into the eye. The color markings range from light to dark brown and the wool extends to the knees in front and usually down to the toes on the hind legs.

The Hampshire.—This breed is characterized by a rather massive, square, deep, well-proportioned form (fig. 8). It is one of the largest of the medium-wool breeds. Hampshire lambs are noted for early maturity and because of this feature, Hampshire rams are very popular in California in mating with range ewes to produce early spring lambs. On account of their large size, they are best adapted to valley conditions, and lambs sired by Hampshire rams require an abundance of green feed for maximum growth.

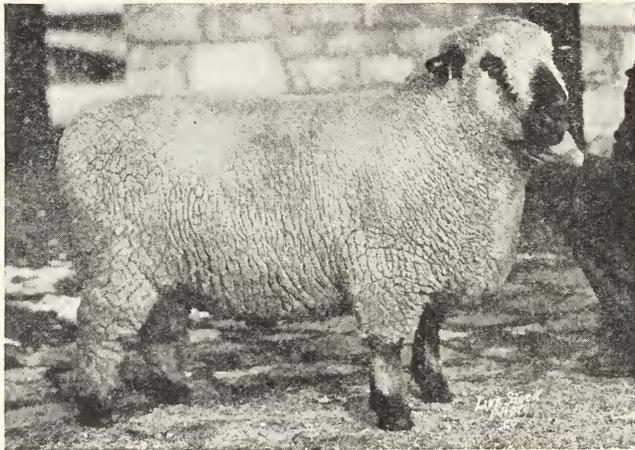


Fig. 8.—Hampshire ram. Massive and rugged in appearance, with heavy bone, slightly roman nose, and wool extending to the eyes. (Courtesy, International Livestock Exposition.)

In addition to the large frame, the Hampshire is heavy boned, has a strong bold head and nose, ears are large and drooping, and the color markings are black. The wool is rather short and light and mature ewes shear 6 to 7 pounds a year of Three-eighths and One-quarter Blood quality.

The Suffolk.—This is a typically black-faced breed recently introduced into California for the purpose of crossbreeding to produce early market lambs. When the Suffolk ram is mated with good grade ewes, the crossbred lambs develop very rapidly, and dress out well when slaughtered; sheepmen who have made this cross are generally well pleased.

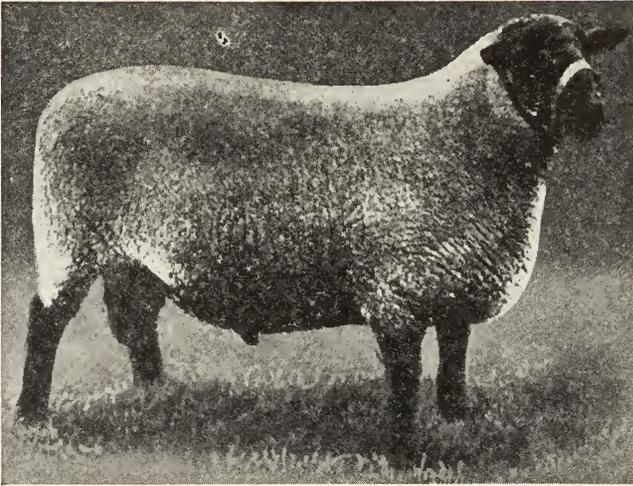


Fig. 9.—Suffolk ram. A square body, bare head and legs, and sharp alert features are characteristic points of this breed. (Courtesy, California Wool Growers Association.)



Fig. 10.—Oxford ram. The impressive feature of this breed is its great size. Typical Oxfords are broad, deep, and square in appearance and noted for a heavy fleece of wool. (Courtesy, International Livestock Exposition.)

The Suffolk is somewhat rangy and upstanding in type (fig. 9), lighter in bone, and seems to lack the thickness of the Hampshire. These sheep are very active and good rustlers. The distinguishing characteristic is a very black bare face and head, the wool covering extending only as far as the ears. The legs are bare and dark black. The wool is short and light and often intermixed with black fibers. It grades Three-eighths Blood in quality.

The Oxford.—This is the largest of the medium-wool breeds, mature rams often weighing 300 pounds or more. Owing to this extreme size, the lambs grow rapidly but do not fatten as readily as some of the smaller breeds. They often attain an excessive weight, not in keeping with present market demands.

The typical Oxford (fig. 10) is large-framed, of square build, usually carrying a rather long, heavy fleece, the annual clip weighing from 11 to 12 pounds per ewe, of One-quarter Blood quality. The face is partly covered with wool, the ears are of medium size and the markings vary from gray to brown. There are very few Oxfords in this state.

The Dorset Horn.—The Dorset (fig. 11) is a white-faced breed and the distinguishing characteristic is that both males and females have horns. They are somewhat larger in frame than the Shropshire, heavier boned and rather coarse in appearance. The fleece is medium in length and rather light, weighing from 7 to 8 pounds and grading Three-eighths Blood.

The Dorset ewes are noted for high fecundity and early breeding habits. It is possible to breed the ewes in the spring to lamb in the fall. They are heavy milkers and the lambs develop rapidly. Dorsets are used extensively in the production of hot-house lambs in the east, although they have never become very popular in California.

The Cheviot.—The Cheviot is a small mountain breed, very active and alert, and distinguished by its pure white face, prominent eyes and erect ears. The breed originated in the Cheviot hills of Scotland and is adapted to rough mountainous grazing, although it has never become popular for cross-breeding purposes in California. The Cheviot produces a rather light fleece, 5 to 6 pounds per year, of One-quarter and Three-eighths Blood quality.

The Corriedale.—The Corriedale (fig. 12) is now classed as one of the medium-wool breeds resembling the mutton type and producing a Three-eighths Blood fleece. The breed was established many years ago in the North Island of New Zealand by crossing Lincoln rams with Australian Merino ewes, followed by a gradual process of selection and intercrossing. A great many Corriedales have been introduced

into this country from New Zealand, particularly into the western states and they are well adapted where sheep are bred for lambs and wool.

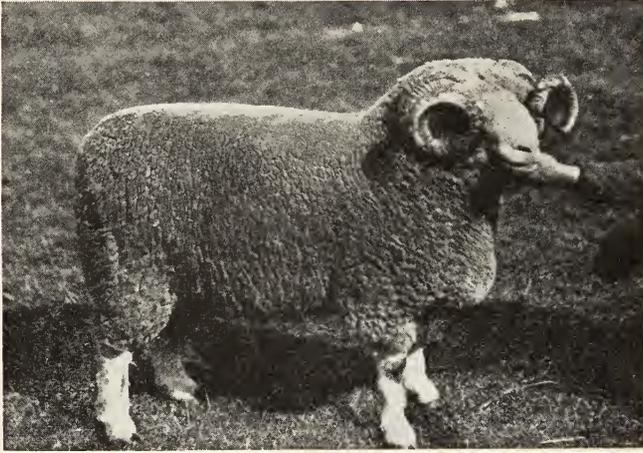


Fig. 11.—Dorset ram. A strong spiral horn, bold head and rugged appearance are the notable features of Dorset rams. The ewes also have light, curved horns. (Courtesy, International Livestock Exposition.)

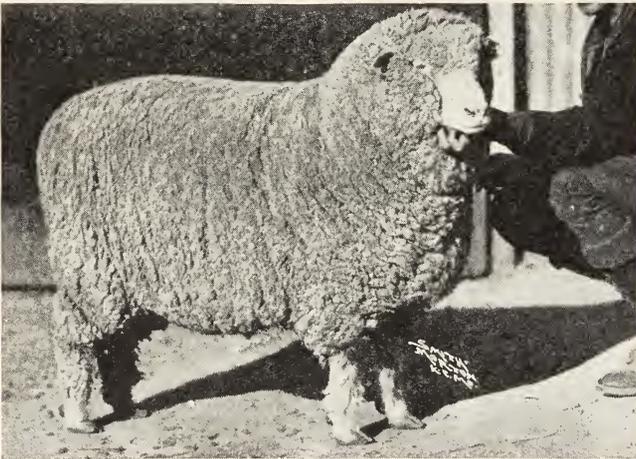


Fig. 12.—Corriedale ram. This breed is medium in size, of reasonably good mutton conformation, and is noted for a superior quality of medium-type wool. (Courtesy, International Livestock Exposition.)

In conformation they are similar to the Shropshire, although somewhat smaller in size. In fleece qualities they are highly commended, producing a light-shrinking wool of good length and shearing from 10 to 12 pounds a year.

LONG-WOOL BREEDS

The long-wool breeds are especially large-framed and deep-bodied and are characterized by long, loose, open fleeces and by white face and leg markings. They are chiefly bred for mutton and seem to thrive best in the coast counties of California where the land is fairly level. The Willamette Valley of western Oregon is the center of the long-wool breeds on the Pacific Coast. With the exception of the Romney, the long-wool breeds do not thrive well in the Sacramento and San Joaquin valleys because of the dry, hot summers.

The Lincoln.—The Lincoln is a large-bodied, rather tall sheep with broad back and full hindquarters. The wool extends down to the eyes, with a typical tuft on top of the head. Mature Lincoln ewes that have been well fed at a year's growth will often shear 16 to 18 pounds and the wool may be 8 inches long. It grades as "Braid," which is the coarsest grade of our market classification.

Lincoln rams are used somewhat in crossing with Rambouillet ewes where it is customary to save the ewe lambs for increase in the flocks or for sale as yearling ewes. The wether lambs, however, are rather late in maturing and this practice of crossbreeding is mainly followed in certain regions of the Rocky Mountain states.

The Cotswold.—The Cotswold resembles the Lincoln in size and conformation, although the face coloring may show a light tinge of brown. The wool extends over the head and hangs in long ringlets over the face when in full fleece. The fleece is somewhat lighter than the Lincoln, the yearly clip weighs about 15 pounds, and the wool hangs in characteristic, wavy ringlets all over the body. It is often faulted for being "kempy" or "hairy" over the thigh, and it grades as Braid.

There are but few Cotswolds in California, although one ranch in Humboldt County has about two thousand Cotswold ewes and they are admirably adapted to north coast environment.

The Leicester.—There are two types of Leicesters, the English and the Border. The latter is the most common in this country and is easily distinguished from other long-wool breeds by the bare head and face. The Leicester, although having a thick, broad back, is somewhat shallow in body and light in belly wool. The wool is long and wavy and grades Common and Braid.

The Romney.—The Romney is well known in California, having proven to be more hardy and better adapted to California valley con-

ditions than the other long-wool breeds. In England they are known as the Romney Marsh, or Kent sheep, but for brevity, the American breeders have dropped the word "Marsh."

They are more compact and lower set than the Lincoln or Cotswold, have a broader, shorter head and stronger chest, although as a breed they are faulted for being low in the back and a trifle flat in the forerib (fig. 13). The fleece is shorter and denser and is of finer grade than other long-wool breeds, grading usually Low One-quarter Blood or Common.

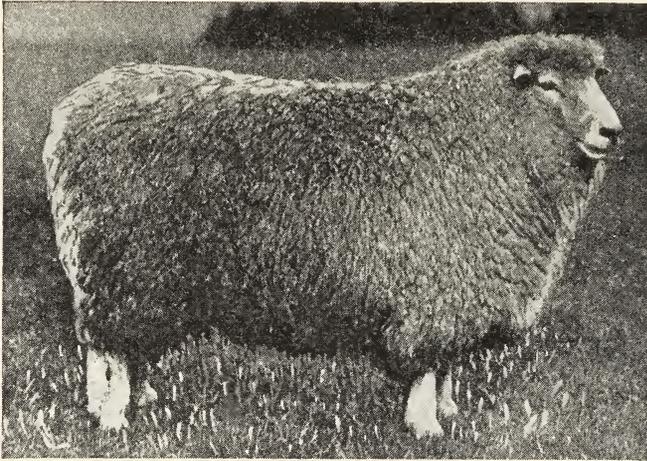


Fig. 13.—Romney ram. A fairly large, compactly built sheep of the long-wool type. The wool is denser and of finer grade than that of the Lincoln. (Courtesy, California Wool Growers Association.)

The Romney has become one of the popular breeds in California. The rams are often bred to Rambouillet ewes when it is planned to use the ewe lambs for breeding stock. The wether lambs of this cross also fatten readily for market.

The Karakul.—The Karakul is often referred to as a fur-bearing sheep, in that the lambs at birth usually have a very lustrous, tight-curling pelt, resembling fur. The Karakul sheep are native to Central Asia. They are medium in size, with black faces and legs and pendulous ears. The wool of the mature sheep is very coarse and is black, brown or some shade of gray. A considerable number have been imported into the United States, and the possibilities of Karakul fur production have been investigated by the U. S. Department of Agriculture.⁸

⁸ Marshall, F. R., L. L. Heller, and V. O. McWhorter. Karakul sheep. U. S. Dept. Agr. Yearbook 1915:254-262. 1916.

MISCELLANEOUS TYPES

There are two types of crossbred sheep which have been developed in this country during the past decade that are attracting considerable attention, namely, the Romeldale and the Columbia.

The Romeldale was developed by a breeder in California through careful selection from the descendants of the Romney-Rambouillet cross. This work was begun in 1915 and by striving for a definite standard a very uniform type of sheep has been developed. The Romeldale resembles the Corriedale in being of mutton conformation and in producing a choice, light-shrinking clip of Three-eighths Blood wool. They have not been bred sufficiently long to be classed as a pure breed.

The Columbia is a crossbred type developed by the Bureau of Animal Industry of the U. S. Department of Agriculture. The original cross was a Lincoln-Rambouillet, and development work was begun in 1912 at Laramie, Wyoming, and later continued at the Range Sheep Experiment Station at Dubois, Idaho. Careful selection has been practiced for sixteen generations and a uniform type has been established. The Columbia sheep are somewhat larger and not as compactly built as the Romeldale, with a trifle coarser and longer fleece.

GENERAL CONSIDERATIONS IN FARM SHEEP RAISING

Pasture and Feed.—The most important factor in successful sheep production is the natural feed supply. Sheep thrive best where they graze over a large area and have a variety of feed. They are close feeders and prefer the short type of grass to heavy, coarse forage. Frequent change of grazing ground is desirable to maintain proper health of the flock.

From about the middle of November to the first of May, green pasture is usually available in the interior valleys of California, namely foxtail grasses, wild oats, bur clover, and alfalfa. Alfalfa pasture is also used for sheep during the winter, although it is harmful to the field to pasture sheep on it very heavily.

Forage crops which may be planted for sheep are barley, oats, wheat, rape, or bur clover, for early spring grazing; Sudan grass and sweet clover for summer pasture. Barley, oats and wheat planted in the fall are often pastured during January and February and then allowed to mature a hay or grain crop. Sudan grass has proven an important summer pasture crop. It may be planted early in April

and in six weeks will be ready to graze. It grows very rapidly and provides an abundance of feed under irrigated conditions until late in the fall. It is best to turn the sheep into the field when the crop is about 6 inches high to avoid the grass becoming too rank and coarse. It does not produce bloat which is so commonly the case in pasturing alfalfa.

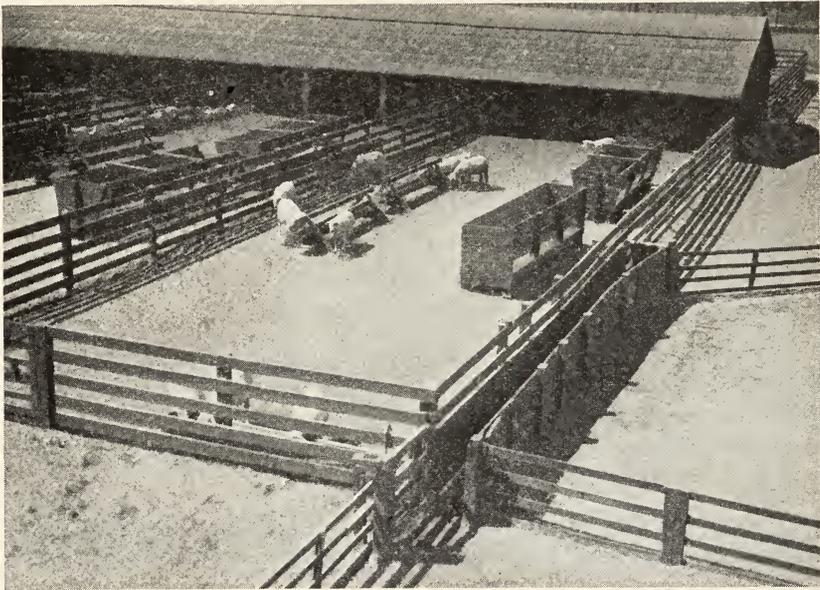


Fig. 14.—Sheep feeding shed, corrals, and parting chute at University Farm, Davis, California. The chute is equipped with two small gates in the wall of the chute about 10 feet from the end, making it possible for two men to part a flock into four lots.

Grain feeding is not generally practiced in farm sheep raising, although some alfalfa hay should be provided during the winter months. In purebred flocks where maximum growth of the lambs is desired, the ewes are often allowed a grain mixture in order to insure a good milk flow. The young lambs are also fed by means of a creep after they are four to five weeks old.

In the northwest and throughout the corn belt states, root crops or silage are provided as a succulent feed for wintering ewes; however, due to the mild winters in California, farmers depend upon alfalfa pasture or native green feed for winter succulence.

Buildings and Fences.—No expensive type of shelter is necessary for sheep in California, although protection from winter rains should be provided in the form of an open shed (fig. 14). Also during lamb-

ing time the ewes should have access to a barn, since it is customary in most parts of the state to lamb during the winter months. On the average farm it is possible to utilize a part of the regular barn during this time and thus avoid construction of a special building for this purpose.

The most practical type of field fence to hold sheep is a 32-inch woven wire with two or three strands of barbed wire above the mesh. Barbed or smooth wire alone will not usually hold sheep. For corrals, board fences about 4 feet high made of 1 by 6 boards are most practical. The lower boards should be placed 2 to 3 inches apart to withhold young lambs.

All sheep ranches should be equipped with a parting chute. This is a chute boarded up tight on the sides, from 12 to 20 feet long, with a small gate at the end so that sheep may be readily segregated by means of the swinging gate at the end (fig. 14).

Labor Requirements.—One often hears the statement that little labor is required in the raising of sheep. Whether this is the case, however, will depend upon the general facilities of the farm, the arrangement of pastures, etc. While it is true that less labor is required with sheep than with most other types of livestock, yet they require frequent attention.

At lambing time it is often necessary to work with the ewes day and night. There are many details in the general management of the flock, such as providing salt and fresh water, "tagging" or clipping the dirty wool off the hindquarters, docking and castrating lambs, treating an occasional sick sheep, watching for foxtail or seeds in the eye, shearing ewes and lambs in the spring and fall; and last, but not least, the young shepherd should form the habit of seeing his flock at least once a day.

Returns from Sheep.—The returns from sheep vary from year to year, depending upon market values of lambs and wool, the percentage of lambs raised and the weight of fleeces. A year ago spring lambs were selling at \$9 to \$10 per head; at the present time they are only bringing \$5 to \$6 per head.

The wool clip, under farm conditions, varies from 8 to 10 pounds a ewe annually. An average price for wool in general is about 30 cents a pound, although in September 1930, the price was in the neighborhood of 20 cents a pound.

It is difficult to estimate the yearly return of a flock of ewes; however, not including charges for labor, the farmer often realizes a net income of \$4 to \$5 a ewe.

It should be remembered that there are unforeseen losses in both ewes and lambs as well as market price fluctuations, and the above figures may not always be obtained by the beginner.

Dogs.—Worthless, roving dogs are one of the greatest menaces to farm sheep raising. In order to protect the flock from dogs the sheep should be penned up in a corral at night as dogs are not likely to molest sheep that are penned. Some farmers practice putting a bell on several sheep in the flock, which serves as an alarm when the sheep are being run and also the ringing of the bell has a tendency to frighten the dogs.

Size of Flock.—The average size of a farm flock consists of forty to fifty ewes. This number will require one ram for breeding and be a sufficient unit to warrant proper care and attention. While it is possible to gain experience with only ten or twelve ewes, it is doubtful if anyone should engage in sheep raising unless the place will carry at least fifty ewes.

By keeping the best ewe lambs for increasing the flock and by discarding the old ewes and any that have not proven satisfactory, the flock may be doubled in number in about three years. By this time the farmer will have gained two seasons' experience and will be able to judge as to the carrying capacity of his place.

SELECTION OF BREEDING STOCK

Kind of Ewes.—The inexperienced farmer would find it best to start with good grade ewes, preferably of the Rambouillet type. These are the most common commercial ewes in California and breeding stock may be easily obtained. Furthermore, this type of ewe is hardy, shears well, breeds uniformly early in season and when mated with a mutton ram produces a satisfactory market lamb.

One often hears the argument advanced that purebred or registered ewes may be kept as cheaply as grades and the returns are much greater. The raising of purebreds and selling of breeding stock is a specialized business, involves a large initial expenditure, special care in feeding and a problem in marketing the offspring; hence it can best be undertaken by persons experienced in sheep production, and the beginner would do better to start with a flock of grade ewes.

The farmer should select young, well-grown, thrifty ewes of uniform type. He should examine the teeth of sheep he intends to purchase to satisfy himself as to their age and also be careful to dis-

card those having spoiled udders. The ewes should be in good breeding condition but not excessively fat, because such may be non-breeders or poor mothers.

Age of Ewes.—Yearlings or two-year-olds are the most desirable for a beginner. They may be higher in price than older sheep, but they are strong and thrifty and have “all their life before them” as the saying goes. Ewes with “broken mouths” may be bought very cheaply, and while many farmers have secured a start by purchasing discarded ewes, it should be remembered that old ewes require alfalfa or Sudan grass pasture during the summer and special care during the winter. They are often poor milkers and are good for only one or two years. In the selection of old ewes for breeding purposes it is most important to inspect the mouth of each ewe and take only those that still have good teeth.

It is comparatively simple to tell the age of sheep up to four years. A lamb has four pairs of small temporary incisors (fig. 15), known as “milk teeth.” At 12 to 14 months the center pair is replaced by a pair of large permanent incisors. At 24 months a second pair of permanent incisors appear, one on each side of the first pair. At 32 to 36 months the third pair of permanent incisors appear and the last pair, or corner teeth, come in at about 44 to 48 months. Sheep that are well fed will change their teeth correspondingly earlier than those that develop normally on pasture.

After sheep are past four years of age, it is impossible to tell the age with any degree of accuracy. At the age of five the teeth become smaller and show wear, and at six the teeth begin to spread and at seven some of the teeth have usually dropped out. The latter is known as a “broken” mouth, and at eight they may have lost all of their teeth. Old sheep that have reached this condition are called “gummers.” The mutton type of ewes lose their teeth and show the effects of old age earlier than Merino ewes.

The Ram.—The ram should be a purebred of good mutton type and a typical individual of the breed. He should be of medium size with good bone, wide chest, straight back, and thick hindquarters, and show masculinity, indicated by a thick, muscular neck, a broad muzzle, and a bright, alert eye. He should preferably be a yearling or two-year old for heavy service. A well-grown ram lamb, eight to ten months old, may be bred to 12 or 15 ewes, a yearling may serve from 40 to 50 ewes, and a two-year-old from 50 to 60 ewes.

A common mistake is often made by the beginner in securing the ram only a few days before he wishes to use him. It is not a good

policy to change the environment and feed of a sire just previous to the breeding season. The ram should be purchased a month or two previous to breeding time, allowing him to become acclimated to the new conditions before being put to service. In case of a shortage of natural feed it is well to feed grain for two or three weeks before breeding season to condition the ram. If practical this may well be continued during the breeding period, particularly if the ram is to be put to very heavy service. Equal parts of whole oats and rolled barley would be a satisfactory ration.

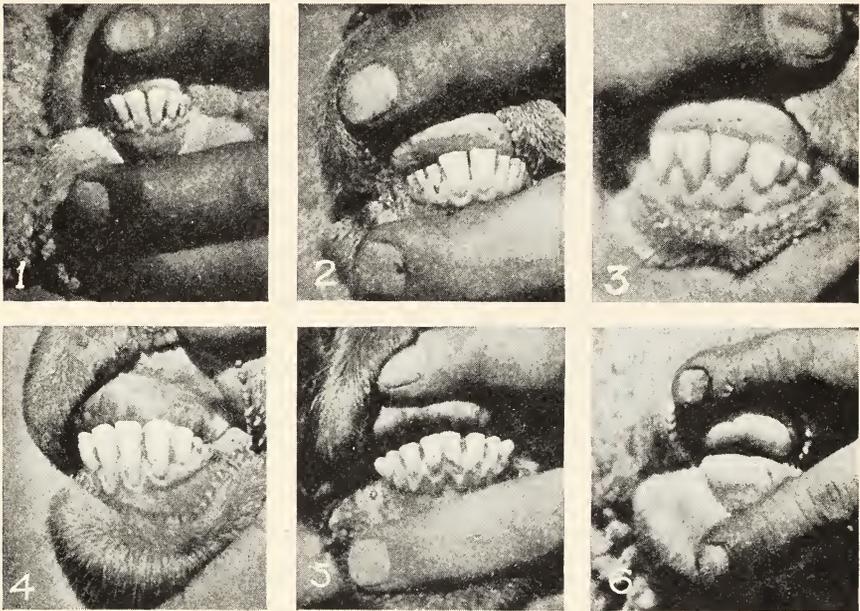


Fig. 15.—Determining the age of sheep by the teeth. (1) Lamb showing four pairs of temporary incisors. (2) One-year-old showing one pair of permanent incisors. (3) Two-year-old showing two pairs of permanent incisors. (4) Three-year-old showing three pairs of permanent incisors. (5) Four-year-old showing four pairs of permanent incisors. (6) Teeth have all dropped out. This usually happens 7 to 8 years of age. The sheep is then known as a “gummer.”

MATING AND BREEDING

The most common practice is to allow the ram to run in the field with the ewes. If a large number of ewes are to be bred to a ram, it is best to turn him with a flock only at night and keep him in the barn during the day. Allow him a ration of grain and hay and place a few ewes with him in order to keep him quiet.

When breeding a ram for the first time, where only one ram is used under farm conditions, it is important to test him as a breeder. This can readily be done by painting his brisket once a day with a mixture of ordinary lubricating oil and lampblack or red lead. When serving a ewe he will leave a mark on her rump. If the ewes which he has bred uniformly take the ram at the next heat period it would be an indication that the ram is a non-breeder and either should be watched closely or replaced by another ram. The ram should remain with the flock for about two months and then be placed in a separate field or pasture, preferably with another ram or wether. It is harmful to allow the ram to run with the flock throughout the year.

In breeding a band of range ewes the "relay method" is recommended wherever practical, namely placing one-half the usual number of rams with the ewes the first two weeks, then taking them out and putting in the other half. The first group is allowed a rest and good feed for a period of two weeks and then placed back with the band, finishing the breeding period with all the rams. This method conserves the strength and vitality of the rams, the ewes are settled more readily, and a larger lamb crop is obtained by reducing the number of dry ewes.

Breeding Time.—Sheep have a definite breeding period, namely, the fall of the year, and only certain breeds, such as the Merino, Rambouillet, and Dorset Horn, will uniformly come in season as early as June or July, hence the common use of grade Rambouillet ewes for early lamb production in California.

The gestation period of sheep varies from 146 to 152 days, usually 147 days, or 21 weeks. If lambs are to be dropped in December and January, the ram should be put with the ewes the first part of July. Many sheepmen plan to have lambs come as early as November and hence put the ram with the ewes the first part of June. Heat periods in sheep last from one to two days and recur every fourteen to eighteen days until the ewes are settled.

Flushing.—At breeding time the ewes should be in good condition and preferably gaining in weight. Placing the ewes on green feed, such as Sudan grass pasture, during the breeding period is a good plan and is known as "flushing." The advantages of "flushing" are securing a large number of twins and getting the ewes to breed close together. Where green pasture is not available heavy barley stubble with more or less wild morning glory is a good substitute and some shepherds even practice feeding a light grain mixture to the ewes once a day.

Breeding Ewe Lambs.—The breeding of ewe lambs is not generally advisable and the safest rule is to breed young ewes so as to lamb for the first time when they are two years old. This is particularly true under range conditions where lambs develop slowly. On the other hand, under California farm conditions where lambs are dropped in December and are well developed by the following fall, it has been found to be profitable to breed the ewe lambs and gain practically a year in productivity. It should be remembered, however, that these ewes have not attained their full growth and they should receive special feed and care during gestation and lactation.

WINTER CARE AND MANAGEMENT

After the ewes are bred they are usually kept on grain stubble or natural pasture where some dry feed is available. Alfalfa fields are often pastured after the last cutting is harvested. Some sheepmen sow barley in September or October on old irrigated ground to provide early green feed.

As the winter approaches and feed becomes short, the ewes should be fed alfalfa hay at least once a day. The young shepherd should examine his sheep from time to time by feeling of their backs to see that they are in good flesh. At no time should pregnant ewes be allowed to lose flesh. An occasional feed of oat hay is beneficial, although there is no better roughage than alfalfa hay for ewes advanced in pregnancy.

In the corn belt states where the winters are severe, corn silage and root crops are commonly fed to breeding ewes and some grain feeding is practiced. However, in most parts of California natural green feed (foxtail grass and wild mustard) is usually available in December and January, and with alfalfa hay as a roughage grain feeding is not necessary. In the coast sections, carrots are sometimes fed and oat and vetch hay may replace the alfalfa of the interior valleys.

In range bands shelled corn or cottonseed cake is fed in case of a shortage of natural feed. One-quarter pound per day per ewe of either shelled corn or cottonseed cake (40 per cent protein) is an average allowance for range sheep where some natural browse and wild feed is available. Begin by feeding only $\frac{1}{8}$ pound for ten days or two weeks and at all times limit the amount of these concentrates, as range ewes are unaccustomed to such rich feeds. Overfeeding and insufficient exercise may cause preparturient paralysis. This disease is discussed in a later section.

Lambing Time.—One writer has said, “Twenty-four hours a day is the price a sheepman pays for his profits during lambing season.” If the shepherd has done his part well in having the ewes in good condition and allowed them plenty of exercise, there should be but little trouble.

At this time the ewes will need the shelter of a barn in which mangers have been arranged for hay feeding. The ewes far advanced in pregnancy should be separated from the main flock. In addition, a number of small pens should be provided to hold a ewe and her newborn lamb. These pens may be conveniently made by taking two light panels and fastening them together with hinges (fig. 16)⁹ and setting

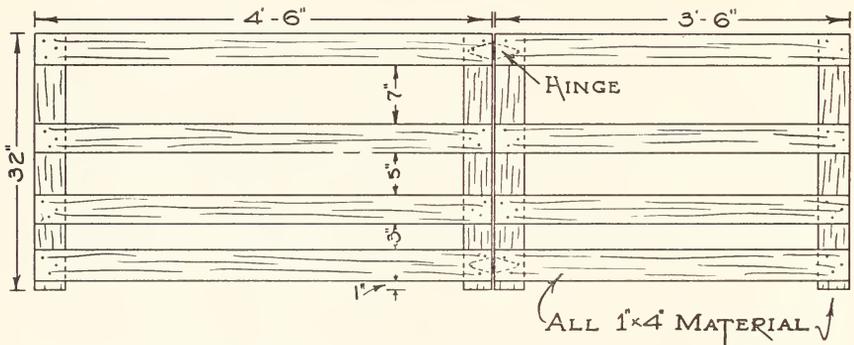


Fig. 16.—Individual portable lambing pen.

them up at right angles in one corner of the barn. The next panel may be set up beside the first, making another small pen and in this way as many pens may be set up as necessary, at little expense. These pens are known as “jails” among sheepmen. When lambing time is over, the panels can be stored away until again needed.

Just before lambing, the ewe becomes restless and appears sunken in front of the hips. She should be placed in a pen by herself and left alone. After a ewe has strained for an hour without delivering the lamb, it is well to offer assistance. The normal anterior position of the lamb at birth is the forelegs extended with the head resting between them. The birth of the lamb in this position usually takes place without artificial assistance.

If the lamb is not in proper position, the shepherd should aim to correct it by inserting his hand and arm and gently turning the fetus into position. Before entering a ewe, however, the shepherd should

⁹ The plans of structures appearing in this circular were prepared in cooperation with Mr. H. L. Belton of the Division of Agricultural Engineering, College of Agriculture.

thoroughly cleanse his hands with soap and water, then lubricate his hands with olive oil or vaseline. When the position is corrected, the lamb can usually be successfully delivered by looping a heavy cord around the front legs and gently pulling outward and downward as the ewe strains.

After the lamb is delivered place the ewe with her lamb in one of the small pens. These pens are especially useful in case of twin lambs so that the young lambs cannot wander away. In a day or so as the lamb becomes strong, transfer ewe and lamb into a larger pen with a few other ewes that have lambed and allow ewes and lambs to have access to a small field. Omit grain from the ration for two or three days, feeding only alfalfa hay, and avoid keeping the ewe and lamb confined too closely. Exercise and sunshine are important factors in the early life of the lamb.

A strong, vigorous lamb will usually stand up and nurse in 15 or 20 minutes, and there is an old saying, "If the lamb finds the teat without help, it is half raised."

If the lamb is weak, the shepherd should wipe the phlegm or membrane from the nostrils and, if not already broken, the navel cord should be severed. By blowing into the mouth, pressing gently on the foreribs, and rubbing the lamb vigorously immediately after birth, it is often possible to revive a lamb that seems apparently dead.

Sometimes lambs become chilled and die unless artificially warmed. The lamb may be placed on a blanket or preferably an old sheep pelt beside a stove and rubbed vigorously to increase the circulation. It may be wrapped in hot flannel cloths, changing the cloths frequently, or if severely chilled it may be bathed for 10 minutes in hot water, as hot as the hand can bear, then rubbed thoroughly dry and wrapped in a hot flannel cloth or placed on a blanket beside a warm stove. A small amount of warm cow's milk may be given by means of a nursing bottle and the lamb returned to the ewe and helped to nurse.

When lambing in a barn there is always some danger from navel ill and it is a good practice to disinfect the navel of the newborn lamb. This may be conveniently done by taking a wide-mouthed bottle partly filled with tincture of iodine and pressing the bottle against the abdomen of the young lamb, allowing the navel to enter the bottle.

Disowned Lambs.—Where the small lambing pens are used there is usually not much danger from ewes not owning their lambs. However, yearling ewes and ewes not in good flesh will sometimes refuse to own their lambs. In some cases it is sufficient to simply draw a

little of the ewe's milk and sprinkle it over the lamb, particularly over the rump. If the ewe still refuses, tie her up reasonably short in the small pen for a few days, hold her while the lamb nurses, and she will usually accept the lamb when the milk flow becomes normal.

Whenever a ewe loses her lamb it is desirable to give her the twin of another ewe. If she refuses to adopt it, simply skin the dead lamb, pulling out the legs like taking off a stocking, and fasten the skin on the lamb to be adopted (fig. 17). She will usually accept it by the scent and in a day or two the skin may be taken off.

Raising Orphan Lambs.—At lambing time there are usually a few orphan lambs, owing to the death of a ewe or the inability of some ewes to nurse twin lambs. It is often advisable to raise these orphan or "bummer" lambs by hand (fig. 18), which is a useful task for the boy or girl in the average farm home. Lambs are easily taught to drink from a nursing bottle with the ordinary lamb nipple and may even be taught to drink from a pan.

The closest substitute for ewe's milk is warm cow's milk, and this should be fed at frequent intervals while the lamb is small. Special care should be taken that the milk is always warmed to blood heat and that the bottles are kept very clean. Allow the lamb to run around in the barn or lot for exercise.

In order to start the lamb "right in life" it is important to see that it gets the colostrum or the first milk from its mother, which acts as a laxative and tends to clear the bowels. If for some reason it is impossible for the lamb to obtain the first drawn milk, a teaspoonful of milk of magnesia should be added to the milk the first day.

The next important step is to avoid overfeeding the first three or four days. Most of the difficulty in raising orphan lambs is due to allowing too much milk the first few days. The following procedure is recommended, although it requires time and patience:

The first two days feed 1 to 2 tablespoonfuls every two hours, omitting night feeding.

The next two days feed 2 to 3 tablespoonfuls every three hours.

The next week feed 4 ounces or $\frac{1}{2}$ cupful five times a day, namely at 6 A.M., 10 A.M., 2 P.M., 6 P.M., and 10 P.M.

The next week feed 6 ounces or $\frac{2}{3}$ cupful four times a day, namely morning, noon, evening, and late at night.

The next week increase the allowance gradually and when the lamb is three weeks old, three feeds per day are sufficient, giving 1 pint at a feeding. As the lamb grows older this amount may be further



Fig. 17.—Fooling a foster mother by placing the skin of her own lamb that died, on another lamb that is to be transferred.



Fig. 18.—Raising an orphan lamb on the bottle; a useful task for the farm boy or girl.

increased to 2 quarts a day, given in three feeds. Some lambs will consume more milk than others and the attendant must be the judge. At the age of six weeks, skim milk may be gradually substituted for the whole milk, so that the lamb will be on a skim milk ration at about eight weeks. However, best results are secured by feeding whole milk, and skim milk is only fed when there are a large number of lambs and the milk supply is limited. Lambs should be fed milk until they are three months old.

At the age of three weeks the young lambs will begin to eat grain and hay. It is a good plan to keep a small amount of bright alfalfa hay before the lambs at all times. After the lamb has learned to eat grain, feed a mixture of equal parts of whole oats, rolled barley and wheat bran by measure twice a day, allowing just what the lambs will clean up. Do not keep young lambs confined too closely, but turn them out on pasture as soon as possible as there is nothing more beneficial than green grass, sunshine, and exercise.

Regularity in feeding, limiting the amount and keeping the bottles clean are essential points to be observed, especially during the first month as young lambs are rather delicate at birth.

Troubles in the Lamb Fold.—Constipation is perhaps the most common trouble among young lambs—indicated by straining and sickly appearance. One or two teaspoonfuls of warm castor oil, according to the size of the lamb, will correct this condition. Sometimes fecal matter adheres to the wool about the tail and thighs, interfering with free passage, and this should be removed by gently scraping with a jack-knife or small stick.

Severe diarrhea or scours sometimes result from overconsumption of milk. Some authors recommend one tablespoonful of cooking soda given in a small amount of warm milk, followed in about four hours with an ounce of white mineral oil.

Sometimes an epidemic of sore eyes is found among young lambs. The eyes become inflamed, a white scum covers the eyeball and tears flow freely. An eye wash consisting of a strong salt water solution or saturated solution of boracic acid applied twice a day with an eye dropper will usually clear up the eye in a short time. In severe cases a pinch of powdered burnt alum may be dropped into the eye.

In Rambouillet and Shropshire lambs we often find the eyelids turning in, causing sore eyes. This condition may be remedied by clipping out a section of the eyelid below the eye with a pair of sharp sheep shears. In healing, the lid contracts and the eyelid becomes normal.

Docking and Castrating.—These are both simple operations and should be done while the lambs are young, from two to three weeks of age. The tail may be cut off either with a sharp knife or hot iron. When cut off with a sharp knife, the wound will heal more readily but there is considerable loss of blood and for that reason many range men have adopted the use of the hot iron (fig. 19).



Fig. 19.—Docking lamb with hot iron. Note the upright board with opening at the bottom which prevents burning the lamb's rump.

In either case the lamb should be securely held by an assistant, with the rump resting on a docking board or table about 36 inches high. The operator holds the knife or iron in his right hand and gently pulls the tail with his left, severing the tail about an inch from the body or between the second and third joints from the root of the tail. The knife should be disinfected by frequently dipping in a 2 per cent solution of sheep dip. In place of a knife, a sharp pair of sheep shears may be used. If the iron is used, it should be heated to a dull redness, not too hot, as a red hot iron severs the arteries too rapidly and bleeding results.

The most ideal method is cutting the tail with a sharp knife (fig. 20) or shears and then searing the main artery just underneath

the tail with a hot pointer, similar to a soldering iron. It is further helpful to dust the wound with a powder consisting of boracic acid and tannic acid, equal parts, or to apply the commercial preparation known as Pinetrol. Do not use the ordinary pine tar as it has a tendency to seal over the stub completely, interfering with proper drainage and causing severe inflammation.



Fig. 20.—Docking lamb with knife. Note the proper method of holding the lamb. The docking bench is 36 inches high and the top is 12 inches wide. It is also convenient to dock on a 1 × 8 board nailed flat on top of the fence of the catching pen (36 inches high) in place of the docking table.

The ram lambs are usually castrated at the same time they are docked, thus avoiding catching and handling the lambs twice. The lamb is held in the same position as in docking and it is important to disinfect the hands and instruments frequently. The lower half of the scrotum is cut off and the testicles may be pulled out “cords and all” by grasping them with the thumb and forefinger. A special type of castrating shears may be obtained at some of the supply houses dealing in stockmen’s equipment.

These operations should be done only on bright, sunny days, preferably in the morning. It will be necessary to separate the ewes and lambs, placing the lambs in a small pen where they may be readily caught. Immediately after the operation, the ewes and lambs should be turned into a pasture or paddock to avoid possible infection about the barnyard.

Recently the "burdizzo" (fig. 21) has been used rather extensively in the castration of lambs. This is an instrument equipped with a special clamp whereby the cord above the testicle is severed without



Fig. 21.—Castrating lamb with the burdizzo. Special care must be exercised to make certain that the cords are severed, clamping one cord off at a time.

cutting into the scrotum. When the cords are severed, the blood supply is cut off and the testicle is absorbed by the body. The burdizzo is also used for docking lambs (fig. 22) by clamping off the tail at the proper place and then cutting the skin by passing a knife inside the closed blades.

When properly used, this instrument has given good satisfaction and is particularly suited for castrating and docking lambs that have attained considerable age (six to eight weeks old). The principal advantage over the old method is that there is no loss of blood in castrating and no possible source of infection, and there is but little bleeding in docking lambs with the burdizzo. The objection, on the

other hand, in castrating is that it is slower and in some cases the cord is not severed, due to the inefficiency of the operator, the clamp not being properly applied. The result is "bucky lambs" at marketing time and in the feed lot, which are objectionable.

Feed and Care of Ewes after Lambing.—The shepherd should watch the udders of ewes that have just lambed, for often the young lamb will nurse one side only and the other side should be milked out. Occasionally a teat is closed up and may require special attention by opening with a teat dilator. Sometimes a ewe does not have enough milk the first few days, particularly when she has twins, and the young lambs may be helped along by allowing them to nurse another ewe for a few times, that has recently lambed.



Fig. 22.—Docking lamb with the burdizzo. The tail has been clamped off and the operator is cutting the skin with a sharp knife.

In case the ewes have been fed a grain mixture, this should be omitted for a few days immediately after lambing, as the ewe is in a feverish condition. Liberal feeding of alfalfa hay and free access to fresh water will supply her needs. Furthermore, lambs do not require much milk the first two or three days. After the milk flow has properly started and the lambs are able to take all the milk, grain feeding may be resumed if desirable. When pasture is available, however, grain feeding is not necessary and very often only alfalfa hay is fed during the lambing period.

Garget or Blue Bag (Mammitis).—Occasionally a ewe will develop a case of garget, or caked udder. It may be caused by the lamb not consuming all the milk; by the udder becoming chilled when ewes are forced to lie on wet, cold ground; by a severe bruise; or some authorities believe it is associated with nutritional disorder producing indigestion. The ewe appears sick and depressed, has no appetite, and upon investigation the udder is found to be severely swollen and the milk is usually stringy. In a few days the udder becomes very hard and it is impossible to draw any milk. It is very important to get at the trouble early and treat the ewe as soon as noticed. Bathe and massage the udder for 15 or 20 minutes in a hot solution of epsom salts (1 pound of salts to 1 gallon of water), adding hot water as required. Repeat this four or five times a day and each time draw out every drop of milk. Apply lanolin, which is a salve obtained at the drug store, or the "old home remedy" of lard and turpentine mixed, about two parts of lard and one of turpentine. Feed the ewe only hay and turn her into a small pasture for exercise.

Feeding Young Lambs Grain in a Creep.—When the lambs reach an age of three or four weeks they begin eating hay and grain and whenever maximum growth and development is desired they should be fed a grain ration separate from their mothers by means of a creep.

A lamb creep may be set up at one end of the barn where it is easy for the lambs to enter. A creep is a small pen, one side of which is closed by means of a panel, equipped with 4-inch upright slats spaced about 8 inches apart. This will allow the lambs to slip through and keep the older sheep out. A grain trough may be placed in the center of the pen and suitable hay racks constructed along the side so the lambs may be given a grain ration and also have access to choice alfalfa hay. It is remarkable how rapidly the lambs develop when they receive a little extra feed in addition to their mother's milk. Furthermore they do not worry their mothers continuously as they are more satisfied.

Under range conditions it has become common practice to feed young lambs grain by means of a creep, particularly the twin lambs. The creep is set up in a convenient location near the bed ground and the young lambs soon learn to come into the creep when they once get a taste of grain.

Any of the common grains seem to be satisfactory: cracked corn, whole oats, steam rolled barley, or milo maize. A mixture of cracked corn and whole oats or steam rolled barley and whole oats plus 10 per cent wheat bran will give good results.

Some sheepmen have found that lambs relish whole milo grain and prefer it to corn or barley. It probably makes little difference as to the exact mixture as long as the lambs get this added nourishment. Feed just what they will clean up, increasing the amount as the lambs get older. By this method it is possible to turn off twin lambs in the spring at practically the same weight and finish as single lambs that have not had grain.

SPRING AND SUMMER MANAGEMENT

Foxtail grass, bur clover, and alfileria provide very early feed, and thousands of lambs are annually fattened on this feed during March, April, and May. Alfalfa fields are also utilized, particularly early in the spring when there is usually a heavy growth of foxtail grass. Later in the season the losses from bloat may become rather severe and sheepmen generally prefer native feed such as bur clover and alfileria for finishing spring lambs. Sudan grass pasture has proven to be an excellent summer pasture crop under irrigated conditions and it is a favorite green forage crop among the purebred breeders of the irrigated sections.

In the early lamb districts the lambs are always marketed before the green feed dries up, namely, by the latter part of May. When the lambs are shipped it is necessary to milk the ewes out two or three times to avoid "spoiled bags." After the lambs are marketed, the ewes usually remain on dry native feed until the grain stubble becomes available, about July 1. Barley stubble is superior to wheat stubble and affords excellent feed for breeding ewes, particularly in years when late spring rains prevail, producing a considerable growth of green feed in the barley fields, mostly morning glory and wild lettuce.

Rotation of Pastures.—There is an old saying among stockmen, "To keep the feed a little better than the stock." This applies particularly in the finishing of spring lambs which are being forced to early maturity and finished for market on green feed and mother's milk. An ample milk flow for the lambs is the first essential which can best be produced by good pasture. In addition to this the lambs require fresh green feed to develop quickly.

In order to provide these ideal conditions some sheepmen operating in fenced enclosures have found it very advantageous to divide certain large pastures into four parts by means of crossfencing. The ewes and lambs are turned into one pasture for two days, then changed to the next pasture for two days, etc., cropping each pasture only two days out of every eight. This practice is known as rotation grazing

and insures a fresh feed supply for the ewes and lambs at all times. The lambs develop more rapidly, attain a heavier weight, and a larger number of sheep can be grazed on a given area.

The cost of fencing is often the controlling factor and in cases where large areas are being grazed it may be more practical to divide the area into two parts and graze one while the other is being rested.

Shearing.—In the middle and southern part of the state mature sheep are generally shorn twice a year, in March and September, while sheepmen in northern California and in the north coast district (Mendocino and Humboldt counties) shear only once a year, usually in April or May. Lambs that are not marketed in the spring should be shorn in the early summer.

There are several advantages in shearing in the fall in southern and middle counties. Sheepmen in these sections find that the ewes when shorn in the fall thrive much better during the following winter, produce more milk during lactation, and raise better lambs than when they are forced to carry a heavy fleece of wool through the winter. The fall clip is often heavily infested with dirt, foxtail and bur clover seed which irritate the skin, and by removing this clip the sheep are greatly relieved. Furthermore the spring wool will be clean and free from defective seeds. Experimental results show that there is but little difference in actual weight of clean wool produced in twelve months when shearing once or twice a year, although shearing once a year results in a considerably longer staple.

Shearing is generally done by professional shearers either with machine clippers or with hand shears. Both are satisfactory when properly used and much depends upon the skill of the individual operator. Machine clippers are more or less replacing the old hand shears because it is common to shear twice as many sheep per day with the clippers as by hand, the fleece is taken off more smoothly with probably less injury to the sheep from cutting. It should be remembered, however, that the wool is removed very close to the skin with the clippers and it is best to keep the sheep in the barn for a few nights in case of cold weather or rain after shearing.

In preparing for shearing, the first requisite is a clean, smooth, board floor, a catching pen for keeping the sheared sheep separated from the unshorn, and a place to throw the fleeces to keep the wool clean. On the farm, shearing is often done in one end of the barn by providing a suitable board floor and pens. It is further important to keep the sheep off feed the night before as it is somewhat dangerous and usually results in some losses to shear sheep that are filled with green forage.

After the fleece is sheared off it should be rolled up, flesh side outward, tags and dung locks thrown out, loose ends thrown into the center. The fleece should be tied with paper twine and the wool packed in large bags, holding from 250 to 350 pounds each.

Black wool and buck wool should be packed separately, although in farm flocks there may be only one or two such fleeces, and these may be put in separate barley sacks before placing into the wool sack. Tags or sweat locks accumulating on the shearing board should be picked up and packed separately.

Dipping.—About ten days after shearing, the entire flock should be dipped, if there are any ticks or lice present. Sheep will not thrive well if infested with these parasites, and furthermore, after the ewes are shorn ticks will leave the ewes and find their way onto the lambs, which are in full fleece. Dipping should be done on a bright, sunny day, preferably in the morning so the sheep will be dry before night. A further discussion of dipping appears in another section.

Trimming Feet.—Farm sheep that are pastured in small enclosures, particularly the Rambouillet or fine-wool type, should have their feet trimmed once or twice a year. The toes grow out very long and the wall of the foot turns in, producing deformed feet (fig. 23). This condition not only causes the animal considerable discomfort but in young growing stock may produce a permanent weakness, namely weak pasterns or ill-shaped legs. Furthermore, such neglected feet are subject to foot rot infection, which is discussed in another section.

The feet may be readily trimmed with a sharp pocket knife or an ordinary pair of pruning shears. The work can best be done during the winter and spring while the ground is wet, which keeps the feet soft.

Marketing Lambs.—Most of the California spring lambs are ready for market at four to five months old, weighing 65 to 85 pounds. Lambs dropped in December and January should be ready for market in April and May. It is very important to have them finished before the green feed dries up, as foxtail seeds and alfileria spears work into the skin and cause the lambs considerable distress. Furthermore, lambs make their greatest rate of gain at the lowest cost when young, and better prices are obtained when they are marketed early.

Lambs may be marketed in several ways: (1) direct to local butchers, (2) sold to country buyers representing San Francisco and Los Angeles packers, (3) sold to speculators or shippers for the eastern markets, or (4) shipped to eastern markets direct by the grower.

It is general practice for the buyers to contract the lambs several months before they are ready for market. A contract is virtually an agreement on the part of the buyer to take all the lambs that he considers fat at a specified price and date of delivery. Such contracts are not generally looked on with favor and the grower should study the market conditions very carefully before contracting. This is the sheepman's yearly harvest and he should make the best of it, for often the method of merchandizing a product determines profit or loss.



Fig. 23.—Sheep with long, ill-shaped feet, due to neglect. In this illustration the front feet were trimmed previous to taking the picture. To avoid foot-rot infection keep the feet properly trimmed.

Those growers who have shipped their lambs east have usually profited by doing so. Railroad facilities are greatly improved over previous years and feeding stations near the central markets have made it possible to ship with a low shrink. Besides, the producer will profit by visiting a central market and seeing his lambs sell in competition with thousands of others. It will acquaint him with the market demand, the importance of finish and quality, and the competition his lambs have to meet. All these things are very helpful to guide him in future production.

Farmers who have small numbers will do best to sell to a reliable local dealer as the lambs become fat, making two deliveries, usually in April and May.

Weaning.—The majority of the lambs in California are not weaned previous to marketing, but are simply taken away from their mothers at sale time. Ewe lambs that are kept over for breeding stock or purebred lambs raised for breeding purposes should be weaned at four and a half to five months of age. This permits putting the lambs on better feed to develop them rapidly, and if ram lambs are allowed to run with the ewes too long they may get some of the ewes with lamb. Ewe lambs and ram lambs should also be separated soon after weaning. In weaning, leave the lambs in the pasture where they are used to run and place the ewes on scant feed. Observe the ewes closely and any with distended udders should be milked out once or twice. Frequently this detail is neglected by the busy farmer, resulting in a number of ewes having spoiled udders at the next lactation period. After the milk flow has ceased the ewes should be placed on good feed to condition them for the next breeding season.

Culling the Flock.—Soon after weaning, the shepherd should go carefully through the flock and cull out old ewes and any that have developed spoiled udders or are barren. These should be fattened and sold to the butcher. The age at which ewes become unprofitable largely depends upon their physical condition and their teeth. The mutton breeds will show the effect of old age at five to six years, while the fine-wool type of ewes are often fairly vigorous until eight.

Salt, Shade and Water.—The breeding flock does not require a maximum supply of feed during the summer, but salt, shade, and fresh water are essential. The most convenient way to supply salt to farm sheep is in brick or block form. However, range men find the half-ground salt more satisfactory. Sheep can get the required amount readily, and since the brick salt is very hard there is danger of the sheep injuring the teeth. They should have free access to salt at all times, and require more salt when on dry feed than they do when on green feed. In fact, some sheepmen prefer to keep salt away from sheep when they are on very heavy green feed early in the spring, as the excess consumption of salt has a tendency to cause scours. There is also an old custom among some shepherds to withhold salt at lambing time on the supposition that the ewes will lick their young lambs more readily. However, it is questionable whether this is based on facts, and in withholding salt proper digestion is interfered with. Besides, there is great danger of ewes overeating on salt after they have been without it for some time.

Much has been said recently in regard to minerals for sheep. Calcium and phosphorus are the principal elements involved and for proper metabolism it is important that these two elements be present in somewhat definite proportions. Phosphorus is likely to be deficient in depleted range areas where sheep are compelled to subsist for months on dry feed. Wherever feed conditions are not favorable a special mineral mixture is recommended, consisting of equal parts of ground salt, steamed bone meal, and ground oyster shell. These should be thoroughly mixed and placed in a trough in place of ordinary salt.



Fig. 24.—Shade and water are very essential during the summer months.

There are many prepared stock foods or condition powders on the market which sell at more or less exorbitant prices, but the above mixture, which may be prepared at a cost of \$30 to \$35 per ton, is equally efficacious in maintaining the health of the sheep by correcting any possible mineral deficiency.

Shade is very important in the summer time and natural shade trees are a great asset to a sheep pasture. Artificial shade is provided when there are no shade trees (fig. 24). Fresh water is indispensable to the health of a flock of sheep. When sheep range in the forest reserve where they have to travel a long way to water and where there is some dew on the feed in the mornings, they are often driven to water only once every three days; however, under valley conditions, particularly during warm weather, they need water at least twice a day.

FEEDS FOR SHEEP

While grain feeding is not commonly practiced in commercial lamb production, similar to the general practices in feeding hogs or dairy cattle, yet in the care and feeding of purebred flocks of breeding sheep, a grain ration is usually provided. Furthermore, range men are finding it more and more necessary to provide supplementary feeds in wintering range ewes. Many growers of early lambs in California are feeding the lambs supplementary concentrates in creeps in order to force growth as rapidly as possible, and there is considerable interest in proper rations for fattening lambs for market; hence a discussion of the most important feed stuffs follows. The digestible nutrients of some common feeds is given in table 5.

TABLE 5
TOTAL DRY MATTER, ASH, AND DIGESTIBLE NUTRIENTS IN 100 POUNDS OF
COMMON FEEDS*

Feed	Total dry matter	Total ash	Digestible Nutrients				Nutritive ratio
			Crude protein	Carbohy- drates	Fat	Total	
Corn.....	89.5	1.5	7.5	67.8	4.6	85.7	1:10.4
Barley.....	90.7	2.7	9.0	66.8	1.6	79.4	1:7.8
Wheat.....	89.8	1.9	9.2	67.5	1.5	80.1	1:7.7
Oats.....	90.8	3.5	9.7	52.1	3.8	70.4	1:6.3
Milo maize (grain).....	89.3	2.8	8.7	66.2	2.2	79.9	1:8.2
Rice (rough).....	90.4	4.9	4.7	64.6	1.7	73.1	1:14.6
Wheat bran.....	89.9	6.3	12.5	41.6	3.0	60.9	1:3.9
Rice bran.....	89.9	9.7	7.9	38.1	8.8	65.8	1:7.3
Cottonseed meal (hot pressed).....	92.2	6.6	33.4	24.3	7.9	75.5	1:1.3
Cottonseed meal (cold pressed).....	92.1	4.2	21.1	33.2	7.4	70.9	1:2.4
Linseed oil meal.....	90.9	5.4	30.2	32.6	6.7	77.9	1:1.6
Recleaned bean screenings.....	88.3	2.6	18.1	50.8	5.3	80.8	1:3.5
Barley screenings.....	88.6	4.2	8.3	47.7	2.5	61.6	1:6.4
Raisins (cull).....	87.0	2.2	2.8	70.0	1.0	75.1	1:25.8
Molasses (cane).....	74.3	6.1	1.0	58.5	59.5	1:58.5
Alfalfa hay.....	91.4	8.6	10.6	39.0	0.9	51.6	1:3.9
Barley hay.....	92.6	6.4	4.6	48.2	0.9	54.8	1:10.9
Wild oat hay.....	92.1	6.4	3.8	42.8	1.4	49.8	1:12.1
Sudan grass hay.....	88.4	7.0	3.7	45.7	0.9	51.4	1:12.9
Barley straw.....	85.8	5.7	0.9	40.2	0.6	42.5	1:46.2
Corn silage.....	26.3	1.7	1.1	15.0	0.7	17.7	1:15.1
Mangels.....	9.4	1.0	0.8	6.4	0.1	7.4	1:8.2
Turnips.....	9.5	0.9	1.0	6.0	0.2	7.4	1:6.4
Pumpkins.....	8.3	0.9	1.1	4.5	0.5	6.7	1:5.1

*Henry, W. A. and F. B. Morrison. Feeds and feeding. 18th ed., pp. 709-743. The Henry-Morrison Co., Madison, Wis. 1923.

Feeds are conveniently divided into four groups:

First: Carbonaceous concentrates, which are mainly the cereal grains, barley, corn, wheat, oats, milo maize, etc. These are the starchy feeds and form the basis of practically all rations.

Second: Nitrogenous supplements, or protein feeds, such as cottonseed meal, linseed oil meal, wheat bran, etc. These feeds contain considerable amounts of the growth producing element, protein, and should form a portion of each ration, particularly for young, growing stock.

Third: Hay crops, which furnish digestible nutrients as well as bulk to promote proper digestion in case of ruminants like sheep or cattle.

Fourth: Succulent feeds, such as corn silage, root crops, and green forage feeds. These are particularly desirable for ewes nursing lambs.

Carbonaceous Concentrates.—The most important grain feeds in California for sheep are barley, oats, and shelled corn. Barley is the leading cereal and for that reason usually the most economical to feed. It is commonly fed whole to sheep. Shelled corn is of similar composition, although somewhat higher in digestible nutrients, and is rated about 10 per cent higher in feeding value than barley. It is especially well adapted as a supplementary feed for range ewes. Oats are the staple grain feed for sheep, particularly for bred ewes and ewes nursing lambs. Oats supply the elements required by the growing fetus, and for milk production, and seem to impart a beneficial effect on the system. Oats, however, are not generally fed to range ewes because of their relatively high price. Wheat, milo maize, cull raisins, and mill screenings may also be fed to sheep in local areas with good results.

Nitrogenous Supplements.—Wheat bran is the staple supplement for sheep as it is laxative, rather bulky, and high in mineral content. In mixed feeds it usually makes up about one-fourth of the ration. Linseed oil meal is rated very high by some shepherds and cottonseed meal is also a valuable supplement, although both of these should be fed in small amounts, not over 10 to 15 per cent of the ration. There are two kinds of cottonseed cake, the hot pressed and cold pressed; the latter contains considerable hull, is lower in protein content, and may be fed in somewhat larger amounts. Bean screenings are frequently fed to sheep, being fairly palatable and are usually obtainable at a low price.

Hay Crops.—Alfalfa is the leading hay for sheep. It is high in protein and minerals, an excellent milk producer and very palatable.

The second and third cuttings are greatly preferred for sheep, as the first cutting is usually rather coarse and stemmy and contains more or less foxtail, which is very objectionable. The grain hays are not particularly adapted for sheep, as they are too coarse, although wild oat hay with considerable bur clover is fairly satisfactory. Sudan grass hay is rather coarse for sheep.

Succulent Feeds.—Corn silage is a very satisfactory feed, particularly for ewes suckling lambs. Mature ewes will consume two to three pounds per day, in addition to a reasonable amount of hay. Root crops, such as field carrots and turnips, are well adapted for sheep. Mangels and sugar beets are thought to produce “gravel” or “calculi” in the urinary tract and should not be fed freely to rams or wethers.

The important cultivated forage crops have been discussed in another place.

Pasturing Alfalfa.—Much has been written for and against alfalfa pasture, and were it possible to pasture sheep on alfalfa during the summer without the constant danger of losses from bloat, it would be the leading forage crop for sheep in the west. However, pasturing irrigated alfalfa, particularly during the summer months is attended with considerable danger and frequent losses due to bloat. Many sheepmen have attempted to raise sheep on alfalfa pasture by rotating fields, and taking special precautions, and yet they have suffered losses. It provides good fall and winter pasture when the plant is more or less dormant. In the Imperial Valley it is common practice to interplant the alfalfa with barley, which tends to reduce the danger from bloat. In turning sheep onto alfalfa, the following precautions should be taken: first, allow the alfalfa to reach the bloom stage; second, turn the sheep in for 20 or 30 minutes, then take them out and in about an hour put them back into the field. Observe them closely and when they are well filled, take them out. Repeat this the second day, and the third day leave them on the alfalfa day and night. This prevents the sheep from becoming very hungry at any time and they are less likely to consume excessive amounts. Furthermore, the mature alfalfa does not produce bloat as readily as the fresh, growing plant. Most sheepmen also take the precaution of having the sheep well filled on dry hay before turning them into a field of alfalfa.

Method of Feeding.—Sheep are usually fed out of racks, and there are several types of racks in use. The combination grain and hay rack (fig. 25) is fairly satisfactory for small flocks. The more common type of rack, however, is the rack built for roughage alone (fig. 26).

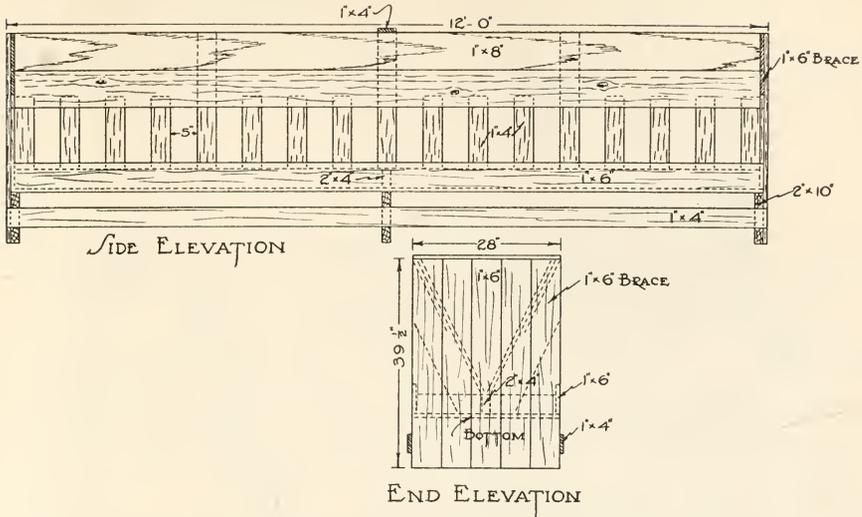


Fig. 25.—Combination hay and grain rack. It may be conveniently set across the barn to serve as a partition.

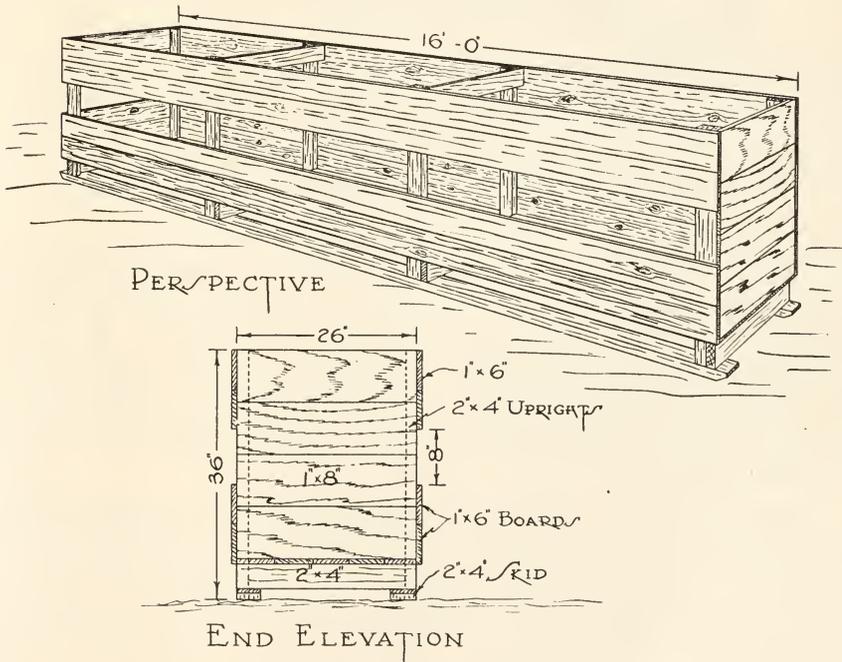


Fig. 26.—Hay rack for sheep. It may be built with or without a floor. It is set on 2 x 4 skids to facilitate moving.

It is simple and easily constructed, although with this type of rack it is necessary to have a separate trough for feeding grain. Important essentials of a good rack are that it prevents waste of hay and avoids excessive amounts of hay and chaff lodging in the wool, particularly on top of the neck.

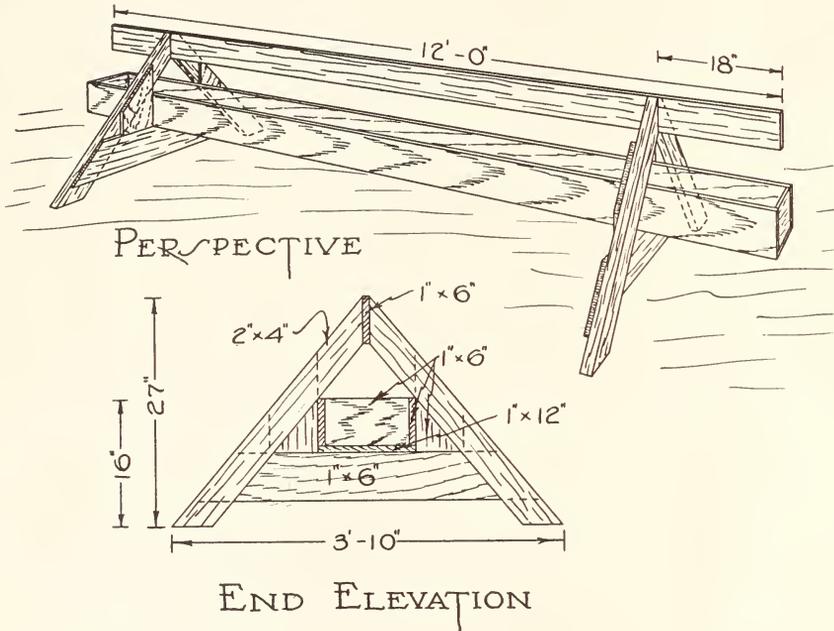


Fig. 27.—Grain trough for sheep. The rail prevents the sheep from getting into the trough.

In sheep barns it is usually most satisfactory to construct permanent mangers against the walls, but a few movable racks are very convenient. Sufficient lineal rack or manger space should be provided to avoid crowding. Mature ewes require about 18 inches and feeder lambs about 12 inches. Grain is usually fed in separate grain racks (fig. 27), and it is very important to have sufficient rack room so that each sheep has a place at the trough.

Rations.—A few practical rations containing approximately the amount of the various nutrients required daily for different types of sheep are herewith given as a guide for the sheepman who finds it necessary to feed grain due to shortage of pasture, or for the breeder of registered breeding stock who wishes to promote maximum growth.

Daily ration for bred ewes weighing 125 to 140 pounds:

RATION 1		RATION 3	
Alfalfa hay	3.0 pounds	Volunteer grain hay.....	3.0 pounds
Whole barley	0.5 pound	Whole barley	0.50 pound
		Cotton seed cake (40 per cent protein)	0.25 pound
RATION 2		RATION 4	
Alfalfa hay	3.0 pounds	Sudan grass hay	2.0 pounds
Whole barley	0.25 pound	Corn silage	2.0 pounds
Whole oats	0.25 pound	Whole barley	0.50 pound
		Cottonseed cake (40 per cent protein)	0.25 pound

If grass or volunteer pasture is available, the grain may be omitted and the amount of hay regulated accordingly. Cracked corn may be substituted for rolled barley. Cottonseed cake should be preferably of the "sheep" or pea size. Grain hay or Sudan grass hay should be well cured and of good quality or sheep will not eat this coarse type of roughage.

Daily ration for mature ewes nursing lambs:

RATION 5		RATION 6	
Alfalfa hay	3 to 4 pounds	Alfalfa hay	2 to 3 pounds
Whole barley 4 parts }	0.50 to	Corn silage	1.5 to 2 pounds
Whole oats 4 parts }	1.0 pound	Whole oats 4 parts }	0.50 to
Wheat bran 2 parts }		Cottonseed cake 1 part }	1.0 pound
		Whole barley 4 parts }	

Daily ration for fattening lambs in dry lot, weighing an average of 60 pounds:

RATION 7		RATION 10	
Alfalfa hay	2.0 pounds	Alfalfa hay (chopped).....	2.0 pounds
Rolled barley	1.25 pounds	Cane molasses	0.5 pound
		Rolled barley	0.6 pound
		Cottonseed meal	0.2 pound
RATION 8		RATION 11	
Alfalfa hay	2.0 pounds	Alfalfa hay	1.8 pounds
Rolled barley	1.0 pound	Rolled barley	0.75 pound
Cottonseed meal	0.15 pound	Bean screenings	0.50 pound
RATION 9		RATION 12	
Alfalfa hay	1.5 pounds	Alfalfa hay	1.75 pounds
Corn silage	1.0 pound	Rolley barley	0.45 pound
Rolled barley	1.0 pound	Cull raisins	0.90 pound
Cottonseed meal	0.2 pound		

In recent years the use of commercially mixed feeds of alfalfa meal, molasses and grain has become common in feed lots. The feeding value of these mixtures depends upon the quality of alfalfa hay used and the amount of ground barley and molasses added. For fattening lambs on full feed the following mixture is quite satisfactory:

Alfalfa meal	50 per cent
Ground barley	30 per cent
Cane molasses	15 per cent
Cottonseed meal	5 per cent

Supplementary Feeding of Range Ewes.—Due to heavier stocking of sheep and the lambing period coming during the winter months, it has become necessary in many sections of California to supplement the range feed. Alfalfa hay is fed wherever practical. It is relished by sheep and stimulates milk flow. Among the concentrates, shelled corn and cottonseed cake are the most common feeds, although whole barley is usually the cheaper in price and only about 10 per cent lower in feed value than corn.

When sheep have access to some green feed, as found on the average California winter range, shelled corn is an excellent concentrate as it supplies the nutrients (carbohydrates and fats) required to balance the high protein content of immature grass and weed plants. It is convenient to feed and is usually spread out on the hard ground. Sheep will pick up every kernel and there is no danger of certain individuals overeating.

Cottonseed cake is a very high protein feed and has a beneficial effect on the milk flow when fed for a month previous to lambing. It is particularly well adapted to supplement dry feed on the range, as it is not only very high in protein but also high in the mineral phosphorus which is greatly lacking in dry grasses. Experience has also indicated that in the absence of green feed, cottonseed cake and alfalfa hay give excellent results, no doubt due to a special balance of the important minerals, calcium and phosphorus. The usual amount fed is $\frac{1}{4}$ pound per day per ewe (1 sack to 400 ewes), in addition to 2 pounds alfalfa hay or natural range. The sheep size is preferred and may best be fed by spreading it out on the hard ground, similar to shelled corn. Many sheepmen have lately preferred the cold pressed cottonseed cake to the ordinary hot pressed cake, as it is less concentrated, containing 28 per cent protein. It is cheaper in price and more bulky and there is less danger of overfeeding. It is usually sold in "flake form" and may be fed in troughs or spread on the ground, allowing $\frac{1}{4}$ to $\frac{1}{2}$ pound per day per ewe.

Whole or Rolled Barley.—There is no special reason why sheepmen should not direct their attention to the use of this home grown grain. It is similar to shelled corn in composition, well liked by sheep, and usually much lower in price. Experiments have shown that sheep do as well on whole barley as on steam rolled barley unless they are old and have poor teeth. Barley should be fed in troughs.

Whole Oats.—Oats is probably the most ideal grain that can be fed to range ewes, although the price in comparison with barley and corn is usually considered prohibitive by sheepmen.

Bean screenings are often utilized for range sheep, provided they can be bought cheaply in comparison with other grains. Cull raisins as well as various types of grain screenings are fed considerably to sheep.

Caution in Feeding.—As a final word in regard to feeds and feeding it is most important to avoid making sudden changes in the feeding program. For instance, when corn or cottonseed cake is first fed to range ewes, it is best to allow only $\frac{1}{8}$ pound per day per ewe the first week, $\frac{1}{4}$ pound the second week, and if necessary increase to $\frac{1}{2}$ pound the third week. Similarly, in feeding alfalfa hay, begin gradually with 1 pound per day while there is still some range feed or pasture available and increase the amount to 2 pounds as necessary.

Variety of grains is also important and instead of feeding only one grain, best results will be obtained by feeding a mixture of at least two grains, namely corn and cottonseed cake, or corn and bean screenings. Watch the ewes carefully and do not postpone grain feeding until all other available feed is gone, but anticipate their needs a month in advance.

When changing abruptly from barley stubble to beet stubble, or grass range to barley stubble, always make the change gradually, holding the sheep back the first four or five days when they reach new feed, particularly if they are in thin flesh or have made a long drive.

AILMENTS OF SHEEP

Wool Maggots.—Wool worms or maggots are one of the most common sources of trouble in the spring of the year. The wool maggot is produced by a small, black fly that lays its eggs in the wool about the dock and thighs whenever filth and manure are allowed to accumulate. These eggs hatch in a few hours, depending on the temperature, and the maggots crawl down near the skin and live on the skin secretions. They migrate through the wool, produce great irritation,

and in severe cases burrow into the flesh, making a bad wound, similar to that made by the Texas screw-worm. The symptoms are restlessness, twitching at the dock, and severely affected sheep will be found lying down in remote corners of the field, separated from the main flock.

Treatment consists of clipping the wool from the infested area, removing the maggots as far as possible, and treating the wound with a 6 per cent solution of sheep dip or a strong solution of copper sulfate or a tar preparation known as Pinetrol. A very satisfactory mixture that can be readily prepared at home is as follows: 2 quarts lubricating or used crankcase oil, 1 pint pine tar, $\frac{1}{2}$ pint gasoline, and $\frac{1}{4}$ pint turpentine.

This mixture will destroy maggots and also act as a fly repellent. Maggots are easily destroyed if the infestation is noticed early. In severe cases an application of pure gasoline may be necessary, this to be followed by the oil preparation.

Wool maggots may be largely prevented by keeping the wool cut close around the dock in the spring of the year, when the sheep are on green feed. Rams sometimes become infested around the base of the horn, owing to an injury caused by fighting, which attracts flies, and such cases should be treated immediately.

Eye Trouble.—In April and May, as the feed dries, there is always considerable trouble from foxtail or wild oat seeds getting into the eyes, particularly with lambs that have a covering of wool over the face. Feeding sheep first cutting of alfalfa hay, which usually contains considerable foxtail, is a further source of trouble. In affected sheep, the wool is usually wet underneath the eye, and the eye appears watery and partly closed. Catch the sheep, remove the seed with the fingers, or if necessary use a small pair of forceps. Wash the eye with a saturated solution of boric acid, or possibly strong salt water. Old sheepmen often use powdered burnt alum, placing a pinch in the eye, which is very effective in clearing up the eye. In severe cases the eye may have turned white or bluish, and it usually takes two or three weeks before the eye becomes normal.

Foot Rot.—During the last few years many sheepmen in California have found their flocks infected with foot rot, which is a chronic, infectious, ulcerative disease of the foot. It spreads rapidly through the flock and although it is not fatal, the animals remain lame and inactive a long time, resulting in loss of body weight, decreased wool clip, diminished milk flow, and finally the probable infection of the young lamb.

“Symptoms:¹⁰ At first there is a slight lameness, and, on examination, the foot is found warm, due to the inflammation. Animals badly affected will go on three legs, or if the forefeet are affected, they rest on their knees, especially while grazing. The lack of wear on the hoofs causes them to become over-grown and distorted, even curling into a spiral, causing the wear to come on the outer wall of the foot. Much of the horn becomes undermined and detached from the underlying tissue; and in old chronic cases, the hoof may be shed, exhibiting fibroid growths of new inflammatory tissue.

“Treatment: The feet that are over-grown or distorted must be carefully pared, and all horn that has been undermined and detached from the underlying tissue should be removed. In the more advanced cases where extensive invasion of the deeper tissues are involved, one must be more thorough in removing all necrotic erosions.

“Many chemicals have been tried in the treatment of this disease with the hope of finding some agent that will effect a rapid cure. Antimony and potassium tartrate (tartar emetic) has been found to be the most active agent so far used. An ointment composed of enough lanolin added to the powdered tartar emetic to make a thick paste and rubbed into the foot and between the dew claws after all the affected part is removed, brings about the desired results. One cannot be too conscientious in the paring and trimming of the feet. If any of the affection is allowed to remain under the horny part of the hoof where the drug cannot penetrate the animal will soon show signs of lameness.”

Preparturient Paralysis of Ewes (Stercoremia).—This so-called lambing paralysis is found mainly with ewes that are far advanced in pregnancy. The exact cause is unknown. Fat ewes that are closely confined and not permitted sufficient exercise are more likely to become affected. It often occurs with range sheep that have been out grazing continuously and upon the approach of winter are brought in and fed liberal amounts of alfalfa hay or other rich protein feed. Ewes that become affected with the disease invariably carry twin or triplet lambs.

“Symptoms:¹¹ The animals appear dull and are inclined to stand around and take very little exercise. There may be some nervous movements of the head and ears, weakness of legs, unsteady gait, and grinding of the teeth. As the condition progresses the animals are prone to lie down as if in a resting position, and will stay in such a

¹⁰ Howarth, J. A. Foot rot in sheep. *Veterinary Medicine* 25(5):186-188. 1930.

¹¹ Howarth, J. A. Preparturient paralysis of ewes. *Calif. Wool Grower*, 5(46):6. Nov. 12, 1929.

reclining position for hours or even days. Sheep that would formerly rise at the oncoming of a person or a dog will pay little or no attention. They will show difficulty in rising and when forced to get up, if such an act is possible, may sometimes walk in circles or stand resting against some object such as a fence or shed. At this stage, the eyesight becomes affected, and although the eyes show no pathological changes, the animals are unable to see. During this time the ewes do not eat or drink, but there is a continual grinding of the teeth.

“Treatment: When this disease makes its appearance in a band of sheep, it is advisable to place these animals on a bare maintenance ration by cutting down on the feed as much as possible and forcing the animals to take exercise. This can be accomplished by placing the sheep on range, stubble, or pasture where feed is so scarce that they will have to cover a lot of ground to obtain their feed. If the sheep are being hand-fed, haul the feed to the back part of the field one to two miles away from the barns or corrals so that they will have to travel for feed, and in this way obtain the desired exercise. It may be necessary in some cases to force the animals to exercise by driving.

“Summary: This disease is not classed as an infectious one due to the fact that bacteriological and other tests have failed to prove it such, but it is generally believed to be caused by a high protein diet and insufficient exercise. The treatment with medicinal agents seems to be of little value, if any. Some authors advise giving purgatives such as salts or oil, but it has been the experience of the writer that animals affected with this disease do not respond to such treatment.”

Prevention is the important measure to avoid the disease and sheepmen should exercise special care in the feeding of ewes that are far advanced in pregnancy. When it becomes necessary to supplement the native feed with hay or grain, always make the change very gradual and limit the amount fed until after the ewes have lambed.

Sheep Scabies.—Sheep-scab has for many years been of greatest economic importance; however, due to close inspection and carefully supervised dipping by state and federal officers, California is practically free from scab at the present time. In 1928–29 there were relatively few outbreaks and these were primarily in the Imperial Valley, where scabies was introduced by sheep shipped into California from neighboring states.

Scab is produced by a small mite which pricks the skin and sucks the blood serum; this causes the sheep to scratch and rub, resulting in the formation of a scab. The mites are very small and can usually be seen only with the aid of a hand lens. They rapidly multiply and

the infestation spreads from place to place. The only satisfactory treatment is dipping, preferably in lime and sulfur dip. When scab is discovered, the first step is to notify the Bureau of Animal Industry of the Department of Agriculture at Sacramento. Dipping is compulsory and is always supervised free of charge by a state or federal inspector and must be repeated in ten days.

Ticks.—In many flocks sheep ticks are more or less prevalent. They are found in the wool and on the skin. They are reddish or brown wingless flies, about a quarter of an inch long and may be readily seen with the naked eye. Sheep ticks suck the blood of the host and when present in considerable number they seriously interfere with the growth of the young lambs. Sheep ticks are readily destroyed by dipping the entire flock in one of the prescribed coal tar, nicotine or arsenical dips, prepared according to directions. The dipping must be repeated in twenty-one days to destroy the young ticks that have emerged since the first dipping. If the water contains considerable alkali salts, it is best to add a pound of concentrated lye to every 100 gallons of water.

Lice.—There are several types of sheep lice, sucking, biting and foot lice.

Foot lice are usually only found on the legs of sheep and can be readily destroyed by walking the sheep through a trough containing a 3 per cent solution of ordinary sheep dip, eight or ten inches deep. Foot lice are light gray or brown in color and although smaller than the tick, they can be seen with the naked eye.

To destroy the other types of lice it is necessary to submerge the sheep in a vat as with dipping for ticks and also to repeat the dipping in about fourteen days. The same prepared dips as described for ticks are satisfactory for lice.

The Stomach Worm.—This is a small worm found primarily in the fourth or true stomach. It has proven a great menace to flocks of the middle west, south and east and has recently become a serious problem in certain sections of the west. In California it is found principally in the coast counties, where moisture is prevalent in the form of heavy fogs and possible summer rains; however, infestations have also been reported from many inland counties.

There are two types of stomach worm, the large, *Haemonchus contortus*, $\frac{1}{2}$ to $1\frac{1}{4}$ inches long; and the small, *Ostertagia circumcincta*, about $\frac{1}{2}$ inch in length. The latter is the principal one found in California and is less severe than the former.

The life history in brief is as follows: The eggs produced by the female worm pass out in the droppings and hatch in a few hours,

under most favorable conditions of warmth and moisture. The larva becomes ensheathed and crawls up blades of grass and is taken up by sheep and lambs as they graze. In the stomach of the host the worms become mature in two to three weeks and are found floating in the contents or attached to the lining of the stomach. They not only interfere with proper digestion, but also suck the blood of the host, causing serious derangement.

Sheep infested with stomach worms appear dull and unthrifty and diarrhea may be present. Later the membranes of the lining of the mouth and eyes become pale and a characteristic swelling may be noticed under the jaw. Sheep become emaciated and finally die.

There are a number of drugs that may be administered, but frequent changing of grazing ground is the first preventive measure. A satisfactory treatment is drenching the sheep with a 1 per cent solution of copper sulfate in water.

To make this solution dissolve $\frac{1}{4}$ pound of copper sulfate crystals in a pint of hot water, then add sufficient water to make 3 gallons. This will be sufficient for one hundred sheep. The mixture should be prepared in a stone or porcelain jar, as copper sulfate corrodes metal vessels.

The dose is 4 ounces for mature sheep; $1\frac{1}{2}$ to 2 ounces for lambs. This may best be given by means of a 4-ounce metal syringe, administering the drench slowly at the base of the tongue. The sheep should be kept off feed for 12 to 18 hours before treatment and 6 hours after treatment.

The carbon tetrachlor-ethylene treatment, or common "Nema Capsule," is also recommended and used quite commonly in California. It comes in 5-cc. capsules for mature sheep and $2\frac{1}{2}$ -cc. size for lambs and is administered by placing the capsule on the back of the tongue with a special pair of forceps. In treating with Nema capsule it is not necessary to keep the sheep off feed before treatment.

In badly infested areas the sheep are treated every thirty days during the summer months, and the concentration of the mixture is increased to $1\frac{1}{2}$ per cent solution. In the interior valleys of California, the hot, dry summers serve as a natural control agency, as moisture is required for the development of the larvae.

The Liver Fluke.—The liver fluke¹² is a leaf-like flat worm found in the liver and gall bladder of both sheep and cattle. It is restricted, however, to certain areas of California, namely, the coast counties, where living springs and stagnant pools are found.

¹² Freeborn, Stanley B. Liver fluke and stomach worm in sheep. California Agr. Ext. Cir. 17:1-14. 1928.

A recent treatment has been found very effective, namely, administering 1 cubic centimeter of carbon tetrachloride. This is given in capsule form and in severe infestations should be repeated in ten days. A certain type of black snail is essential in the life cycle of the fluke, and the destruction of these snails is an important part of liver fluke control. These snails are found in wet places caused by overflowing springs, and in stagnant pools, and such breeding grounds should be treated with powdered bluestone (copper sulfate) or be fenced off completely. Too close grazing is also to be avoided.

Lung Worm.—This is a thin, thread-like worm which inhabits the bronchial tubes. The general symptoms are a chronic cough, general emaciation and profuse diarrhea in advanced stages. Medicinal treatment has never proven very satisfactory and preventive measures consist in keeping the animal in thrifty condition by proper feeding so as to resist lung worm attacks.

*Tape Worm.*¹³—The sheep tape worm is found in certain sections of the state, primarily in the coast counties. It attaches to the lining of the small intestine and interferes with digestion, causing sheep to become unthrifty, weak, and emaciated, accompanied usually by diarrhea. Various treatments have been recommended, one of the principal drugs being kamala. A dose of 1 dram to lambs has given good results. Oleoresin of male fern may be given instead in doses of 1 dram in 2 to 4 ounces of castor oil. A mixture of 1 per cent solution of copper sulfate and 1 per cent solution of nicotine sulfate (Black Leaf 40) has also been recently recommended. This may be made by dissolving 4 ounces of copper sulfate in $\frac{1}{2}$ gallon of hot water and 4 ounces of nicotine sulfate in $\frac{1}{2}$ gallon of warm water. When cool, mix and add sufficient water to make 3 gallons. This mixture is destructive to the stomach worm and tape worm.

The Sheep Gadfly.—The sheep gadfly is the cause of grub in the head. It is a small, black fly, very active during early spring and summer. It lays eggs on the nose of the sheep, which hatch readily and the larvae crawl into the frontal sinuses of the head, causing considerable irritation. The sheep will be seen holding its head to one side and walking in a circle. No effective remedy is known. A rather crude preventive measure consists in applying pine tar to the nose. This is sometimes done by constructing a special type of salt trough which is smeared with pine tar so that the sheep will automatically tar their noses and faces when licking salt. The tar acts as a fly repellent.

¹³ Hall, Maurice C. Parasites and parasitic diseases of sheep. U. S. Dept. Agr. Farmers Bul. 1330:12-17. 1928.

SHEEP GRAZING ON THE NATIONAL FORESTS OF CALIFORNIA

There are eighteen National Forests in California, comprising about nineteen million acres of land, of which about eleven million acres are suitable for grazing. These National Forests are located in the Sierra-Nevada Range, the Coast Range, and extensions of these ranges. During 1928, 434,898¹⁴ sheep and goats (not including lambs and kids under six months of age), were grazed on these forests.

The sheepmen who use the National Forests must own at least two acres of grazing land and one-quarter acre of agricultural land per head of sheep. The average grazing season on the National Forests is only about four months, usually from May to September. The rest of the time the sheep are kept on private ranches, either owned or leased, and on the public domain. The fresh mountain feed and cool summers provide ideal conditions for developing and finishing lambs.

The public domain in California comprises nineteen million acres. Some of it is suited to yearlong grazing, although a large part of it is used primarily for sheep during the winter.

Sheepmen are assigned to certain allotments on the National Forests and the average size of such an allotment is usually about 10,000 acres for a band of 1,200 ewes and their lambs. Established permittees are able to secure ten-year permits if desired. Sheep and cattle are not usually allotted to the same range, although in some ranges the best use of the forage can often be secured by allotting both sheep and cattle.

Grazing Fees.—The grazing fee varies according to the quality and accessibility of the range. Beginning with 1928, there has been a gradual yearly increase to continue for a period of four years, and in 1931 the average charge in California will be from 5.5 to 6.0 cents per head per month, while the average rate has been 3.5 to 4.0 cents. The grazing fee represents only a small part of the total cost incident to grazing a band of sheep in the National Forest.

National Forests Fully Stocked.—Owing to the increased development of the livestock industry in California, practically all the available grazing land in the National Forests is now fully occupied. New bona-fide settlers within or in the vicinity of the National Forests are favored, provided they own sufficient ranch property to carry their sheep when not on the forest. There is very little opportunity for

¹⁴ Voorhies, Edwin C., and W. E. Schneider. Economic aspects of the sheep industry. California Agr. Exp. Sta. Bul. 473:121-124. 1929.

stockmen to acquire new grazing privileges, since all the allotments are taken up and there are several thousand applications on the waiting list. In order to acquire a forest grazing permit at this time, in most cases, it is necessary to purchase stock and ranch property of established permittees.

To attempt to secure a permit, application should be made to the Forest Supervisor, indicating the particular part of the forest where the permit is desired, giving the number of stock owned and the character and location of the ranch property. The Supervisor will inform the applicant as to the possibility of securing a permit.

COST OF PRODUCTION OF RANGE SHEEP

Many people have become over-enthusiastic about the profits in sheep raising, due to the fact that the market price for lambs and wool has been very favorable during the last five years. Seasonal rainfall has provided natural feed, sheepmen have specialized in producing early lambs of good quality, and large numbers of spring lambs have been exported to eastern markets where high prices have prevailed.

On the other hand, the average layman is not familiar with the financial status of the sheep business, the many items of cost and the general overhead, and anyone contemplating an investment in sheep should make a careful study of the expenditures and receipts over a period of years.

Cost of production studies have been reported by a number of state experiment stations, and table 6 is herewith given as a guide and illustration of production costs.

This table indicates a total cost per ewe per year of \$7.99 and a corresponding income from the sale of lambs and wool at \$8.40, leaving a net profit of only 41 cents.

Extensive cost of production studies have not been made in California; although, in a yearly study (January 1, 1928, to January 1, 1929) by Mr. Donald Smith, Farm Advisor of Tehama County, including eight flocks, it was shown that the yearly cost was \$7.88 per breeding ewe, the income was \$10.84, yielding a net return of \$2.96 on an average sale price of 10.76 cents per pound for lambs and 33.4 cents per pound for wool.

In this study it was found that feed constituted 40.5 per cent; labor, 33.9 per cent, and all other items, 25.6 per cent of the total cost.

Wool contributed 31.4 per cent; sale of lambs and other stock, 67.9 per cent, and miscellaneous items, 0.7 per cent of the gross income.

TABLE 6
STATEMENT OF COSTS AND INCOME IN PRODUCING MUTTON AND WOOL ON
EASTERN OREGON RANGES¹⁵

<i>Expenses</i>	1200 head	Per head
1 herder for 12 months at \$100 (including board).....	\$1,200.00	\$1.00
½ camp tender, 12 months at \$120 (1 camp tender for 2 bands).....	720.00	.60
Extra help at lambing (2 men, 2 months at \$90).....	360.00	.30
Interest, upkeep, and depreciation on camp tender outfit and miscellaneous	360.00	.30
Shearing and packing wool	300.00	.25
Cost of summer and winter range:		
Interest on 3 acres winter range (5 per cent on \$7 per acre) \$1.05		
Taxes on 3 acres at 11 cents33	
Free range, 2 ½ acres.		
Summer range, ⅔ National Forest and ⅓ leased land24	
	1,944.00	1.62
Hay, 250 pounds per head at \$8 per ton.....	1,200.00	1.00
Ram service	240.00	.20
Taxes	180.00	.15
Interest at 8 per cent on average value of \$8.44	810.24	.68
Losses at 10 per cent, 120 head at \$8.44	1,012.80	.84
Depreciation at \$1.17 on 1,080 head	1,260.00	1.05
Total expenses	\$9,587.04	\$7.99
 <i>Returns</i>		
960 lambs weighing 65 pounds at 10 cents	\$6,240.00	\$5.20
9600 pounds wool at 40 cents	3,840.00	3.20
Total returns	\$10,080.00	\$8.40

NOTE: Death loss and depreciation may be made up by buying enough yearling ewes each year to keep the ewe band up to standard.

The cost of such replacement should be as shown below:

256 yearling ewes at \$11	\$2,816.00	
Credit by 136 old ewes sold at \$4	544.00	
Net cost	\$2,272.00	\$1.89

It will be noted that the final cost of replacement is the same as the combined figure for losses and depreciation previously given.

The most important factor contributing to profitable sheep production is the number of lambs raised per 100 breeding ewes. In this study, the four low records having 74.7 lambs raised per 100 ewes, made a net profit of 98 cents per sheep unit. The four high records, 89.4 lambs raised per 100 ewes bred, made a net profit of \$2.89 per sheep unit. "Sheep unit" includes breeding ewes, wethers, rams and ewe lambs on a per head basis.

The second important factor is the average weight of lambs sold. The four flocks having the lowest weight per lamb, namely 67.0 pounds, made a net profit of \$1.17 per sheep unit. The four flocks having the highest weight per lamb, 79.9 pounds, made a net profit of \$2.76 per sheep unit.

¹⁵ Potter, E. L., and H. A. Lindgren. Cost of producing mutton and wool on eastern Oregon ranges. Oregon Agr. Exp. Sta. Bul. 219:5-13. 1925.

STATION PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION

BULLETINS

- | No. | No. |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 253. Irrigation and Soil Conditions in the Sierra Nevada Foothills, California. | 408. Alternaria Rot of Lemons. |
| 263. Size Grades for Ripe Olives. | 409. The Digestibility of Certain Fruit By-Products as Determined for Ruminants. Part I. Dried Orange Pulp and Raisin Pulp. |
| 277. Sudan Grass. | 410. Factors Influencing the Quality of Fresh Asparagus After it is Harvested. |
| 279. Irrigation of Rice in California. | 412. A Study of the Relative Value of Certain Root Crops and Salmon Oil as Sources of Vitamin A for Poultry. |
| 283. The Olive Insects of California. | 414. Planting and Thinning Distances for Deciduous Fruit Trees. |
| 304. A Study of the Effects of Freezes on Citrus in California. | 415. The Tractor on California Farms. |
| 310. Plum Pollination. | 416. Culture of the Oriental Persimmon in California. |
| 313. Pruning Young Deciduous Fruit Trees. | 418. A Study of Various Rations for Finishing Range Calves as Baby Beeves. |
| 331. Phylloxera-resistant stocks. | 419. Economic Aspects of the Cantaloupe Industry. |
| 335. Coconut Meal as a Feed for Dairy Cows and Other Livestock. | 420. Rice and Rice By-Products as Feeds for Fattening Swine. |
| 343. Cheese Pests and Their Control. | 421. Beef Cattle Feeding Trials, 1921-24. |
| 344. Cold Storage as an Aid to the Marketing of Plums, a Progress Report. | 423. Apricots (Series on California Crops and Prices). |
| 346. Almond Pollination. | 425. Apple Growing in California. |
| 347. The Control of Red Spiders in Deciduous Orchards. | 426. Apple Pollination Studies in California. |
| 348. Pruning Young Olive Trees. | 427. The Value of Orange Pulp for Milk Production. |
| 349. A Study of Sidedraft and Tractor Hitches. | 428. The Relation of Maturity of California Plums to Shipping and Dessert Quality. |
| 353. Bovine Infectious Abortion, and Associated Diseases of Cattle and New-born Calves. | 430. Range Grasses in California. |
| 354. Results of Rice Experiments in 1922. | 431. Raisin By-Products and Bean Screenings as Feeds for Fattening Lambs. |
| 357. A Self-Mixing Dusting Machine for Applying Dry Insecticides and Fungicides. | 432. Some Economic Problems Involved in the Pooling of Fruit. |
| 361. Preliminary Yield Tables for Second-Growth Redwood. | 433. Power Requirements of Electrically Driven Dairy Manufacturing Equipment. |
| 362. Dust and the Tractor Engine. | 434. Investigations on the Use of Fruits in Ice Cream and Ices. |
| 363. The Pruning of Citrus Trees in California. | 435. The Problem of Securing Closer Relationship between Agricultural Development and Irrigation Construction. |
| 364. Fungicidal Dusts for the Control of Bunt. | 436. I. The Kadota Fig. II. The Kadota Fig Products. |
| 366. Turkish Tobacco Culture, Curing, and Marketing. | 438. Grafting Affinities with Special Reference to Plums. |
| 367. Methods of Harvesting and Irrigation in Relation to Moldy Walnuts. | 439. The Digestibility of Certain Fruit By-Products as Determined for Ruminants. II. Dried Pineapple Pulp, Dried Lemon Pulp, and Dried Olive Pulp. |
| 368. Bacterial Decomposition of Olives During Pickling. | 440. The Feeding Value of Raisins and Dairy By-Products for Growing and Fattening Swine. |
| 369. Comparison of Woods for Butter Boxes. | 444. Series on California Crops and Prices: Beans. |
| 370. Factors Influencing the Development of Internal Browning of the Yellow Newtown Apple. | 445. Economic Aspects of the Apple Industry. |
| 371. The Relative Cost of Yarding Small and Large Timber. | 446. The Asparagus Industry in California. |
| 373. Pear Pollination. | 447. A Method of Determining the Clean Weights of Individual Fleeces of Wool. |
| 374. A Survey of Orchard Practices in the Citrus Industry of Southern California. | 448. Farmers' Purchase Agreement for Deep Well Pumps. |
| 380. Growth of Eucalyptus in California Plantations. | 449. Economic Aspects of the Watermelon Industry. |
| 385. Pollination of the Sweet Cherry. | 450. Irrigation Investigations with Field Crops at Davis, and at Delhi, California, 1909-1925. |
| 386. Pruning Bearing Deciduous Fruit Trees. | 451. Studies Preliminary to the Establishment of a Series of Fertilizer Trials in a Bearing Citrus Grove. |
| 388. The Principles and Practice of Sun-Drying Fruit. | 452. Economic Aspects of the Pear Industry. |
| 389. Berseem or Egyptian Clover. | 453. Series on California Crops and Prices: Almonds. |
| 390. Harvesting and Packing Grapes in California. | 454. Rice Experiments in Sacramento Valley, 1922-1927. |
| 391. Machines for Coating Seed Wheat with Copper Carbonate Dust. | |
| 392. Fruit Juice Concentrates. | |
| 393. Crop Sequences at Davis. | |
| 394. I. Cereal Hay Production in California. II. Feeding Trials with Cereal Hays. | |
| 395. Bark Diseases of Citrus Trees in California. | |
| 396. The Mat Bean, <i>Phaseolus Aconitifolius</i> . | |
| 397. Manufacture of Roquefort Type Cheese from Goat's Milk. | |
| 400. The Utilization of Surplus Plums. | |
| 405. Citrus Culture in Central California. | |
| 406. Stationary Spray Plants in California. | |
| 407. Yield, Stand, and Volume Tables for White Fir in the California Pine Region. | |

BULLETINS—(Continued)

- | | |
|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| No. | No. |
| 455. Reclamation of the Fresno Type of Black-Alkali Soil. | 465. Curly Top Symptoms of the Sugar Beet. |
| 456. Yield, Stand and Volume Tables for Red Fir in California. | 466. The Continuous Can Washer for Dairy Plants. |
| 458. Factors Influencing Percentage Calf Crop in Range Herds. | 467. Oat Varieties in California. |
| 459. Economic Aspects of the Fresh Plum Industry. | 468. Sterilization of Dairy Utensils with Humidified Hot Air. |
| 460. Series on California Crops and Prices: Lemons. | 469. The Solar Heater. |
| 461. Series on California Crops and Prices: Economic Aspects of the Beef Cattle Industry. | 470. Maturity Standards for Harvesting Bartlett Pears for Eastern Shipment. |
| 462. Prune Supply and Price Situation. | 471. The Use of Sulfur Dioxide in Shipping Grapes. |
| 464. Drainage in the Sacramento Valley Rice Fields. | 474. Factors Affecting the Cost of Tractor Logging in the California Pine Region. |
| | 475. Walnut Supply and Price Situation. |

CIRCULARS

- | | |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| No. | No. |
| 115. Grafting Vinifera Vineyards. | 269. An Orchard Brush Burner. |
| 117. The Selection and Cost of a Small Pumping Plant. | 270. A Farm Septic Tank. |
| 127. House Fumigation. | 276. Home Canning. |
| 129. The Control of Citrus Insects. | 277. Head, Cane, and Cordon Pruning of Vines. |
| 164. Small Fruit Culture in California. | 278. Olive Pickling in Mediterranean Countries. |
| 166. The County Farm Bureau. | 279. The Preparation and Refining of Olive Oil in Southern Europe. |
| 178. The Packing of Apples in California. | 282. Prevention of Insect Attack on Stored Grain. |
| 203. Peat as a Manure Substitute. | 284. The Almond in California. |
| 212. Salvaging Rain-Damaged Prunes. | 287. Potato Production in California. |
| 230. Testing Milk, Cream, and Skim Milk for Butterfat. | 288. Phylloxera Resistant Vineyards. |
| 232. Harvesting and Handling California Cherries for Eastern Shipment. | 289. Oak Fungus in Orchard Trees. |
| 239. Harvesting and Handling Apricots and Plums for Eastern Shipment. | 290. The Tangier Pea. |
| 240. Harvesting and Handling California Pears for Eastern Shipment. | 292. Alkali Soils. |
| 241. Harvesting and Handling California Peaches for Eastern Shipment. | 294. Propagation of Deciduous Fruits. |
| 243. Marmalade Juice and Jelly Juice from Citrus Fruits. | 295. Growing Head Lettuce in California. |
| 244. Central Wire Bracing for Fruit Trees. | 296. Control of the California Ground Squirrel. |
| 245. Vine Pruning Systems. | 298. Possibilities and Limitations of Cooperative Marketing. |
| 248. Some Common Errors in Vine Pruning and Their Remedies. | 300. Coccidiosis of Chickens. |
| 249. Replacing Missing Vines. | 301. Beekeeper Poisoning of the Honey Bee. |
| 250. Measurement of Irrigation Water on the Farm. | 302. The Sugar Beet in California. |
| 253. Vineyard Plans. | 304. Drainage on the Farm. |
| 255. Leguminous Plants as Organic Fertilizers in California Agriculture. | 305. Liming the Soil. |
| 257. The Small-Seeded Horse Bean (<i>Vicia faba</i> var. <i>minor</i>). | 307. American Foulbrood and Its Control. |
| 258. Thinning Deciduous Fruits. | 308. Cantaloupe Production in California. |
| 259. Pear By-Products. | 309. Fruit Tree and Orchard Judging. |
| 261. Sewing Grain Sacks. | 310. The Operation of the Bacteriological Laboratory for Dairy Plants. |
| 262. Cabbage Production in California. | 311. The Improvement of Quality in Figs. |
| 263. Tomato Production in California. | 312. Principles Governing the Choice, Operation and Care of Small Irrigation Pumping Plants. |
| 265. Plant Disease and Pest Control. | 313. Fruit Juices and Fruit Juice Beverages. |
| 266. Analyzing the Citrus Orchard by Means of Simple Tree Records. | 314. Termites and Termite Damage. |
| | 315. The Mediterranean and Other Fruit Flies. |