Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

PRODUCTION PRACTICES FOR CALIFORNIA SHEEP

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CALIFORNIA AGRICULTURAL
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for
CALIFORNIA SHEEP

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PRODUCTION PRACTICES FOR CALIFORNIA SHEEP

Shepherding is one of the oldest professions known to mankind. Dating back to biblical times, the care of sheep has been used in song and story as a symbol of the simple life. But the sheep business as it exists today in California is a complex enterprise.

This manual acquaints you with the principal aspects of sheep production in California—the breeds raised; sheep as a business; equipment you will need; the feeding of sheep; and a calendar of operations for a typical year. A list of reference books and periodicals has been added for those who wish to read further on particular phases of sheep raising.

This manual replaces Manual 16.

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DISTRIBUTION, BREEDING AND SELECTION

Domestic sheep were first introduced into California in 1769. They were brought here by the Franciscan fathers, who were then establishing their chain of missions along El Camino Real. These sheep, of Spanish origin, were low-grade, of the coarse-wool type. They were used by the mission fathers as a teaching aid in missionary work with the natives. The men were taught the care and management of the flocks, and the women learned the art of making clothing from the wool. Sheep also supplied food and fiber to the colonists.

In 1825 about one million head of sheep were kept by the seventeen missions, and another million was owned by ranchers. In these early days the coastal district of California was a great sheep-producing region. Of economic importance were the clothing and blankets made by the women of the mission, and the large numbers of pelts and quantities of tallow processed and sold to trading ships.

During the period of 1832–1848 the disposal of livestock was placed in the hands of government officers. By their ruling much of the livestock property was sold to interests outside the missions.

With the discovery of gold in California in 1848 and the influx of fortune-seekers from all parts of the country, the demand for fresh meat increased greatly. Lambs brought $12 and wethers $15 per head. Large numbers of sheep were slaughtered, and by 1850 only 17,514 head of sheep remained—less than 1 per cent of the number roaming the ranges of California 25 years before. During the period of 1852—1857, 551,000 sheep were imported into California by the trail route from New Mexico.

Following the gold-rush days many enterprising and progressive sheepmen began to improve their flocks. They imported purebred sheep from Vermont, New York, Ohio and Pennsylvania. Spanish Merinos were first brought to California by Curtis and McConnell of Sacramento. Large numbers of high-priced sheep were also brought into California from Australia. It is reported that during the period of 1856–1860 as many as 200 purebred sheep were exhibited at fairs as a single exhibit.

The first California sheep and wool growers association was organized on September 24, 1860, to promote sheep breeding and wool growing in all its branches and to prevent a monopoly on the wool market of the state. The California Wool Growers Association is the state's oldest agricultural organization.

Sheep numbers increased rapidly from 1860 to 1876. Over six million head were reported in the state, in 1876, producing a wool clip of 56,550,970 pounds. During the period 1880–1890 sheep numbers gradually decreased mainly because of the low price of wool and the competition for grazing lands from other agricultural industries. According to E. J. Wickson's book "Rural California," more than 225,000 sheep were trailed eastward in 1881. During the nineties sheep numbers still continued to decline, and their farm value reached an all-time low of $1.50 per head.

In the decade 1900–1910 conditions for raising sheep remained adverse. In 1906 the U.S.D.A. placed a grazing fee on domestic livestock grazed on the National Forests. Public policy appeared to be against the wool producer.

New interest was awakened in mutton sheep with the outbreak of the World War in 1914, and sheep values increased. In spite of this, during the period 1914–1920 numbers did not expand.

During these different periods, a gradual change took place in sheep breeding, feeding, management, and marketing. At slaughter four- to six-months-old milk-fat lambs of good breeding replaced the aged wether, which had been kept mainly for its wool. With the aid of scientific data, sheepmen began selective breeding for wool and lamb production. Although the American people do not favor mutton, they like lamb. The demand for lambs is such that about 70 per cent of the sheepman's income in California is from this source, while 30 per cent comes from wool.

Between 1920 and 1944 sheep numbers fluctuated from slightly over 2,000,000 to about 3,500,000 head, with a peak population in 1934. From 1944 to 1950 the numbers gradually decreased, reaching a low point of 1950 of only 1,756,000; by the beginning of 1954 there were again 2,034,000 sheep in California, but by January 1, 1966, the number had decreased to 1,511, 000 head.

Among the reasons for the decline from the 1934 peak of production are these: Lands formerly used for sheep have gone into other crops, roads and housing. Other enterprises proved more profitable. Skilled labor has been difficult to secure. Wool prices have been relatively low. Grazing allotments have been reduced, predatory animals and uncontrolled dogs have been a problem, and competition by wildlife, especially deer, for range forage increased. Brush encroachment has reduced the forage available to sheep in the range area.

It is generally agreed that if sheep numbers are to be materially increased, more large farm flocks must be established with management adopting more intensive systems of production.

IS YOUR AREA SUITED FOR SHEEP PRODUCTION?

Before entering the sheep-production business, study your area to determine if it is suitable for such an enterprise. Although sheep raising is carried on in most sections of the state, the largest population is found in the great interior valleys—Sacramento and San Joaquin.

Commercial and farm flocks make up the largest percentage of sheep population but in some areas the purebred business is highly developed.

WHAT BREED TO CHOOSE

Most breeds fall into four general groups —fine wools, long wools, medium wool dual-purpose, and medium wool mutton breeds. Here are the advantages and disadvantages of each group.

The fine wool breeds were selected from the original Spanish Merino and

Breeds of Sheep Grouped According to Wool and Mutton Type
(Breeds most common in California in italics)

Fine wools	Long wools	Medium wool dual-purpose	Medium wool mutton breeds
Rambouillet	*Romney*	*Columbia*	*Hampshire*
Merino	Lincoln	*Corriedale*	*Suffolk*
	Cotswold	Romeldale	Shropshire
	Leicester	Targhee	Southdown
	Border Leicester	Panama	Dorset
			Cheviot
			Oxford

have been the basic type for range-sheep production.

Advantages

- They are rugged—can stand extremes of heat and cold and can exist under unfavorable feed conditions.
- They produce a desirable clip of wool. Fine wool normally sells for the highest price per pound on a clean basis.
- They possess herding instinct—will band together under range-herding conditions.
- They breed early—in April, May, June and July—to lamb in the fall. This is important under California conditions.
- They are long-lived. Many ewes will live to be 10 to 12 years of age.

Disadvantages

- They lack heavy muscling typical of the improved meat breeds.
- Lambs tend to grade lower as carcasses mostly because of poorer conformation.
- Hoof growth is more rapid and more extensive than other breeds so that under conditions of high rainfall and on irrigated pasture frequent trimming is necessary.
- Their wool tends to be high in shrinkage.
- Their dense, finer and somewhat shorter fleeces predispose the animals to fleece rot and fly strike (maggots resulting from fly eggs) in a high-rainfall environment.

The long-wool breeds were developed in England under cool, moist conditions, where feed supplies are favorable. They are not well adapted to most California conditions.

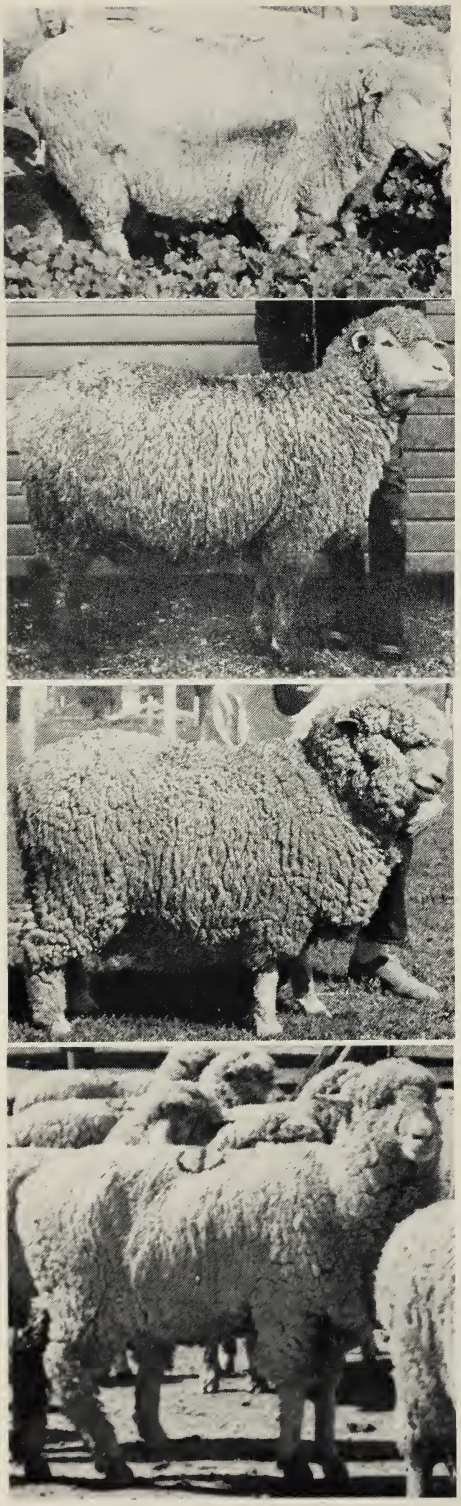
Advantages

- They are large.
- They are rapid-growing (but late-maturing).
- They—particularly the Lincoln—cross well with fine-wool breeds to produce intermediate or dual-purpose sheep.
- Ewes are good milk producers.
- They can stand wet weather, and the Romney breed is said to be more resistant to foot-rot than other breeds.
- They produce a heavy clip of wool, low shrinking and coarse in texture.

Disadvantages

- They are not adapted to hot, dry climate. This limits their usefulness to only a small section of the North Coast area of California.
- They must have an adequate feed supply, and are not so rugged as fine-wool sheep.
- They do not produce such a desirable carcass as mutton breeds.
- Their wool sells for a lower price because coarse wool is in less demand than fine wool (but the increased yield may compensate for the selling price).
- They lack the herding instinct.

Rams. The two principal breeds used commercially with white-faced ewes are Hampshire (left) and Suffolk (right).



The medium-wool dual-purpose breeds were developed by crossing the long-wool breeds with the fine-wool breeds in an attempt to combine the desirable characters of both groups and eliminate as many of the bad points as possible. All these breeds except the Targhee are essentially half long-wool and half fine-wool breeding. The Targhee is approximately three-fourths fine wool and one-fourth long wool. The bulk of the commercial ewes in California are some mixture of the fine-, medium-, and long-wool whiteface breeds.

Advantages

- Their lambs, because of conformation and milk production are improved over the fine-wool breeds, reach market weight at a younger age and are more desirable from the standpoint of carcass.
- The length of staple and the clean weight of wool clip are increased over the fine-wool breeds, but the wool is still fine enough to receive a good price per pound.
- Wool produced is free of black fibers and has desirable quality.
- They maintain the herding instinct of fine-wool sheep.

Disadvantages

Ewes. Breeds used to produce commercial lambs are: Left top to bottom—Columbia, Targhee, Corriedale, Rambouillet; below—Romney.

- They are less rugged than fine-wool sheep.
- Some are smaller than long-wool sheep.
- They will not usually breed so early as fine-wool breeds.

The mutton breeds were developed primarily for their lamb-producing ability. Their principal use under California conditions is to furnish sires for the production of market lambs.

Tests at the University of California Hopland Field Station comparing different breeds as sires of market lambs have shown that lambs sired by Suffolk rams have the most rapid growth rate followed in order by those sired by Hampshire-Suffolk crossbreds, Hampshires, Dorsets, and Southdowns. Dorset cross lambs tend to reach market finish at younger ages, with Hampshire and Hampshire-Suffolk sired lambs also reaching market finish at a slightly younger age and lighter weight than Suffolk crosses. Southdowns reach market grade at the lightest weights, but because light-weight lambs do not command a premium in markets in this country, these lambs return less income than those from heavier breeds.

The mutton breeds are all meat-type breeds tending to be better muscled than range breeds. However, the two types differ little in the proportion of edible meat per pound of carcass. Nor is there much difference in eating quality of the meat from lambs of different breeds, at the same carcass grade.

Because of the increased size of the lambs produced, most commercial lambs in California are sired by Suffolk or Hampshire rams.

Advantages

- Lambs of excellent quality and grade can be produced.
- Ewes are prolific, good milkers and good mothers.

Disadvantages

- Ewes breed late. Very few lambs are born in the fall. Most lambs will be born from December through March.
- Ewes are short-lived.
- Wool clip is light in weight and usually is contaminated with black fiber.
- Mutton breeds will not herd well; they do not have the flocking instinct.

For these reasons it is not recommended that mutton-breed ewes or mutton-breed crossbred ewes be used as commercial breeding ewes.

BREED YOUR OWN REPLACEMENT EWES?

Because most commercial ewes are bred to mutton-breed rams, send all lambs, both ewes and wethers, to market, and replace your breeding ewes from other sources.

Historically, California sheepmen have found it economical to buy replacement ewes from out-of-state breeders. Because good replacement ewes are harder to find, breeders tend to show interest in raising their own replacement stock.

Reasons why some sheepmen produce their own breeding ewes:

- The flock can be improved by a selective breeding program under the direct supervision of the sheepmen.
- Records can be kept on the sheep and replacements saved from only the most productive lines. The sheepman can select for twins, good milkers, desirable fleece, etc.
- Breeding ewes are acclimated, because they are ranged in the same environment in which they are born and reared.
- Breeding ewes are lambing at the same season in which they themselves were born, whereas a ewe

from the Rocky Mountain area born in April may be expected in California to lamb in November.

- By not bringing new sheep onto the ranch each year, the sheepman avoids introduction of diseases or parasites.
- California-bred replacement ewes can be bred as lambs under good management and feed conditions.

Reasons why some sheepmen prefer not to produce their own breeding ewes:

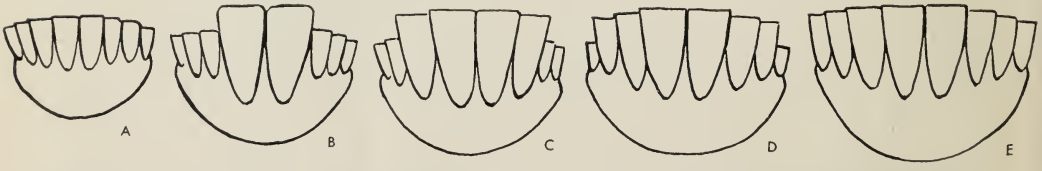
- The sheepman must use two kinds of rams, whiteface rams of the desired breed to produce his replacement ewes, and blackface rams to produce market lambs. The best ewes should be bred to the whiteface rams.
- Lambs marketed are of two types—whiteface wethers and blackface ewes and wethers. Whiteface wethers will weigh slightly less than the blackface wethers.
- Replacement ewe lambs should be cared for in a separate group from the main breeding band. (The breeding of ewe lambs will be discussed on page 45).
- By purchasing replacement ewes as yearlings, breeders may be able to winter more breeding ewes and thus maintain a larger economic unit.
- The cost of breeding replacements on the ranch is probably greater than that of buying them.

HOW TO SELECT YOUR BREEDING STOCK

Ewes. Breeding ewes, regardless of breed, should be large and deep-bodied, standing on straight legs with ample bone and showing some femininity and breediness. Ewes should be free of wool around the eyes to avoid wool-blindness. Wool should be characteristic of the breed, dense, long staple, and moderately fine.

Determine age of ewes by examination of their teeth. At the same time "overshot" and "undershot" mouths can be detected. This is a condition where the incisors fail to meet the dental pad at the correct place. Check ewes that have previously lambed for sound udders; those showing pendulous udders or udders with hard spots may not be able to raise another lamb.

Aged ewes, sometimes called "broken-mouthed" ewes (with some teeth miss-



Frontal views of the lower jaws of sheep of various ages. The upper jaw has no incisor teeth in the front.

A—All of the lamb teeth are small and are temporary. These are shed to make way for the permanent type at later ages.

B—Mouth characteristic of yearlings. The two large teeth in the center are permanent incisors which come in immediately upon loss of the temporary central pair.

C—Two pair of permanent incisors, characteristic of two-year-olds.

D—Mouth of three-year-olds: three pairs of permanent incisors, the temporary pair on each side being much smaller by contrast.

E—Full mouth condition characteristic of four-year-old animals.

At five and six years of age, these permanent teeth wear down and appear more slender with flatter grinding surfaces. At variable ages, depending on breed, teeth begin to spread and loosen through the "spreader," "broken mouth," and "gummer" stages. The latter has no incisor teeth at all. Large growthy animals often replace temporary with permanent incisors earlier than the ages given.

SCORE CARDS USED IN GRADING SHEEP

WHITEFACE DUAL-PURPOSE SHEEP

Size and conformation, 70 per cent	*Per cent*
Weight for age and scale	40
General appearance and breed type	4
Shoulders, chest and spring of ribs	5
Back and loin	3
Rump and leg of mutton	10
Natural fleshing	3
Feet and legs	5
TOTAL	70
Fleece, 30 per cent	
Wool grade (breed considered) and uniformity (all parts of body)	12
Length of staple	12
Density	3
Character (crimp, color of secretions, freedom from hair)	3
TOTAL	30

BLACKFACE MUTTON SHEEP

Size and conformation, 90 per cent	*Per cent*
Weight for age and scale	50
General appearance and breed type	7
Shoulders, chest and spring of ribs	7
Back and loin	4
Rump and leg of mutton	12
Natural fleshing	5
Feet and legs	5
TOTAL	90
Fleece, 10 per cent	
Wool grade (breed considered) and uniformity (all parts of body)	2
Length of staple	4
Freedom from black fiber	2
Belly wool	2
TOTAL	10

ing), can often be bought cheaply, but they will require extra care and attention in order to raise another lamb crop. Since a rather high death rate is to be expected among them, it is risky for a beginner to start in the sheep business with such ewes.

Rams should be purebreds or first crosses of purebred stocks of the breeds desired. Each should be medium-to-large for the breed, with sound feet and legs, wide chest, straight back, and thick hindquarters, and should show masculinity (indicated by a thick, muscular neck, a broad muzzle, and heavy bone structure). Carefully examine the wool of rams to be used as sires of replacement ewes. It should be typical of the breed (rams' wool may be slightly more coarse than that of ewes), and should show length, density, and uniformity of diameter (fineness) over the entire body. The wool on mutton-breed rams is of little concern to the sheepman because all the lambs produced by these rams will be marketed as fat or feeder lambs.

HERITABILITIES OF IMPORTANT TRAITS IN SHEEP

	*Per cent**
Prolificacy (twinning)	10–15
Birth weight	30
Weaning or yearling weight for age	25–30
Type at weaning	10–15
Finish or condition at weaning	10–15
Fleece:	
Face covering	40
Yearling fleece weight	40
Staple length, weaning	40–50
Grade (fiber diameter)	40–50

* Scale: 0–20 = low
20–40 = moderate
above 40 = high

SELECTION METHODS

To improve the production and quality of your flocks, ask your local Farm Advisor for advice and aid in establishing a practical systematic plan.

For many years, sheep have been selected largely on the basis of general appearance, without much consideration of individual records of performance under test or of subsequent production of wool or lamb offspring. Research indicates that selection with higher ultimate performance can be made more efficient by use of a record system for purebreds and a mass selection system for grade sheep. In these systems selection pressure for purely breed characters and classical standards of conformation are minimized and greater emphasis is placed on measuring characteristics that have economic value in commercial production, that is, on increasing the number, amount, and market desirability of the products.

The Sheep Improvement Committee of the American Society of Animal Science is endeavoring to get sheep operators in all states to use uniform selection methods and to emphasize the most important production traits. The following recommendations for selection of California sheep are based on the Committee's findings.

For purebred breeders and farm flocks. The purebred breeder identifies each animal, and keeps a record of sire, dam, and birth dates. Most breeders also keep other records but this varies among operators.

With animals of good breed type, conformation, soundness and health, select primarily for growth rate, prolificacy, fleece weight, wool grade and staple length (the last three emphasized in dual-purpose sheep), smooth bodies without wrinkles, and open faces to avoid wool blindness.

Because the sire has much more influence on flock improvement than any one ewe, evaluate rams more critically than ewes.

In all systems of selection, replace the

existing ewes and rams as soon as superior flock replacements are available.

The score cards on page 7 are used by University of California specialists in evaluating sheep for conformation, type, quality, and character. The grading program also considers quality, density, and staple length of fleece. Its main purpose is to evaluate sheep uniformly in comparison to sheep in general. This evaluation is similar to the system used for grading feeder and fat lambs and to the grading method employed in beef-cattle improvement work.

In addition to evaluating the sheep for conformation and wool, you may wish to keep accurate records on the production of each individual ewe or ram, including fleece weights, birth weights, and weaning weights of lambs. Such data will enable you to cull more effectively.

In conducting such a program you need: a suitable scale for weighing sheep; accurate breeding and lambing records; a flock book with separate record sheet for each ewe; a uniform system of grading each animal; standard record forms to assure uniformity.

It is necessary for you to have an interest in the program and be willing to keep records in cooperation with the farm advisor. The best time to start a record of performance and a grading project is in the spring, usually after shearing.

Culling. Cull any flock of sheep at the start of an improvement program to remove those that have defects serious enough to constitute unsoundness. Also cull all animals with undesirable inheritable traits sufficiently pronounced so that you don't wish to save replacement ewe lambs from such parents. These cull points include such characteristics as evidence of disease, unsoundness because of injury or malformation such as ruptures, bad udders, abnormal jaw formations, unsound feet and legs, extreme lack of density in fleece, poor fleece length, colored fleece in a white breed, extreme coarse fiber, or kempy fleece.

After having removed the culls, you may use the score card to grade the remaining ewes of the flock. For a more accurate system of evaluating and selecting sheep it is necessary to keep more detailed records and use them in an appropriate manner. This is more costly in terms of your time but will result in a greater rate of improvement.

Correction factors. Lambs are born at different times and are weaned at different ages; twin lambs grow at a slower rate than singles; ram lambs grow faster than wethers or ewes; two-year-old ewes (first lambers) no not produce as heavy lambs as do mature ewes. These differences make it impossible to compare production among ewes so that either sires or dams can be rated as to productivity unless appropriate correction factors are used. Correction must be made for age, type of birth (twin or single), type of rearing (reared as single or twin), maturity of dam, and sex of lamb.

Where adjustment of records is made solely for accurate selection of individual animals, a simple procedure is to select within sex, twin or single, and yearling or mature ewe group. By listing lambs from such groups separately and selecting equal proportions of each, adjustment is accomplished automatically. Selection for twinning, which is recommended, can be accomplished by selecting a higher proportion of twins than of singles.

Because growth rate of lambs is so variable by area, use multiplicative rather than additive corrective factors. Correction to ewe lamb, 120 days of age, single birth, and mature-dams status is most practical for overall use because purebred operators commonly produce few wethers and commercial operators few rams. Productivity records should be readily comprehensible and comparable for these two types of operator.

If you have sufficient numbers of animals, get the correction factors within the current year from the flock being selected. Where sufficient numbers are not

available three or more years' records can serve to establish corrections. Use the table on page 00 to make these corrections for all except age.

Age correction can be made for lamb weights by weighing lambs as near as possible to 120 days, dividing the age in days by the actual lamb weight, and multiplying the answer by 120. Thus, the final answer becomes the adjusted weight for age at 120 days. Birth weights of lambs in such calculations are ignored because the sheepman is primarily interested in the lamb weight at selling time and not in the proportion of that weight gained after birth.

In comparing records from different sires or dams, it is imperative that such records be from animals reared in the same flock, on the same ranch, and under similar conditions of management and feeding. Creep feeding part of the flock, for instance, will result in higher production records for such animals unless this is taken into account by an additional calculated correction.

Recommended Multiplicative Factors for Adjusting 120-Day Weights to Ewe Lamb, Single, Mature Dam Basis*

Sex of lamb	Type of birth	Age of dam	Farm flocks Multiplicative Factors	Range flocks Multiplicative Factors
Ewe	Single	Mature	1.00	1.00
Ewe	Single	Two year	1.07	1.07
Wether	Single	Mature	.95	.95
Wether	Single	Two year	1.02	1.02
Ram	Single	Mature	.88	.88
Ram	Single	Two year	.94	.94
Ewe	Twin	Mature	1.13	1.18
Ewe	Twin	Two year	1.21	1.26
Wether	Twin	Mature	1.07	1.12
Wether	Twin	Two year	1.15	1.20
Ram	Twin	Mature	.99	1.04
Ram	Twin	Two year	1.06	1.11
For twins reared as singles				
Ewe		Mature	1.06	1.09
Ewe		Two year	1.13	1.17
Wether		Mature	1.01	1.04
Wether		Two year	1.08	1.11
Ram		Mature	.93	.96
Ram		Two year	1.00	1.03

* Data derived from a large number of studies conducted at the University of California and elsewhere.

Weight and productivity ratios. Once the records are corrected, measure lamb productivity per ewe by the corrected total lamb weight produced per ewe. This method puts heavy emphasis on selection for twinning, which is desirable. This measure can be made more meaningful if used as a weight ratio. First, determine the mean productivity for the flock; then divide the productivity of each individual ewe by the mean productivity of the flock to get the percentage of deviation or the difference of each ewe from the flock mean. Thus if the mean lamb productivity of the flock is 80 pounds and one ewe produced twins and

a total of 140 pounds of lamb on a corrected basis, her productivity weight ratio is 175 (140 ÷ 80 = 175).

If you take individual fleece weights at shearing, establish a combined productivity ratio based on an index for production of lamb and wool—one times total corrected lamb weight plus three times wool weight. Determine the productivity ratio for each ewe in the flock. Then divide the combined ratio of individual ewes by the mean combined ratio from the flock, to get the individual ewe's percentage of deviation from the mean of the flock on this combined index.

Use of a current figure for average value per pound of live lamb (e.g. 25¢) and for wool (e.g. 60¢) will help you arrive at a dollar value of this production.

Sire progeny group summaries can be compiled from progeny data where a number of individual sires are separately mated to comparable groups of ewes. Where ewes are not randomly allotted to individual rams, accurate evaluation is not possible because dam influences may prejudice findings in favor of one or more sires among those tested. Use at least ten ewes per sire mating group to insure sufficient progeny.

Sire evaluation. The desirable genetic potential of sires can be evaluated by different procedures. These are, in order of increasing intensity and accuracy: pedigree; visual appraisal including show winnings; performance testing, or measurement of the individual's own performance; and progeny testing, or measurement of progeny performance. The latter may include only growth rate and conformation score, but for maximum value should also include carcass evaluation.

The following data are considered a minimum for an evaluation procedure for rams:

1. Sire number.
2. Breed designation.
3. Whether derived from a breeding line with a history of twinning.
4. Type of birth.
5. How reared, single or twin.
6. Grease weight of fleece produced at 200 days of age (for whiteface breeds).
7. Weight per day of age to 200 days from birth. Weight per day of age to yearling is slightly more desirable, but does not allow the sire to be bred as a lamb after testing.
8. Use of the seventh-rib probe as an estimate of carcass fatness. The seventh-rib probe measurement is taken with a needle and measures the distance from skin surface to rib surface over the seventh rib about half way between top of the back and the chest floor immediately behind the shoulder.
9. In the absence of further testing procedures, place primary emphasis in selection on sires from twin-producing lines, those with maximum growth rate, and—among high growth-rate rams—those with less fat.

The University of California is conducting a sire testing program in cooperation with interested breeders. Contact your county Farm Advisor for aid in this program.

MASS SELECTION FOR COMMERCIAL SHEEP

Publication AXT-178, ABC System of Selection Replacement Ewes, is available from your County Livestock Farm Advisor who can aid you in sorting ewes and starting this selection system. The publication gives a detailed description of the system.

Briefly, ewes are divided into three groups:

A-group ewes are physically sound and chosen for large size, open faces and sturdy appearance with good conformation, evidence of vitality, and smooth, unwrinkled bodies. The wool is without colored or off-fiber such as kemp or coarse hair, and is uniform in fleece grade over the body. The fleece is dense, long in staple, and of the desired grade.

Open-faced ewes (right) produce more lambs and pounds-of-lamb per ewe per year than those with closed faces (left). This is true even where wool-blind ewes have had their faces shorn periodically throughout the year.

B-group ewes are similar to the above but lack one or more of the desired characters.

C-group ewes are unsound or so poor in one or more characteristics that they should be culled.

Once graded, the groups are branded or eartagged separately; colored plastic eartags are useful.

The A group is bred to the best rams of the desired breed available to you, and a maximum number of replacement ewe lambs are saved from these ewes. Where more replacements are needed, add the best ewe lambs from B group. Producers commonly segregate twins at lambing to make up a separate flock. Where this is done, or twins are otherwise identified, it is recommended that twin origin be emphasized in replacement ewe selection.

B-group ewes are bred to the next best rams, and C-group ewes are bred to blackface rams, with all offspring sent to slaughter.

In subsequent years and as opportunity allows, the original C-group ewes are sold and replaced by more desirable animals.

Various refinements of this system are possible. For instance, all ewes can be eartagged by individual number and individual fleece weights can be recorded.

After a number of generations and where sufficiently high-merit purebred rams are not available from purebred breeders, an additional group called the supers can be selected from among A-group ewes. This super group can then be used to produce rams for use as flock sires. For this step the number of ewes in the operation should be large enough to avoid serious inbreeding. At least five and preferably eight to ten sires should be used in the ram-producing flock.

Animals with an overshot jaw do not do well and should be culled from the breeding flock because this character is hereditary.

Large, well-built ewes—part of Ken Sexton's super flock, at his Stone Valley Ranch, west of Artois.

CROSSBREEDING

Most sheepmen follow the practice of crossbreeding in at least a portion of their operations. They usually breed whiteface ewes of various breeds or crosses to blackface mutton-type rams, to produce market lambs. Results of these matings have been excellent.

Results of crossbreeding trials by the U.S.D.A. as well as by various experiment stations, including that in California, indicate that crosses between closely related breeds do not perform appreciably better than the average of the parental crosses. On the other hand, widely different breeds, such as the Lincoln and Rambouillet, can be crossed to advantage.

The greatest benefit has resulted when crossbred mothers have been used in production. The superiority due to crossbreeding is usually most pronounced in traits that are little influenced by heredity, such as increased vigor of the lamb, or increased mothering by the ewe resulting in more and heavier lambs at weaning. Some trials have shown higher condition scores for the crossbred offspring and greater wool production than for parental lines.

Where the sheepman raises his own replacements, the most practical method of crossbreeding is probably crisscrossing.

The crisscross method requires that you keep two flocks of ewes separate during breeding and also at lambing unless each lamb can be eartagged at birth to indicate flock origin.

The two flocks, A and B, are set up as follows: Flock A is mated each year to one particular breed of rams, breed X, and flock B to a second breed of rams, breed Y. Each year replacement ewes for flock A are chosen from the ewe lamb offspring of flock B and those for flock B must come from flock A. If this is continued for four flock generations (complete flock replacement each time) the ewes of flock A become 2/3Y 1/3X, while ewes from flock B are 2/3X and 1/3Y. If the system is continued, the breed contributions will remain stable in those proportions.

A three-way rotational cross of the theoretical breeds X, Y and Z can be set up in a similar manner. Here three separate flocks are required—A, B, and C. A is bred to X rams, B to Y, and C to Z.

Replacement ewe lambs for flock A come from flock B ewe lambs, B from C, and C from A. Within four flock generations A flock becomes 4/7Y, 2/7Z and 1/7X, B flock becomes 4/7Z, 2/7X and 1/7Y, and C flock will stabilize at 4/7X, 2/7Y and 1/7Z. As with the two-way cross, these proportions will remain stable as long as the system is continued.

The original breeding of the ewes in the flocks at the start of either of these systems becomes unimportant within four flock generations as by that time it will be almost completely replaced by sire-breed influence. For either of these systems, as well as other crossbreeding systems, only excellent sires from the various

Broken-mouth ewes sturdy enough to produce another lamb crop if provided with excellent feed and care.

breeds should be used. Genetically poor sires cannot be made to produce excellent offspring through the use of crossbreeding.

Because crossbreeding results in a blending of the characteristics of the parental breeds as well as in hybrid vigor, use only breeds desirable in all important production respects, or you will sacrifice some trait important to production.

SHEEP RAISING AS A BUSINESS

THE PROS AND CONS OF SHEEP RAISING

Before you go into the business of raising sheep, you will want to study the costs of production (see pages 18 to 20) and the possible income on farm flocks and range flocks.

Consider these advantages of sheep-raising as a business:

Sheep produce two crops each year—lamb and wool.

Returns come relatively fast. Ewe lambs can be bred to lamb as yearlings. Lambs are marketed young—at four to seven months.

Sheep utilize roughages as their primary feed supply. They do not need large amounts of purchased feeds.

Lambs will fatten on good pasture alone, without any supplemental feed.

Sheep are easily handled and moved.

Equipment and shelter can be relatively simple and inexpensive.

Sheep can aid in a weed-control program and reduce the fire hazard on the ranch or farm.

The disadvantages of sheep raising are:

Sheep are naturally defenseless and, unless protected against their enemies, severe losses will occur from stray dogs and predatory animals, such as coyotes, bobcats, and bear.

Sheep, like other animals, are subject to external and internal parasites which will cause losses unless the shepherd remains alert.

Sheep must either be watched continually by a herder or pastured in fields that are fenced "sheep-tight" (with a woven-wire fence).

Foot troubles will occur if sheep are forced to stay on muddy, wet ground.

In general, sheep require more attention and labor than do cattle.

CALIFORNIA'S SIX TYPES OF SHEEP OPERATIONS

Range commercial sheep—herded. Sheep are operated in bands of from 500 to 2,000 and are constantly under the care of a herder. They utilize desert and mountain ranges and may pasture alfalfa, irrigated pasture, grain fields and beet tops. Available range is nearly all utilized by present operators.

This type of operation is a specialized business requiring experience and skillful management.

Range commercial sheep—fenced pastures. Sheep are grazed in fenced fields of varying size. The land is owned or on long-term lease. This operation requires large initial investment, but a comparatively lower cost of operation.

Ewe lamb operation. The ewe lamb operator imports ewe lambs from out of state in late summer and fall, winters them over and resells them to other sheepmen after spring shearing. He may also act as a dealer by buying ewe lambs out of state on orders from California sheepmen for direct delivery. For this enterprise you must have range or pasture available, be well financed and be skilled in buying and selling animals.

Purebred sheep. The primary source of income from a purebred flock is through the sale of rams to commercial sheepmen. This enterprise requires the ability to select desirable breeding stock and facilities, particularly feed supply, and to keep animals in desirable condition at all times. Commercial sheepmen demand high-quality, well-grown rams. A beginner should not start in the purebred business. It is much better to gain experience first with commercial sheep.

The farm flock. This enterprise may vary from a few head to a few hundred sheep on a farm. In this case sheep are usually only one source of income. Thirty to forty breeding ewes is considered a minimum economic unit. The farm flock owner must be prepared to spend some time with his animals during the critical lambing period though this usually occurs during a normally slack season.

Fattening feeder lambs. Most feeder lambs are fattened on irrigated pastures in the Sacramento, San Joaquin, and Imperial valleys. This operation will be discussed under lamb fattening, on pages 75 to 80. A smaller number of lambs are fattened in feedlots on dry feed.

HOW TO START A SHEEP ENTERPRISE

If you want to start a sheep enterprise, you should, in addition to liking sheep and having some experience with them, consider the following questions.

- Is a source of feed available for every month of the year?
- Are fences "sheep-tight"?
- Are there facilities for caring for sheep at lambing? At shearing?
- Can the sheep be kept out of mud during wet weather?
- Are dogs and predators likely to be a serious menace?

You can establish a farm flock in several ways. A start with bummer lambs (young orphans) from some recognized breeder may enable you to begin on a small scale with a very small investment. Fair-sized enterprises have eventually developed from bummer lambs used in projects by 4-H Club and FFA members. The care and feeding of these is discussed in the section on calendar of operations.

Healthy, thrifty, well-bred, broken-mouth ewes can also be used to start a farm flock. Ewes of this kind, culled from range bands, are sometimes available on the market at reasonable prices. If given proper feed and care, such ewes will often raise another lamb crop or two. Do not

buy ewes that are too old, because the death loss is apt to be high.

Occasionally owners are obliged to sell their breeding stock for various reasons. They are likely to sort their ewes for sale, as for instance yearlings, running ages (two to five years) and solid mouths (six years or older but with all the teeth solid in the mouth). The latter may be priced very reasonably at 50 per cent or more of the value of yearlings. Such ewes, if sound and strong, are of maximum fertility and, with good feed and care, may produce several more lamb crops.

A small flock of well-bred ewe lambs, yearlings, or two-year-old grade ewes will need less care and attention than the above groups. The initial cost will be greater, but in the long run they may be the cheapest buy.

HANDLING SHEEP

Whenever you have to handle individual sheep, enclose the flock or band in a small corral. A beginner often makes the mistake of placing a few sheep in a big enclosure. This is hard on both the sheep and the sheepman.

Do not catch a sheep by the hind leg. The animal will fight in this position, and you risk crippling it by pulling the hip out of the socket. Catch the sheep by grasping the rear flank just in front of the stifle joint. By lifting slightly, you can immobilize the animal without any great struggle. The other correct way is to catch the sheep by the head.

A sheep hook or shepherd's crook may be used in large bands for catching ewes on the open range. Use it only when absolutely necessary, because you may cripple the sheep by careless handling.

Once the sheep is caught, hold it by placing one hand under its jaw near the mouth and the other hand behind the head or on the rump just above the dock. If the sheep tries to go forward, lift up on the chin and place your knee in front of the brisket. If it tries to back up, put pressure on the end of the dock.

Never, under any circumstances, pull on the wool! This results in pain to the sheep and will only cause it to fight more.

PREDATOR AND DOG CONTROL

Agencies responsible for controlling predatory animals and sheep-killing dogs are numerous in California. For example, a large number of counties have cooperative predatory-animal agreements with the United States Fish and Wild Life Service and the California Fish and Game Department. A check in 1966 showed that 40 Califorina counties were operating under this cooperative agreement with these two agencies.

In a few counties, a predatory-animal control is handled directly by the county government through the Board of Supervisors. Some counties do not work under a paid hunter and trapper system but funds are appropriated on a county basis for the payment of bounties on predators.

Where sheep losses have occurred from sheep-killing dogs, a few counties have organized strong, workable dog ordinances. Under this control system an efficient, alert poundmaster is employed. His job is to see that all dogs are licensed each year, to impound unlicensed dogs, and to determine the ownership of dogs that are found harassing, wounding, or killing sheep.

The headquarters of the poundmaster vary. Some work out of the county sheriff's office, others with the agricultural commissioner. Some have their own offices within the county government.

California has a fine dog law, and all sheepmen should be familiar with its provisions. A copy of this law can be obtained from the California Wool Growers Association, 3382 El Camino Avenue, Suite 6, Sacramento, California 95821.

In addition to making use of the state and county government program for predatory-animal control, individual sheepmen may hire capable hunters and

trappers. In some areas several sheepmen cooperatively employ hunters and trappers. Other sheepmen may pay bounties to hunters for animals that kill sheep. Still other do their own hunting and trapping.

If you suspect sheep losses to be from predatory animals or dogs, get in touch with your local trapper, hunter, or poundmaster. In case you do not know how to reach these agents, you can contact your local Farm Advisor or local wool growers association for information.

MARKETING LAMBS

California is in a favorable position for marketing her lamb crop. Because of mild winters, growers are able to finish and market lambs during the months of April, May, and June. Because lambs are usually in short supply at that season, the price is generally higher than after July 1.

During these spring months, California lambs are exported to eastern markets to relieve the surplus. A total of 119,000 head were shipped in 1964 and 52,000 in 1965. During the remainder of the year, California is a deficit area, and large numbers of lambs are shipped into the state, both for immediate slaughter and for fattening before slaughter. In 1965 1,274,000 sheep and lambs were shipped in from out of state.

PRODUCTION COSTS

Because sheep return two incomes per year (wool and lamb) many people may become overenthusiastic about the profit in sheep raising. Before investing in the sheep business, you had better become familiar with certain costs of production and expected returns.

Successful sheep raising is largely dependent on sound, progressive management such as correct breeding, feeding, and marketing practices. The chief profit-determining factors are:

- Quality and quantity of lambs and wool.
- Prices received for lambs and wool.
- Annual costs per sheep.

Production costs and the returns from a sheep operation both vary, within each sheep-producing area and also from ranch to ranch. It is, therefore, difficult to present definite cost-and-return data.

The information on costs and income (pages 18 to 20) can be used as a guide (using current and local prices) when figuring costs, incomes, and investments. If an income falls below these estimates, a careful analysis of the management becomes necessary.

In studying the income and expense statement you see that the big cost item is feed, which includes both raised and purchased. Next largest cost is labor. On the other hand, the largest income is from lamb, followed by wool. Therefore, if net income is to be materially increased, you must try to keep feed and labor costs low, and increase the quality and quantity of lamb and wool produced.

SHEEP PRICES VERSUS CATTLE PRICES

Prices are favorable for sheep production, as compared to cattle. For example, it is usually assumed that a beef steer will put on 300 pounds of gain during a pasture season. If at least four ewes can be managed on the same amount of pasture as one steer, the four ewes on good feed comparable to the feed producing 300 pounds of beef should produce four 90-pound lambs, or 360 pounds of meat. In addition, these four ewes should also produce at least 32 pounds of wool. According to present-day estimates, this would be equivalent in value to 80 pounds of lamb. Thus,

1 steer produces 300 pounds gain,
4 ewes produce 440 pounds gain.

At present, prices of grass-fed cattle and lamb are about the same. With range or pasture conditions adaptable to either, sheep are usually more profitable than cattle.

Farm Sheep Flocks—100 Ewes

Production Data

Ewes—5 per cent mortality, 15 per cent culled—20 lambs kept as replacement ewes
Lambs—120 per cent raised
Rams—One per 25–50 ewes. Purchase replacements as necessary

Sample Income and Expense Per 100 Ewes

Income			
Lambs sold, 100 head @ 90 lb—9,000 lb @ 20 cents		$ 1,800.00	
Ewes sold, 15 head @ 120 lb—1,800 lb @ 05 cents		90.00	
Rams sold, 1 head @ 150 lb—150 lb @ 03 cents		4.50	
Wool, 1,000 lb @ 62 cents		625.00	
Total income			$ 2,519.50
Expense			
Replacement ram, one		100.00	
Pasture:			
Natural range 50 acres—400 hd months @ 60 cents	$240.00		
Irrigated pasture 15 acres—500 hd months @ $1.20	600.00		
Stubble 25 acres—200 hd months @ 40 cents	80.00		
Total pasture	920.00		
Hay, 60 days @ 3 lb—9.0 tons @ $30	270.00		
Grain for lambs, 30 days @ ¼ lb—750 lb @ $3.00	22.50		
Salt and mineral, 600 lb @ 02 cents	12.00		
Total feed		1,224.50	
Shearing and wool bags, 103 hd @ 60 cents		62.00	
Taxes and miscellaneous		150.00	
Labor, 300 hr @ $1.40		420.00	
Investment and Depreciation			
	Original cost	Depreciation	
Buildings and fences	$ 800.00	$ 40.00	
Equipment	300.00	30.00	70.00
Stock—100 ewes and 3 rams	2,800.00		
Land for corrals and sheds	500.00		
Interest, 5 per cent on $3,850*			192.50
Total cost			2,219.00
Net profit			$ 299.50

* Based on half the original cost of building and equipment and original costs of other items.

COST AND INCOME

Farm flocks. The table on page 18 shows a cost and income summary for a sample farm flock operation. In actual operations of such a flock, the owner usually decreases feed costs by using unsalable crop residues and homegrown feeds such as grains and hays. Labor charged here commonly represents odd hours of effort by the owner or members of his family. Buildings and equipment often are existing structures on the ranch not otherwise in use or used only in part for the sheep. The savings available from such items plus the fact that interest is a return to the owner where capital is not borrowed, may greatly increase the profit from such an enterprise. Gross income can be increased considerably by producing more lambs, by more intensive care, and by carrying lambs to greater weights.

Range Sheep Flock—1,000 Ewes

Production Data

Ewes—7 per cent mortality, 18 per cent culled, 250 ewe lambs kept as replacements
Lambs—90 per cent raised—all from mature ewes (120% of lambs from 750 mature ewes)
Rams—one per 30 ewes

Sample Income and Expense Per 1,000 Ewes

Income			
Lambs sold, 650 head @ 85 lb—55,250 lb @ 20 cents		$11,050.00	
Ewes sold, 180 head @ 120 lb—21,600 lb @ 05 cents		1,080.00	
Rams sold, 6 head @ 145 lb———870 lb @ 03 cents		26.10	
Wool, 10,000 lb @ 62 cents		6.200.00	
Total income			$18,356.10
Expense			
Replacement rams, 7 head @ $100		700.00	
Feed:			
Range, 1500 acres—10,000 hd months @ 60 cents	$6,000.00		
Stubble 250 acres—2,000 hd months @ 45 cents	900.00		
Hay, 30 days @ 3 lb—45 tons @ $30	1,350.00		
Grain, 30 days @ ½ lb, 7.5 tons @ $50	375.00		
Salt and minerals, 3 tons @ $35	105.00		
Total feed		8,730.00	
Horse, 1 @ $100		100.00	
Dogs, 2 @ $25		50.00	
Truck, 2,000 miles @ 07 cents		140.00	
Taxes and Miscellaneous		1,500.00	
Shearing and wool bags, 1,030 hd @ 60 cents		618.00	
Labor, 2,500 hours @ $1.40		3,500.00	

Investment and Depreciation

	Original cost	Depreciation		
Buildings	$ 5,000.00	$250.00		
Equipment	2,000.00	200.00		
Stock Ewes, 1,000 @ $25	25,000.00		450.00	
Rams, 33 @ $100	3,300.00			
Land for corrals	1,000.00			
Interest @ 5 per cent on $32,800*			1,640.00	
Total expense				17,428.00
Net profit				$ 928.10

* Based on half the original cost of buildings and equipment and on original cost of other items.

Range sheep. The table on page 19 shows a cost and income summary for a sample range sheep flock operation with an excellent percentage of lambs reared. To an actual range sheep operator expenses seem exhorbitant and he will use every opportunity to reduce costs. Feed is purchased either as pasture, hay, or grain at the most reasonable price available. Hay and grain may be purchased and held partly for insurance against a critical range-feed shortage. If not used one year, it is held over for the next year. As much as possible of the labor is furnished by the owner and his family, and with some of the 1,000-ewe operations no labor is hired at all. Buildings and equipment are kept up by home repair. Where

the owner is not borrowing money for capital investment items, the interest is a return to him. Such practices, as mentioned above, can contribute considerably to the profitability of a range sheep operation. The operator may also increase gross income by rearing more lambs and to greater weights. Purchasing replacements rather than rearing them at home may allow more mature ewes to be ranged, thus allowing production of more lambs. Increased lamb production may also result from range improvement practices such as brush removal, reseeding, and fertilization.

If this example operator were able to purchase good replacement yearling ewes, of the type desired, at $30.00 per head rather than rear his own, he could expect the following:

The purchased yearling ewes would produce approximately 90 per cent of lambs weighing 75 pounds each at selling time. Yearlings tend to lamb later and produce less milk so lambs are lighter. The result would be 225 more lambs, or 16,875 more pounds of lamb, worth $3,375.00.

The owner would now sell 1,125 lambs (900 of these from the 750 mature ewes) and 76,500 pounds plus 16,875 pounds for a total of 93,375 pounds of lamb, worth $19,675.00. This is $8,625.00 more than his lamb income projected in the table on page 19.

Cost increase due to the $7,500.00 annual cost of yearlings plus $125.00 (5 per cent interest on this investment) would bring the total cost increase to $7,625.00.

The net result, therefore, would be $8,625 minus $7,625, for a total net profit increase of $1,000.

If he continues the procedure assumed in the table on page 19, but breeds his ewe lambs, he can expect them to produce a 70 per cent lamb crop weighing about 70 pounds at market. At 18 cents per pound this amounts to $980.00 in net profit. But ewe lambs require even more careful lambing management than yearlings.

Rearing your own replacements allows you to select for twinning and for growth rate as well as for fleece production and other traits. You usually will not be able to purchase replacements having the desired level of these characteristics.

SPACE AND EQUIPMENT

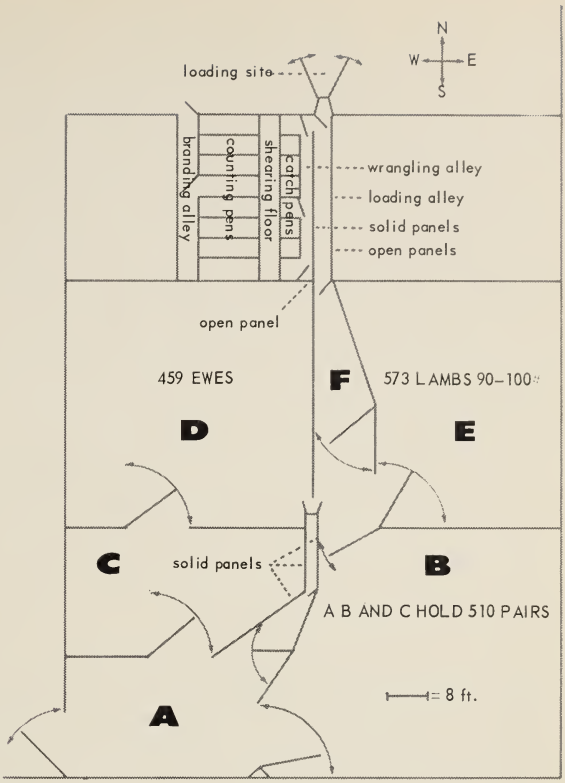
Land space and requirements for breeding ewes

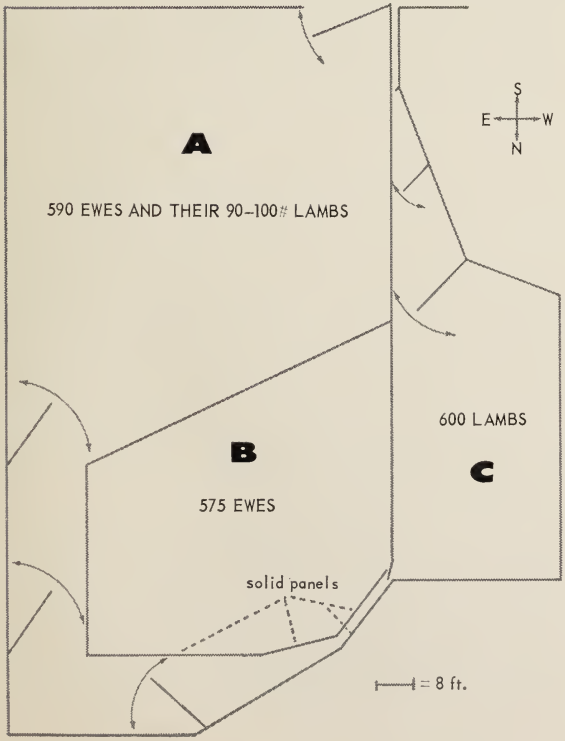
Ranges and cultivated fields vary in carrying capacity depending on brush or rock cover, depth, fertility, rainfall, temperature, and plant type. Nevertheless, it is useful to have some concept of expected land needs.

The best California native grassland—usually open rolling burr clover range—will carry a maximum of one ewe per acre or $\frac{1}{5}$–$\frac{1}{7}$ of an animal unit. In hilly to mountainous areas where brush is present in varying amounts, 2½ acres per ewe may be characteristic of the better range. Similar but poorer range may require 5–7 acres per ewe.

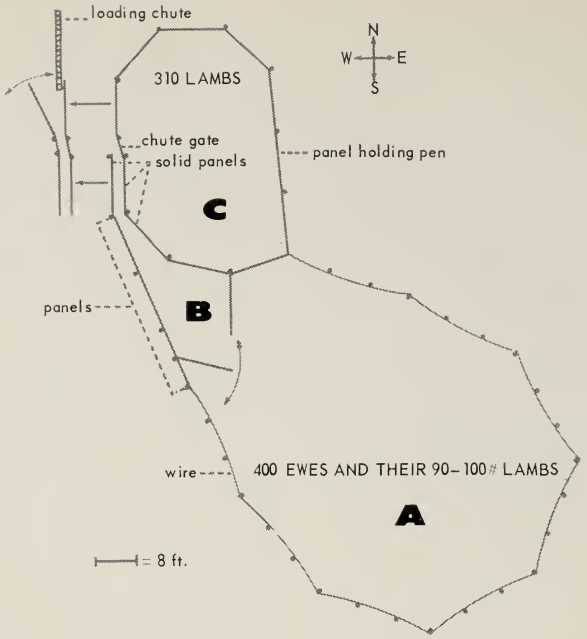
Good irrigated pasture, as in the Sacramento Valley, may carry two ewes per acre during the winter and, depending on fertilization and stand, six ewes or more per acre during the summer. However, ewes on such pasture become heavily parasitized unless treated periodically, and they also tend to become overfat. Breeding performance may be reduced in summer feeding. Land value for other crops usually makes the use of irrigated pasture uneconomical for feeding ewes throughout the year. Stocking rates for fattening

Permanent corral for small ranches where space is at a minimum. In the corrals shown, 6 sq ft per animal are allowed for breeding ewes heavy with lamb and in the wool. The sheepman's maximum space needs for dry ewes of large type are about 5 sq ft per ewe. Extra space for larger holding pens is recommended, to be figured on the basis of twice the number of ewes owned times 5 sq ft. Ideally, the sorting chute should run north so that any time of the day the sheep passing through will not face directly into the sun.





Permanent corral for more extensive holdings where space is not at a premium. Note that the curved chute runs southwest indicating that it should be used in the morning because the position of the sun by mid-afternoon will make its use difficult. The fact that the sheep enter pen A from the south will make them pass through the chute more easily in trying to return south. In such structures, livestock scales may be set up on an alternate route to the loading site as lambs pass from pen C to the truck.



Temporary corral may be set up in short order where corral facilities are not available. The approach pen B, chute, and at least most of the holding pen C should be made out of panels which should be lightweight and strong. They are best constructed of ¾-inch resawed fir. Uprights on the panels should all be on one side. This makes for easier transport and loading on pickup trucks. The remainder of the corral is constructed of woven wire and should be double-decked on 5½ or 6 ft steel posts. Because most of the pressure against this fence will come from the inside, twice as many steel posts are used on the outer perimeter as inside the corral. The posts are zigzagged after both ends of the wire are tied solid in order to tighten the wire. The upper deck can be woven on the posts with occasional ties of short pieces of baling wire between upper and lower deck.

lambs are covered in the section on lamb feeding.

Develop an overall sheep-handling plan

Among the best investments a sheepman can make is well-planned sheep equipment such as corrals and other handling devices that will save labor and cut shrinkage to a minimum. No one plan is suitable for all ranches. However, certain features and construction details might be usable on any ranch.

A good, practical set of corrals and equipment should make it possible to sort, brand, mark, load, unload, weigh, spray, shear, and treat sheep. Drinking water should be in or near the corrals. Shade and weather shelters are desirable in some areas. Valuable equipment should be strongly built and painted to preserve the material.

Corrals and structures should be arranged for convenience and be laid out and planned to be economical and serviceable. In selecting a site for corrals and equipment, choose a location, if possible, in the center of the ranch operation.

This will reduce the distance of movement of stock. The area should be well drained and the soil of sandy texture.

The loading chute

Locate the loading chute so large trucks and trailers can reach it easily at any time of year. After you have selected the site for the chute, the corral and other equipment can be built around it. For ease in working sheep through chutes, they should if possible face north and uphill. Sheep do not drive well toward the sun.

Corral space

For corral construction take into account the desirable space allotment for different classes of sheep to be held in a particular pen for several hours or overnight. For ewes in the wool and heavy with lamb, allow 6 square feet per animal; for dry ewes recently shorn, 5 square feet; for 100-pound wooled lambs or with No. 1 pelts, 4 square feet. Build the largest pen to accommodate the largest number you plan to have in one flock. This would be up to 2,000 dry ewes for large operators, or a specified number of ewes and 100-pound lambs for small-flock owners. Make outside fences or paneling 5 feet high, inside pen fences 4 feet high. Keep chute sides at least 36 inches above ground level and, like the chute approach pen, of solid panel construction. Panels used for movable corral construction are best made from tough Douglas fir ¾ inch resawed boards, 6 inches wide, with uprights on one side only to facilitate loading and hauling.

SPACE REQUIREMENTS FOR SHEEP IN TRUCKS AND TRAILERS

Net weights (loaded off pasture or feedlot)	Space per animal
Pounds	*Square feet*
55–60 (wooled lambs)	2
55–60 (recently shorn lambs)	1.8
70 (wooled lambs)	2.3
75 (recently shorn lambs)	2.2
90–100 (wooled milk lambs)	2.6
100 (fed lambs No. 1 pelt)	2.6
110 (fed lambs No. 1 pelt)	2.6
110 (fat ewes No. 1 pelt)	2.8
120 (ewes No. 1 pelt)	3
130 (ewes No. 1 pelt)	3.2
125 (wooled ewes)	3.3
135 (wooled ewes)	3.4
145 (heavy wooled ewes to start lambing in ten days)	3.7
115–120 (pairs of wooled ewes with 100 per cent of 50 lb lambs)	3.9

Note: For railroad stockcars add .1 square foot to the individual space requirement for each category above. Trucks and trailers come in various bed lengths. Commercial livestock trucks are about 7 feet 8 inches inside bed measurements. Railroad stockcars are either approximately 40 or 36 feet long with width varying from 8 to more than 9 feet. Car size is printed on the side of the car. Both trucks and railroad cars may be double-decked. A few commercial trucks have a small basket deck beneath the bed.

Slatted-floor housing

Slatted floors for sheep production within open-type or completely enclosed structures have been investigated in the United States and Great Britain. Such structures have been used where ewes are confined continually through breeding, gestation, lambing, and lactation, and also for early weaned lambs being finished for market. Space recommendations have varied from trial to trial. The University of Illinois has used 20 to 24 square feet of floor space per ewe and lamb, while Virginia Polytechnic Institute has recommended 14 square feet. The University of Illinois has found 4 to 5 square feet of space sufficient for weaned lambs.

Movable slatted floors, for better cleaning, are 3 to 4 feet above ground and are constructed of wood or metal, usually in 4×8 or 4×5 foot sections. Slatted floors are commonly of oak, treated wood, or metal. Slats in wooden floors are 2×2 inch, in metal floors 1½ inch wide with ⅝ inch spacing. Virginia Polytechnic found expanded metal floors ⅛ inch thick with $\frac{9}{16}$ inch × ⅝ inch diamond shaped holes most desirable. This material is purchased in 4 foot widths and 8, 10, or 12 feet long.

Sheep shelters

Low-cost shelters, placed on the bedding ground, will provide protection from the rain and wind for the young lambs. See University of California leaflets 118 (A Plastic-Roof Sheep Shelter) and 186 (Plywood Sheep Shelter) for more information.

It has been shown that many lambs can be saved if shelter is provided at night. A lamb that has a chance to dry off and regain normal body temperature will feel more like following his mother the next day.

Saving one or two lambs per hundred ewes will pay for the shelter.

Scales

Scales are essential for many sheep ranches. Operators say they pay for themselves the first year.

Locate scales so that movement of sheep is cut to a minimum. Arrange the plan in such a way that sheep can be worked in adjoining corrals without passing over the scales. The only time animals should cross the scales is when they are being weighed. The scale pen should be slightly smaller and attached to the weighing platform.

The feed yard

The feed yard should provide labor efficiency, good drainage, and protection for both feed and animals from weather.

Gates should be large enough to allow the use of mechanized equipment for feeding animals, and for cleaning corrals and equipment. Allow 20 square feet of corral space and 1 foot of manger space for each lamb.

Sheep dogs

One of the most important single items of equipment on a sheep ranch is a well-

MINIMUM SPACE REQUIREMENTS FOR SHEEP

Animals	Manger or feed rack	Self-feeder	Trough per head		Sorting chute width	Feedlot outside	Under shelter
			Water	Salt			
	Inches					*Square feet*	
Feeder lambs	12	4	.4	.3	16	20	8
Ewes	14	4	.3	.3	17	20	12
Rams	15	4	.35	.3	18	20	12

Reg Griffin's sheep dog "Moss," demonstrating the high degree of training required to have the dog work quietly and easily without undue disturbance.

trained dog. It is difficult to operate a sheep enterprise of any appreciable size without such help. When moving a flock, a dog well schooled in the fundamentals of working and handling sheep is more valuable than several men. On the other hand, a poorly trained dog, one that will not respond to commands, or one that lacks the natural ability for working sheep, is useless and can cause much damage and loss to the flock.

Training sheep dogs is a highly skilled profession. A book available on the subject is listed in the source books, page 91.

You may acquire a good sheep dog in many ways. One way is buying a well-bred pup of any of the recognized breeds of sheep dogs. At present, the Border Collie seems to be the most popular. However, many breeds and types are used in the sheep business.

In training the pup, patience plus some knowledge of dog training are essential; observing experienced trainers in action may also be helpful. If you do not have the time or knowledge required for training a dog, employ a good trainer. You may want to buy a dog already schooled in handling sheep.

Treat the dog with kindness, yet insist that he obey commands. When he does a good job reward him. A little petting at the proper time will keep the dog interested in his work, and he will respond more readily to commands.

FEED REQUIREMENTS

Sheep depend almost entirely upon the plant world for their feed. Among our farm and range animals the sheep is outstanding in its ability to produce efficiently upon cheap feeds such as grass, legumes, browse, and hay. For greatest efficiency, however, the sheep must receive all nutrients it requires. Not only must these feed constituents be adequate, but the animal will use the various nutri-

DAILY NUTRIENT REQUIREMENTS OF SHEEP
(Based on air-dry feed containing 90 per cent dry matter)

Body weight	Gain or loss	Feed		Daily nutrients per animal									
		Per animal	Percentage of live weight	TDN	Digestible energy	Protein	Digestible protein	Calcium	Phosphorus	Salt	Carotene	Vitamin A	Vitamin D
Pound		*Pound*	*Per cent*	*Pound*	*megcal**	*Pound*		*Gram*			*mg*	*mcg†*	*I.U.*
EWES—Nonlactating and first 15 weeks of gestation													
100	0.07	2.6	2.6	1.3	2.6	0.21	0.12	3.2	2.5	9.0	1.7	244	250
120	0.07	3.0	2.5	1.5	3.0	0.24	0.13	3.3	2.6	10.0	2.0	292	300
140	0.07	3.4	2.4	1.7	3.4	0.27	0.15	3.4	2.7	11.0	2.4	341	350
160	0.07	3.8	2.4	1.9	3.8	0.30	0.16	3.5	2.8	12.0	2.7	390	400
EWES—Last 6 weeks of gestation													
100	0.37	3.8	3.8	2.0	4.0	0.32	0.18	4.2	3.1	10.0	5.8	586	250
120	0.37	4.2	3.5	2.2	4.4	0.34	0.19	4.4	3.3	11.0	6.8	702	300
140	0.37	4.6	3.3	2.4	4.8	0.36	0.20	4.6	3.5	12.0	7.9	819	350
160	0.37	4.8	3.0	2.5	5.0	0.37	0.20	4.8	3.7	13.0	9.1	937	400
EWES—First 8–10 weeks of lactation													
100	−0.08	4.6	4.6	2.7	5.4	0.40	0.22	6.2	4.6	11.0	5.8	586	250
120	−0.08	5.0	4.2	2.9	5.8	0.42	0.23	6.5	4.8	12.0	6.8	702	300
140	−0.08	5.5	3.9	3.1	6.2	0.44	0.24	6.8	5.0	13.0	7.9	819	350
160	−0.08	5.7	3.6	3.1	6.2	0.46	0.25	7.1	5.2	14.0	9.1	937	400

EWES—Last 12–14 weeks of lactation													
100	0.07	3.8	3.8	2.0	4.0	0.32	0.18	4.6	3.4	10.0	5.8	586	250
120	0.07	4.2	3.5	2.2	4.4	0.34	0.19	4.8	3.6	11.0	6.8	702	300
140	0.07	4.6	3.3	2.4	4.8	0.36	0.20	5.0	3.8	12.0	7.9	819	350
160	0.07	4.8	3.0	2.5	5.0	0.37	0.20	5.2	4.0	13.0	9.1	937	400
EWES—Replacement lambs and yearlings													
60	0.30	2.7	4.5	1.5	3.0	0.30	0.16	2.9	2.6	8.0	1.7	176	150
80	0.20	3.2	4.0	1.6	3.2	0.28	0.15	3.0	2.7	9.0	2.3	234	200
100	0.14	3.4	3.4	1.7	3.4	0.26	0.14	3.1	2.8	10.0	2.8	293	250
120	0.07	3.4	2.8	1.7	3.4	0.24	0.13	3.2	2.9	11.0	3.4	351	300
RAMS—Lambs and yearlings													
80	0.40	3 2	4.0	2.0	4.0	0.32	0.18	3.0	2.7	9.0	2.3	234	200
100	0.30	3.7	3.7	2.1	4.2	0.32	0.18	3.1	2.8	10.0	2.8	293	250
120	0.20	4.2	3.5	2.1	4.2	0.32	0.18	3.2	2.9	11.0	3.4	351	300
140	0.10	4.6	3.3	2.3	4.6	0.32	0.18	3.3	3.0	11.0	4.0	409	350
160	0.10	4.8	3.0	2.4	4.8	0.32	0.18	3.4	3.1	12.0	4.5	468	400
LAMBS—Fattening													
60	0.35	2.7	4.5	1.5	3.0	0.32	0.18	2.9	2.6	8.0	1.0	146	150
70	0.40	3.1	4.4	1.8	3.6	0.34	0.19	2.9	2.6	8.0	1.2	170	175
80	0.45	3.4	4.3	2.1	4.2	0.36	0.20	3.0	2.7	9.0	1.4	195	200
100	0.40	3.9	3.9	2.4	4.8	0.36	0.20	3.1	2.8	10.0	1.7	244	250

* One pound of TDN = 2 megcal. digestible energy.

† Vitamin A alcohol, 0.3 mcg is equivalent to 1 I.U. of vitamin A activity. If vitamin A acetate is used, the Vitamin A alcohol should be multiplied by 1.15 to obtain equivalent vitamin A activity. The comparable multiplier for vitamin A palmitate is 1.83.

NUTRIENT REQUIREMENTS OF SHEEP

In Percentage or Amount Per Pound of Total Ration
(Based on air-dry feed containing 90 per cent dry matter)

Body weight	Daily gain or loss	Daily feed			Percentage of ration or amount per pound of feed								
		Per animal	Percentage of live weight	TDN	Digestible energy	Protein	Digestible protein	Calcium	Phosphorus	Salt	Carotene	Vitamin A	Vitamin D
Pound		*Pound*	*Per cent*		*megcal**	*Per cent*					*mg*	*mcg†*	*I.U.*
EWES—Nonlactating and first 15 weeks of gestation													
100	0.07	2.6	2.6	50	1.00	8.0	4.4	.27	.21	0.8	0.7	94	96
120	0.07	3.0	2.5	50	1.00	8.0	4.4	.24	.19	0.7	0.7	97	100
140	0.07	3.4	2.4	50	1.00	8.0	4.4	.22	.17	0.7	0.7	100	103
150	0.07	3.8	2.4	50	1.00	8.0	4.4	.20	.16	0.7	0.7	103	105
EWES—Last 6 weeks of gestation													
100	0.37	3.8	3.8	52	1.04	8.4	4.6	.24	.18	0.6	1.5	154	66
120	0.37	4.2	3.5	52	1.04	8.2	4.5	.23	.17	0.6	1.6	167	71
140	0.37	4.6	3.3	52	1.04	8.0	4.4	.22	.16	0.6	1.7	178	76
160	0.37	4.8	3.0	52	1.04	7.8	4.3	.22	.16	0.6	1.8	195	83
EWES—First 8–10 weeks of lactation													
100	−0.08	4.6	4.6	59	1.18	8.7	4.8	.30	.22	0.5	1.3	127	54
120	−0.08	5.0	4.2	58	1.16	8.4	4.6	.28	.21	0.5	1.4	140	60
140	−0.08	5.5	3.9	56	1.12	8.0	4.4	.27	.20	0.5	1.5	149	64
160	−0.08	5.7	3.6	55	1.10	8.0	4.4	.27	.20	0.5	1.6	164	70

EWES—Last 12-14 weeks of lactation													
100	0.07	3.8	3.8	52	1.04	8.4	4.6	.26	.20	0.6	1.5	154	66
120	0.07	4.2	3.5	52	1.04	8.2	4.5	.25	.19	0.6	1.6	167	71
140	0.07	4.6	3.3	52	1.04	8.0	4.4	.24	.18	0.6	1.7	178	76
160	0.07	4.8	3.0	52	1.04	7.8	4.3	.24	.18	0.6	1.9	195	83
EWES—Replacement lambs and yearlings													
60	0.30	2.7	4.5	55	1.10	11.0	6.0	.21	.19	0.6	0.6	65	50
80	0.20	3.2	4.0	50	1.00	8.7	4.8	.20	.18	0.6	0.7	73	62
100	0.14	3.4	3.4	50	1.00	7.6	4.2	.20	.18	0.6	0.8	86	74
120	0.07	3.4	2.8	50	1.00	7.0	3.9	.20	.18	0.7	1.0	103	88
RAMS—Lambs and yearlings													
80	0.40	3.2	4.0	62	1.24	10.0	5.5	.20	.18	0.6	0.7	73	62
100	0.30	3.7	3.7	57	1.14	8.6	4.7	.18	.16	0.6	0.8	79	68
120	0.20	4.2	3.5	50	1.00	7.6	4.2	.17	.15	0.6	0.8	84	71
140	0.10	4.6	3.3	50	1.00	6.9	3.8	.16	.14	0.5	0.9	89	76
160	0.10	4.8	3.0	50	1.00	6.6	3.6	.15	.14	0.5	0.9	98	83
LAMBS—Fattening													
60	0.35	2.7	4.5	55	1.10	12.0	6.6	.23	.21	0.6	0.4	54	56
70	0.40	3.1	4.4	58	1.16	11.0	6.1	.21	.18	0.6	0.4	55	57
80	0.45	3.4	4.3	62	1.24	10.7	5.9	.19	.18	0.6	0.4	57	59
90	0.45	3.7	4.2	62	1.24	9.5	5.3	.18	.16	0.6	0.4	59	61
100	0.40	3.9	3.9	62	1.24	9.4	5.2	.18	.16	0.6	0.4	62	64

* One pound of TDN = 2 megcal. digestible energy.

† Vitamin A alcohol, 0.3 mcg is equivalent to 1 I.U. of vitamin A activity. If vitamin A acetate is used, the vitamin A alcohol should be multiplied by 1.15 to obtain equivalent vitamin A activity. The comparable multiplier for vitamin A palmitate is 1.83.

ents to better advantage if they are available in the proper balance.

Sheep receive much of their feed in the form of pasture or range feeds, thus you must judge the feed value they are obtaining from this vegetation. A thorough understanding of the fundamental requirements for the proper nutrition of your animals will help you assess their need for supplemental feed. It is especially important to know when to use supplements, and how much to use and still operate economically sound.

THE NUTRITIONAL NEEDS OF SHEEP

The nutritive requirements shown in tables A and B were prepared by the subcommittee on sheep nutrition of the National Research Council.

The two tables on pages 26 to 29 give the requirements per animal daily, and the requirements in terms of the percentage composition needed in the total feed of the animal. The second table is particularly valuable when you compute feed mixtures or compare the feeding value of a specific feed to the need of a particular class of sheep. The various parts of the tables and their uses are explained below.

Body weight (col. 1). The weight of the average sheep in the flock may be used as a guide. If the members of the flock vary widely in body size, sort them into uniform groups and feed them according to size. This will also prevent the larger sheep from getting an undue share of the feed.

Gain or loss (col. 2). These estimates indicate the gain or loss expected under usual conditions with healthy sheep. Obviously, the gain will be decreased if the animals are fed at levels lower than those recommended in the tables.

Feed (cols. 3 and 4). The figures given for the various classes and weights of sheep may be used as a guide to how much feed to allow each animal per day. These figures may be regarded as a "governor" to regulate the bulkiness of the daily feed. For example, the other requirements given in the tables for a breeding ewe might be met by feeding her 1 pound of barley and 1 pound of cottonseed meal per day. However, the ewe would go off feed unless she had access to some bulky feed such as hay or straw. On the other hand, the requirements of a fattening lamb might be met by feeding him 4 or 5 pounds of alfalfa hay. As the lamb would not have the room in his digestive tract to handle this much bulk, he would not eat all of this hay. He would grow, but he would not fatten to suitable market condition. By following the recommendations of the tables, we find that in order to stay within the limitations for dry matter and yet furnish enough energy (TDN) we must feed the lamb a fairly large proportion of a concentrated feed such as barley or corn.

The feed requirement and percentage of live weight are further indicators of the level at which the sheep should be fed depending upon their intended uses.

Total digestible nutrients (TDN) and digestible energy (DE) (cols. 5 and 6). The total digestible nutrients (or energy) are the fuel upon which the animal body functions, just as gasoline is the fuel that furnishes the energy for an automobile. Sheep need energy to maintain the body functions, grow wool, and store fat; and, in the case of the ewe, to nourish the unborn lamb or produce milk for the suckling lamb.

A lack of energy is probably the most common deficiency in sheep production. Sheep often do not get *enough* to eat, or the feed they do eat does not contain enough energy to meet their needs. When sheep are on good feed and receiving more energy than they require, some of this excess energy is stored in the form of fat. When the feed is poor and the energy needs are not being met, the sheep will draw upon fat stores to make up for the energy deficiency. The sheepman then will say that his sheep are "losing condi-

tion." Unless sheep are on very poor feed, the wool will continue to grow. An inexperienced sheepman therefore may not notice that the sheep are losing condition, because the wool will cover some of this loss. If an energy deficiency continues long enough, the sheep will become weak and eventually die of starvation.

Protein or digestible protein (DP) (cols. 7 and 8). Requirements are given both for crude protein and digestible protein. Commercial feeds list the composition as only total protein, but the digestible protein—available in most common feedstuffs—gives a better indication of the feeding value of feed, particularly in the case of roughages.

Digestible protein refers to that portion of the protein furnished by the feed that is actually digested and available in the body for use by the animal. Protein, the part of the feed containing nitrogen, is essential to the sheep for growth, for body maintenance and repair, and for wool development; to the pregnant ewe for proper development of her unborn lamb; and to the lactating ewe for secreting milk. The animal must have an adequate supply of protein in order to use efficiently the other nutrients provided by the feed. A deficiency of protein will result in reduced body and wool growth, poor development, reduced appetite, and inefficient use of the feed.

Animals such as pigs and poultry are very exacting in the kind as well as the amount of protein they require. However, if provided with enough protein of any kind, the bacteria and microorganisms that live in the rumen or paunch of sheep will convert this protein into a form that can be utilized by the animal. Thus our main concern about protein in sheep feeding is that the animal receive an adequate supply. Growing lambs and pregnant and nursing ewes have a relatively high protein requirement.

Urea as a source of protein. Urea, an inorganic compound rich in nitrogen, furnishes no energy when used in the ration. For this reason its use is recommended only when other protein sources are scarce or expensive.

In ruminants such as sheep or cattle, microorganisms present in their rumen or paunch are able to incorporate the urea nitrogen into the protein of their own bodies. As these organisms pass down the digestive tract, their body protein is in turn digested and used by the ruminant. Feed grade urea is approximately 262 per cent protein equivalent. The addition of 1 pound per 100 pounds of ration, therefore, increases the ration protein content by 2.62 per cent.

Extensive experimental work with urea indicates that it may be safely used to replace about 30 per cent of the protein of rations in pen-fed animals, and 25 per cent in rations of range animals. Be certain to mix the urea uniformly in with other feed to promote even consumption among animals. If this is not done, palatability problems and even toxicity will be encountered. To obtain good results from urea feeding, the ration must contain rich sources of energy such as carbohydrates. Therefore, grains such as barley, corn, or milo are commonly fed with it. A feed supplement containing urea, grain, molasses, alfalfa meal and molasses has proven to be an effective way of increasing nitrogen intake. Biuret, another nonprotein nitrogen source, shows some promise as a protein supplement. Urea has been fed to ewes, ewes and lambs, or to weaned lambs with good results when used as recommended above.

The minerals (cols. 9–11).

Calcium and phosphorus (cols. 9 and 10) are the main minerals found in bones. Young, growing lambs and pregnant and milking ewes have a high calcium and phosphorus requirement. In general, roughages, especially alfalfa, have a high calcium content. Sheep usually receive enough roughage so that there is little likelihood of their suffering from a calcium deficiency. Concentrates

—that is, grains and especially the high-protein concentrates such as cottonseed meal—are high in phosphorus. Roughages, however, may be low in phosphorus, especially when grown on soils that are low or borderline in this mineral. As sheep depend primarily on roughages for their feed supply, a phosphorus deficiency is much more likely than a deficiency of calcium. Phosphorus is likely to be deficient in dry range feed. This may be indicated by slow growth, unthrifty appearance, or listlessness. In extreme cases sheep may have a depraved appetite; that is, they will chew on bones, fences, or rocks. Lambs on a phosphorus-deficient ration may develop crooked legs.

Covered salt trough for year-around use in permanent range situations.

Salt (col. 11). Sodium and chlorine are furnished sheep as ordinary stock salt. Although exact salt requirements for sheep are not known, sheep should have free access to salt, because it serves many regulatory functions in the body and stimulates the appetite. Animals that are deprived of salt develop a craving and may resort to chewing wood, licking dirt and similar manifestations of an unsatisfied appetite. In certain range areas the forage contains adequate salt. In other areas where poisonous plants are a problem, salt may lessen the likelihood that the sheep will eat the poisonous plants.

Salt is ordinarily supplied to sheep as half-ground salt or block salt. Under range conditions, ½ to 1 pound of salt is usually provided per sheep per month. In feed mixes it is customarily added at the rate of 0.5 per cent of a complete mix or at 1.0 per cent of a concentrate mix or a supplemental feeding mix.

In addition to the mineral requirements listed in the tables, the following minerals may be important in sheep feeding.

Iodine is needed in the animal body for the proper functioning of the thyroid gland. When an animal does not receive enough iodine the thyroid gland enlarges which is commonly known as goiter. If sheep are deficient in iodine, lambs will be born with a characteristic enlargement of the throat. These lambs are usually born dead or die soon after birth. An iodine deficiency has been observed in a few localities in California but is not widespread. Iodine may be most economically and safely furnished to sheep by feeding iodized salt. Although this salt contains only 0.0078 per cent iodine, it will furnish adequate iodine for the sheep.

Iron is necessary for proper blood formation in the animal body. An iron deficiency has never been demonstrated in sheep. Therefore it can be assumed that they ordinarily receive plenty of iron in their feed.

Copper is needed for normal wool growth and for the prevention of a condition of lambs called "swayback" or "enzootic ataxia." In copper deficiency the wool loses its crimp and is referred to as "steely" wool. When sheep are suffering from a low copper intake, the lambs are born weak, lack muscular coordination, and soon die. Pigmented wool or hair will have a pale color and in severe cases show no pigment at all. This condition has never been observed in the United States, but is of considerable importance in Australia. It appears unlikely that sheep in California ever lack copper unless the area is high in molybdenum. Sheep ap-

A deficiency of these minerals will cause trouble:

- phosphorus—depraved appetite; poor gains
- sodium and chlorine (supplied in salt)—reduced gains
- iodine—goiter; weak and dead lambs
- copper—swayback and steely wool
- cobalt—loss of condition and appetite; eventual death
- sulphur—poor appetite; reduced gains

An excess of these minerals will cause trouble:

- fluorine—differential wear of teeth
- molybdenum—scouring, gray or white wool in black sheep
- selenium—sloughed hoofs and stiff joints.

pear to be quite vulnerable to excess amounts of copper in their ration. Use with caution trace mineral mixes containing high amounts of copper, or feed supplements, or milk substitutes for lambs supplemented with copper; they may be toxic. See section on molybdenum for an explanation of its effect on copper needs.

Cobalt, although needed in only minute amounts, is essential for the production of thrifty sheep. Cobalt-deficient areas have been found in many parts of the world, including Australia, Scotland, and some areas of the United States. To date, no cobalt-deficient areas have been detected in California. Sheep suffering from a lack of cobalt go off feed, lose condition, become weak and anemic, and eventually die. It has been shown that cobalt must be present for the microorganisms in the rumen to produce vitamin B_{12}, which is essential to the sheep. Recent tests on the use of "cobalt bullets" as a source of cobalt for lambs showed no advantage to this additional cobalt in tests conducted in several counties.

Sulphur is essential in the sheep ration. Wool contains a relatively high percentage of sulphur. Most forage will contain adequate amounts of sulphur to meet the needs of sheep. When non-protein nitrogen such as urea is used to satisfy part of the nitrogen requirements of sheep, additional sulphur may be needed in the ration, perhaps in the form of inorganic sulphur or organically combined sulphur. Certain soils in California are sulphur deficient and respond to sulphur fertilization. It is probably more economical to supplement the soil and increase the feed supply than it is to feed sulphur supplements to the sheep.

Fluorine may cause poisoning if it is present in large amounts. Raw rock phosphate should never be used as a phosphorus supplement because it carries enough fluorine to be toxic to sheep.

Molybdenum is important because an excess is poisonous. In some areas of California sheep and cattle will scour because there is too much molybdenum in the forage. Sheep receiving a high molybdenum ration will scour and lose weight. Animals with pigmented coats may be pale to colorless. Both copper and sulphur are known to be related to the metabolism of molybdenum. The harmful effects of molybdenum may be counteracted by supplementing livestock with copper. Because molybdenum toxicity is known to occur in certain areas of California, consult your local Farm Advisor about any suspected molybdenum toxicity.

Selenium also causes poisoning when it is present in excess. The most characteristic symptom is the soreness and sloughing of the hoofs and stiffness of the joints. This condition has been found in South Dakota and Wyoming. There is no evidence that it occurs in California, but it may be deficient in certain areas. White muscle disease in calves and lambs has been related to a deficiency of selenium and vitamin E. Because excess amounts of selenium have toxic effects, use selenium as a supplement only under

RATION FORMULATION FOR EWES IN DIFFERENT STAGES OF REPRODUCTION
(by using the tables on pages 26-29 and 36-37)

Stage of reproduction	Feed	Total feed	Digestible protein	Total digestible nutrients	Calcium	Phosphorus	Salt	Carotene
		Pound			*Gram*			
	Recommended allowance..	3.0	0.13	1.5	3.3	2.6	10.0	2.0
For a 120-pound ewe for the first 15 weeks after breeding	3.0 pounds alfalfa hay furnishes.....	3.0	0.32	1.53	16.2	2.9	....	4.08
	Salt.....	(½ oz)	....	....	....	....	14.2	....
	Recommended allowance..	4.4	.19	2.3	4.5	3.4	11.0	7.3
For the same ewe (now weighing approximately 130 pounds) the last six weeks before lambing	Alfalfa hay.....	4.2	0.44	2.14	22.9	3.8	....	57.12
	Barley.....	0.25	0.02	0.20	.06	.44	....	.....
	Salt.....	(½ oz)	....	....	.....	....	14.2	.....
	Total.....	4.45	0.46	2.34	22.96	4.24	14.2	57.12
	Recommended allowance..	5.0	0.23	2.9	6.5	4.8	12.0	6.8
For the same ewe (now weighing 120 pounds) nursing lambs during first 8-10 weeks of lactation	Alfalfa hay.....	4.0	0.42	2.04	21.79	3.63	....	54.4
	Barley.....	1.0	.08	0.78	0.23	1.77	....	.....
	Salt.....	(½ oz)	....	....	.....	....	14.2	.....
	Total.....	5.0	0.50	2.82	22.02	5.40	14.2	54.4

RECOMMENDED NUTRIENT ALLOWANCES IN PERCENTAGE OR PER POUND OF FEED

The computation is simplified by using tables on pages 28–29 and 36–37, particularly for formulating more complex mixtures.

Requirements for 70-pound lamb, (expected daily gain 0.40 lb)		Total feed, air dry basis 3.1	Total digestible protein 6.1	Total digestible nutrients 58	Calcium 0.21	Phosphorus 0.18	Carotene 0.4
	Per cent of ration	*Pound*	*Per cent*				*mg/lb*
Formula for mixed feed							
Alfalfa hay	51.6	...	5.47	26.3	0.62	0.10	13.6
Barley	25.8	...	2.01	20.1	0.01	0.10	....
Molasses dried beet pulp	22.6	...	1.36	16.0	.13	0.02	....
Salt	0.6	...	....	....	....	....	....
	100.6	3.1*	8.84	62.4	0.76	0.22	13.6

* Obtained from the table on pages 28-29.

the direction of your local veterinarian.

Magnesium. Little is known about the magnesium requirement of the sheep, but low blood magnesiums are found in the case of grass tetany. Report cases of suspected grass tetany in sheep to your local Farm Advisor or veterinarian.

Zinc is known to be essential to sheep but no deficiencies have been reported under practical conditions in California.

Mineral mixtures for sheep

Although sheep are known to require the several essential mineral elements, feeds commonly available will furnish these minerals except in unusual cases. Except for iodized salt, the California Experiment Station has no evidence of a need for the feeding of complex mineral mixtures to sheep. If there is any question of a phosphorus deficiency, steamed bone meal or other phosphorus supplements can be provided quite economically. Money commonly spent for minerals for sheep can be used to better advantage by buying supplemental feed to correct the more fundamental deficiencies of energy and protein encountered in range sheep.

FORMULATING A SELF-FEEDING MIXTURE FOR FATTENING LAMBS

Using table on pages 26–27, first complete a ration for an average lamb in the lot.

Recommended Daily Nutrient Allowance per Animal

Requirements for 70-pound lamb (expected daily gain 0.40)	Total feed, air dry basis, 3.1	Total digestible protein 0.19	Total digestible nutrients 1.8	Calcium 2.9	Phosphorus 2.6	Salt .018	Carotene 1.2
	Pound			*Gram*		*Pound*	*mg*
Ration:							
Alfalfa hay	1.6	.17	.81	8.71	1.45	....	20.8
Barley	.8	.06	.62	.18	1.42	....	....
Molasses dried beet pulp	.7	.04	.50	1.78	.25	....	....
Salt	.018	...	...	....	....	.018	....
Total	3.1	.27	1.93	10.67	3.12	.018	20.8

To obtain the mixture on a percentage or 100-pound basis, it is necessary to convert the above ration to percentage, as in the upper table on this page.

$\frac{1.6}{3.1}$ = 51.6 per cent alfalfa.

$\frac{.8}{3.1}$ = 25.8 per cent barley.

$\frac{.7}{3.1}$ = 22.6 per cent molasses dried beet pulp.

$\frac{.018}{3.1} = \frac{.6}{100.0}$ per cent salt.

Feedstuffs	Dry matter	Protein digestible	Energy/lb digestible*	TDN	Fat	Crude fiber	Ash	Calcium	Phosphorus	Carotene
	Per cent		*kcal*	*Per cent*						*mg/lb*
Alfalfa hay, early bloom	90	11.6	1040	52	2.0	26.8	8.5	1.12	0.21	51.9
Alfalfa hay, mid bloom	89	10.6	1020	51	1.8	27.5	7.6	1.20	0.20	13.6
Alfalfa silage	30	3.4	360	18	1.1	9.1	2.8	0.48	0.16	12.4
Almond hulls, IXL	90	0.0	1440	72	....	....	....	....	....	....
Almond hulls, Mission	90	0.0	1060	53	....	....	....	....	....	....
Annual grasses, mostly soft chess, seed stage, nearly mature	91	....	920	46	....	....	....	0.35	0.20	....
Annual grasses, soft chess and fescue, mature dry	90	....	800	40	....	....	....	0.30	0.20	....
Apple pomace, dried	89	1.7	1280	64	....	....	....	0.10	0.09	....
Asparagus butts, dried	91	9.7	940	47	....	....	....	....	....	....
Barley grain, Pacific Coast	90	6.9	1580	79	....	....	....	0.06	0.33	....
Barley hay	87	4.3	980	49	1.9	23.0	6.8	0.18	0.26	....
Barley straw	88	0.6	820	41	1.6	37.3	5.8	0.30	0.08	....
Beans field	90	20.2	1580	79	....	....	....	0.15	0.57	....
Beans, lima	90	18.7	1560	78	....	....	....	0.09	0.37	....
Bean straw, field	89	3.0	900	45	....	....	....	1.67	0.13	....
Bean straw, lima	90	6.0	960	48	....	....	....	....	....	....
Beet molasses	77	3.5	1220	61	0.2	0.0	8.2	0.16	0.03	....
Beet pulp with molasses, dried	92	6.0	1420	71	0.5	15.6	5.7	0.56	0.08	0.1
Beet pulp, wet	10	0.5	200	10	0.2	2.2	0.4	0.09	0.01	....
Beet tops, green	18	1.7	200	10	....	....	....	0.18	0.04	....
Brewers' grains, dried, from California barley	91	14.4	1200	60	....	....	....	0.16	0.47	....
Brewers' grains, wet	24	4.2	320	16	....	....	....	0.07	0.12	....
Broad-leaf filaree, mature dry	90	....	860	43	....	....	....	1.70	0.13	....
Broad-leaf and red-stemmed filaree, mixed, mature, dry, leached	90	....	740	37	....	....	....	2.30	0.10	....
Broad-leaf filaree—grass mixture as grazed by cattle	90	0.0–2.0	800	40	....	....	....	....	0.31	....
Bur-clover, green, seed stage	90	11.8	1120	56	....	....	....	0.86	0.30	....
Bur-clover, seed stage, dry leached by 0.3 inch rain	90	10.6	1020	51	....	....	....	0.89	0.29	....
Bur-clover, seed stage, dry leached by 0.8 inch rain	90	10.3	960	48	....	....	....	0.93	0.19	....
Clover, bur	21	3.8	300	15	....	....	....	0.20	0.07	....
Clover, ladino	16	3.7	220	11	....	....	....	0.20	0.07	25.2
Clover, ladino and grass pasture, much ladino	20	2.9	280	14	....	....	....	0.30	0.08	....
Clover, ladino and grass pasture, mostly grass	20	2.0	260	13	....	....	....	0.16	0.07	....
Beet tops	80	7.7	960	48	....	....	....	0.45	0.19	....

Cane molasses	74	0.0	1080	54	0.1	0.0	8.6	0.66	0.08	....
Carrot roots	12	0.9	220	11	....	....	....	0.05	0.04	....
Coconut meal, expeller	93	16.5	1540	77	6.6	11.6	6.9	0.21	0.61	....
Coconut meal, solvent	92	18.1	1380	69	1.8	15.4	5.6	0.17	0.61	....
Corn dent silage	26	1.5	340	20	0.8	6.7	1.5	0.10	0.06	6.1
Corn distillers grains with solubles, dried	92	19.9	1620	81	9.3	9.0	4.3	....	....	....
Corn, white, hominy feed	90	7.8	1660	83	6.1	5.0	3.0	0.02	0.58	....
Corn stover, mature	87	3.1	960	48	1.0	32.3	6.2	0.40	0.07	1.4
Corn yellow dent, gr 2	89	6.9	1600	80	3.9	2.3	1.2	0.02	0.31	0.8
Cottonseed hulls	90	0.2	880	44	1.4	42.8	2.5	0.14	0.09	....
Cottonseed meal, expeller	93	33.5	1460	73	5.8	10.7	6.1	0.18	1.15	....
Cottonseed meal, solvent	91	34.5	1320	66	1.6	....	6.5	0.15	1.10	....
Cottonseed, whole	93	17.1	1820	91	....	....	....	0.14	0.70	....
Figs, dried	..	4.0	1380	69	....	....	....	....	....	....
Fish meal (over 63% protein)	93	60.1	1480	74	....	....	....	4.14	2.67	....
Mangel roots	9	0.6	180	9	0.1	0.8	1.1	0.02	0.02	....
Milo—see sorghum										
Oat hay	90	3.8	900	45	2.5	27.5	6.1	0.23	0.21	40.1
Oat straw	90	1.4	900	45	1.9	36.9	7.4	0.30	0.09	....
Oats, wild	37	1.9	380	19	....	....	....	0.09	0.10	....
Oats, Pacific coast	90	7.6	1440	72	....	....	....	0.09	0.33	....
Orchard grass, pasture	24	2.2	240	12	....	....	....	0.14	0.12	26.6
Peanut meal, expeller	92	41.2	1540	77	5.9	10.7	5.7	0.17	0.57	0.1
Potatoes, dried	90	3.0	1460	73	....	....	....	0.04	0.26	....
Potato tubers	21	1.3	360	18	0.1	0.4	1.1	0.01	0.05	....
Rice bran	91	8.5	1360	68	15.1	10.9	10.9	0.06	1.82	....
Rice polishings	90	6.7	1700	85	13.2	3.3	8.0	0.04	1.42	....
Rye grain	89	9.9	1440	72	1.6	2.3	1.9	0.06	9.34	0.0
Rye grass, Italian, pasture	20	1.6	200	10	....	....	....	0.13	0.08	21.5
Sorghum, kafir, grain	87	9.0	1240	79	2.5	2.5	1.6	....	....	....
Sorghum, milo, grain	89	8.6	1420	84	2.8	2.4	1.9	....	....	....
Sorghum, silage	29	0.6	303	17	0.8	7.8	2.2	0.10	0.06	4.4
Soybean meal, expeller	90	39.4	1480	74	4.7	5.8	5.7	0.27	0.63	0.1
Sudangrass hay	89	4.3	980	48	2.0	25.7	8.5	0.50	0.28	....
Sudangrass, pasture stage	22	2.4	280	14	....	....	....	0.12	0.10	21.5
Sugar beets	16	1.2	280	14	....	....	....	0.04	0.04	....
Vetch and oat hay, half vetch	90	7.0	1000	50	....	....	....	0.55	0.26	....
Wheat bran	89	12.2	1160	58	4.1	10.0	6.1	0.14	1.17	....
Wheat, soft, Pacific coast	89	8.3	1600	80	2.0	2.7	1.9	....	....	....
Wild oat hay	92	3.6	980	49	....	....	....	0.22	0.25	....
Winery pomace	89	1.9	620	31	....	....	....	....	....	....

* Digestible Energy—this column is inserted for use of those who prefer this rather than TDN as a basis for evaluating feed energy. This column is based on 2000 times the percentage of TDN.

Fresh-shorn springers showing the crooked legs characteristic of rickets on irrigated pasture. The lamb on the left suffered a broken hind leg when caught by the shearer.

The vitamins (cols. 12–14)

Carotene-vitamin A (cols. 12–13) is the most important vitamin for sheep production. Sheep obtain vitamin A from carotene present in green plants. Certain yellow feeds such as yellow corn, carrots, and sweet potatoes also furnish carotene. The degree of green color is a practical guide to the carotene content of roughages. Sheep may suffer a vitamin A deficiency when they are kept on dry, mature, and weathered forage for long periods. Pregnant ewes low in vitamin A will give birth to weak or dead lambs. Lambs are always born with too small a storage of vitamin A; it is, therefore, essential that they receive from the ewe colostrum milk, which is rich in this vitamin.

The requirements are given as carotene or vitamin A in the tables on pages 26 to 29. Fortunately, sheep have the capacity to store large amounts of vitamin A during the green-feed season and hence will probably not require vitamin A supplementation unless they are kept on dry feed low in carotene for a period of four months or more.

Vitamin D (col. 14) is normally obtained by sheep through the action of sunlight on a substance present in the sheep's skin in most of California. If sheep do not receive sunlight, lambs may develop rickets from a lack of vitamin D. Under usual farm and range conditions sheep never lack this vitamin. However, in past years sheep on irrigated pasture during winter and spring in the Oakdale and Dixon areas have suffered from rickets. New Zealand workers have shown that a similar condition there is due to antagonism between carotene and vitamin D. When sheep are covered with wool, the sun is low on the horizon, and grass is in a period of lush growth with carotene intake at a high level, part of the small amount of vitamin D produced in the skin, already marginal, becomes unavailable to the animal. Long periods of foggy or overcast weather worsen the condition. The result is rickets. Although the California situation has not been carefully investigated, the situation appears similar in all respects. New Zealanders overcome this deficiency by treating ewes and lambs with massive injections of vitamin

D at the beginning of winter or by feeding sun-cured hay over the winter.

In addition to the vitamin requirements listed in the tables on pages 26 to 29, the following vitamins are worth mentioning:

The vitamin B complex is not believed to be of importance in a sheep diet. Mature sheep are able to synthesize vitamins in the rumen. Young lambs require the B vitamins in their feed, but these are normally supplied in the ewes' milk.

Vitamin E is important in prevention of muscular dystrophy or white muscle disease in suckling lambs. Selenium is also partly responsible for this disease. Lambs suffering from this disease become stiff and unable to rise to nurse. They will eventually die of starvation. As the colostrum milk is high in vitamin E, this is another reason for making sure that the newborn lamb gets a good fill of it. The deficiency may also be prevented by properly feeding the ewe so that her milk will provide an adequate supply of vitamin E for the nursing lamb. Treatment of dystrophic lambs in the early stages with vitamin E and selenium has been effective. Proprietary products containing E and selenium are also available for preventive treatment in problem areas.

COMPOSITION OF FEEDS

The average composition of feeds commonly used for sheep feed in California is shown in the table on pages 36 and 37. This table, although it represents the best available information, does not always reflect the exact analysis of all feeds. For example, alfalfa hay may contain more than 10.6 per cent digestible protein and 13.6 milligrams of carotene per pound; but on the other hand, badly weathered alfalfa may contain considerably less than the lower values given.

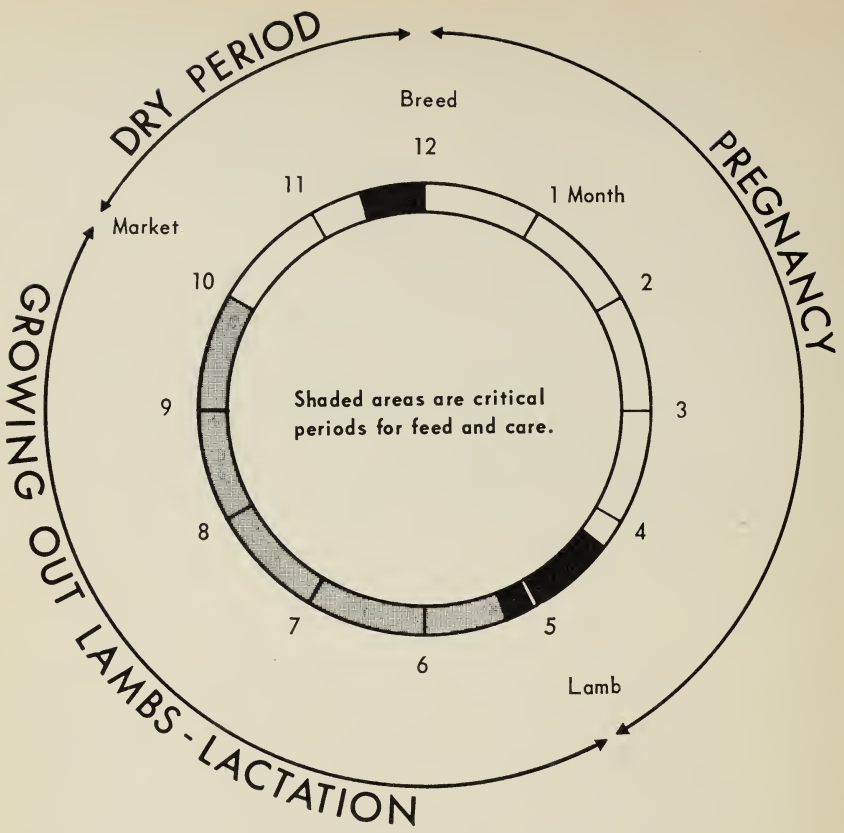
How to compute rations. The examples show how the tables of recommended allowances and the feed-composition tables may be used for computing rations for sheep that are receiving all of their feed in the form of harvested roughages and concentrates.

SUPPLEMENTAL FEEDING

Because sheep spend most of the year on range or pasture, it is important to estimate the nutrients the animal is able to obtain in grazing and to detect any deficiencies. To help you estimate the principal nutrients, the table on pages 36 and 37 presents data on some of the more common California range and pasture plants. The nutritive needs of the flock vary with the stage of reproduction or growth of animals in the flock (see also the tables on pages 26 to 29).

The drawing on page 40 indicates critical periods when nutrition and care are most important in the productivity of the ewe flock. The periods shaded dark are the most critical. Flushing for 17 days prior to breeding promotes fertility and multiple births. A high plane of nutrition for three weeks prior to lambing increases mothering instinct, lamb birth weight and lamb energy reserves, and ewe energy and protein reserves for milk production. These factors are important for survival and subsequent growth of the newborn lamb. The dark area representing one week after birth indicates the necessity of good rations, shelter, and intensive care in this period. The greatest mortality of lambs occurs at birth and during the first week thereafter.

The stage of maturity of pasture plants is important in assessing their value to the animal. The figure on page 41 illustrates the changes that occur in range forage with the progression of seasons. At the beginning of the growing season, especially when rainfall is frequent and heavy, forage plants may contain as much as 90 per cent moisture, and only 10 per cent dry matter. At that time it may not be possible for a sheep to eat enough of this watery feed to meet its energy requirements. If it is assumed that the ewe



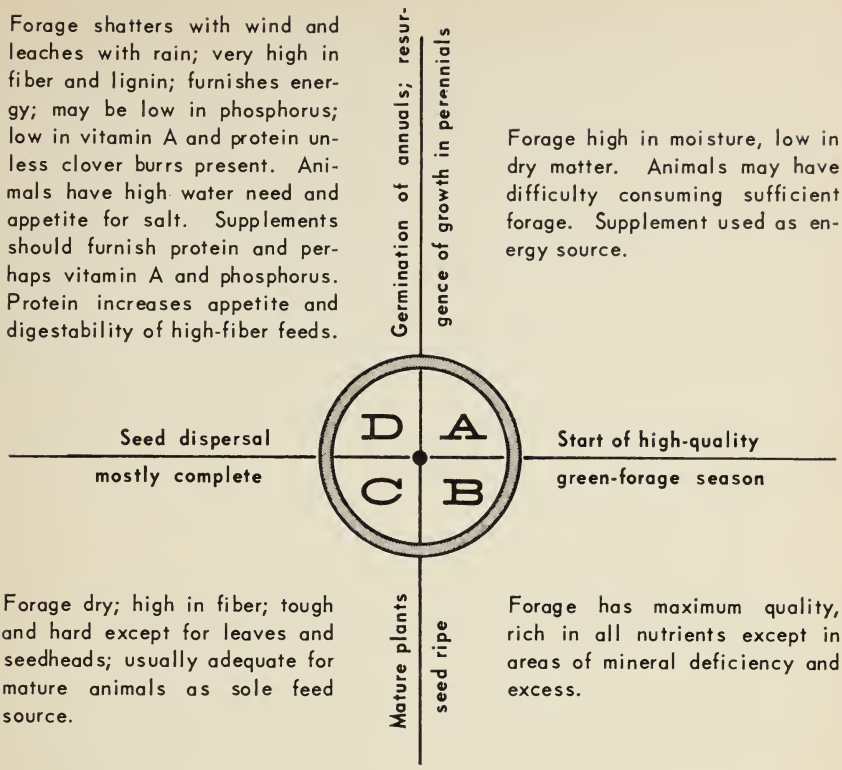
The sheep production year.

will not eat more than 20 pounds of this forage per day, she will suffer from an energy deficiency (see bottom table on page 35). The feed should be supplemented with grain or hay to get enough energy to care for her needs.

As the feed "hardens" (that is, as the dry matter increases) the ewe is able to get her needs from the native forage.

Quadrants C and D in the figure on page 41 show the changes that take place in range forage as it matures and dries. Nutritionally important is the fact that the protein, phosphorus, and carotene decrease and the fiber increases. As the fiber increases, the digestibility and thus the feeding value of the feed decreases. Bur clover is one of the best range plants because it contains a high level of protein and phosphorus. It retains a relatively high level of these nutrients when dry and mature, in contrast to most dry range plants which are very low in these nutrients. The table on page 41 shows the deficiencies a ewe would be subject to during the summer and fall months, when grazing on a range consisting of annual grasses such as soft chess and fescue that are mature and dry. One-half pound per day of 43 per cent protein cottonseed meal will balance all of the deficiencies except that of carotene.

Fortunately the sheep can store a large supply of vitamin A in the liver, and thus survive reasonably long periods of vitamin A or carotene deficiency. However, sheep that are on dry feed for long periods should be supplemented with alfalfa hay of good quality or alfalfa pellets, that will furnish adequate carotene. Commer-



cially available products containing stabilized vitamin A can provide this vitamin in a dry form that can be mixed with supplemental feeds.

Native perennial grasses occur only in a few, principally coastal areas of northern California. These, like the browse plants that stay green through the summer months, are valuable as a supply of protein and carotene for range sheep. The brush must be low enough for the sheep to reach and open enough so that they can move through it easily. Following a burn many brush species furnish highly nutritious green sprouts. Salt may be used safely to limit the intake of supplemental

DEFICIENCIES OF DRY SUMMER AND FALL RANGE

Item	Total feed	Digestible protein	Total digestible nutrients	Calcium	Phosphorus	Salt	Carotene
	Pound			*Gram*			
Recommended daily allowance for a bred ewe weighing 120 pounds	3.0	0.13	1.5	3.3	2.6	10	2.0
Annual grasses, soft chess, and fescue, mature and dry, provide	3.0	0.00	1.42	4.9	3.3	..	...
Deficiencies	...	0.13	0.08	...	..	10	2 0
Supplement needed							
Cottonseed meal (solvent process)	0.5	0.172	0.33	0.34	2.5	..	...
Salt	(10 gm)	....	....	...	...	10	...

feeds as long as adequate water is available and close by. When amounts of supplemental feeds are limited, the use of salt to control the intake insures that every sheep gets some of the supplemental feed. Unfortunately, sheep increase in their tolerance to salt and it may be necessary to increase the salt percentages in the mix as the season progresses. Salt mixes of up to 13.9 per cent in a pelleted ration have been used to limit the intake of feed by pregnant and lactating ewes without obvious ill effect. Ground grains or meals are commonly used with salt content of 15 to 25 per cent.

FREQUENCY OF FEEDING

In a mild climate supplementing growing ewe lambs once a week with a protein feed such as alfalfa hay or one of the oil meals is just as efficient as feeding daily. Usually a week's ration will last two to three days, allowing less aggressive animals an opportunity to eat. In daily feeding they are often driven away from the feed trough by the other ewes. When fed weekly, the animals do not run for the feed truck every time they see it. More trials are necessary to evaluate this practice for ewes and lambs.

Under conditions of severe cold, animals fed a total ration once a week may suffer more from exposure because for part of the week they do not get the heat produced at the time of digestion. This would not be true of rations consumed more evenly throughout the week.

CALENDAR OF OPERATIONS

To aid novice sheepmen in organizing their work, this section will carry a group of sheep through a complete yearly cycle.

BREEDING SEASON

The date when rams are placed with ewes will depend upon when the lambing season occurs. The gestation period of the ewe is approximately 147 days, varying from 142 to 152 (about five months). Choose the lambing season after considering the following:

- Most importantly, lambs born early will be old enough to utilize the spring growth of natural feed and can be sold as "fats" before the feed dries.
- Marketing the lambs early in spring will bring the higher price usually paid before July 1.
- Weather during lambing.
- Feed available for lambing.
- Shelter for ewes at lambing time.
- The pressure of other work.

The normal breeding season of sheep is autumn, but in California it is usually desirable to breed ewes in late spring and summer. Since the ewes are breeding out of season, and environmental temperatures are high, the rams must be left with them for at least three months, and even then there may be some ewes that will not breed. Where early fall lambs are desired, it is especially important that the ewes carry some fine-wool blood. Dorset Horn ewes also commonly breed early.

Number of rams needed. Under range-breeding conditions, three rams are commonly used per hundred ewes bred. Under pasture conditions, one yearling ram may settle up to 50 ewes. Beyond two years of age, rams are usually not so active. One ram, if young, vigorous, and fertile, can settle 100 ewes or more. However, epididymitis and other diseases affecting fertility make it advisable to use a larger proportion. Because rams occasionally are infertile, more than one ram per flock is advised. Ram lambs, if well

Feeder lamb being drenched before going on irrigated pasture.

grown, may be bred to as many as 20 ewes.

Care of ewes before breeding. Usually the previous crop of lambs will be weaned a few weeks before the breeding season. After the lambs are removed, hold the ewes on dry feed until a few days before turning in the rams. Ewes should not be overly fat when placed with rams.

Drenching the ewes to reduce the load of internal parasites should be done at this time. (The parasites will have increased during the green-feed season. If their number is reduced by drenching at the beginning of the dry feed season, the ewes will probably not be reinfected while on dry feed.)

Dipping. If the sheep are infested with any external parasites, such as ticks or lice, spray or dip the sheep before breeding. Various treatments are available for control of these pests. Publication AXT-172 "Control of External Parasites of Livestock" for the current year is available from your county Farm Advisor's office. Flushing is generally believed to increase the number of eggs shed by the ewe, resulting in an increased number of twins at lambing time. Workers at the U. S. Sheep Experiment Station at Dubois, Idaho, have shown that flushing is of highest benefit if done for 17 days preceding the time rams are put with ewes. Flushing for more than 34 days prior was a disadvantage.

Care of rams before breeding season. Buy rams well in advance. If possible, they should be on the ranch for a few weeks before being turned in with the ewes and should be well fed during this period. Rams lacking in condition may be fed as much as a pound of grain per day for about a month.

Rams are subject to a bacterial infection of the epididymus—a coiled tube, lying externally on each testis. It carries semen from the testis and also acts as a storage area for semen before ejaculation. Such infection, called epididymitis, greatly reduces fertility of rams, and may even completely sterilize them.

Flock of sheep passed rapidly and easily through a spray chute.

The University of California School of Veterinary Medicine recommends that all rams be vaccinated against this disease initially at weaning (4½ to 5 months of age) and again 30–60 days later. Where the initial vaccination is given early and the disease incidence in the flock is high, a third vaccination may be advisable. Vaccinations must be given by a veterinarian.

Flock rams should have a booster shot annually, given 30–60 days prior to breeding.

When purchasing rams, buy only from breeders who follow such a vaccination program.

If the rams are carrying much wool, shear them before turning them in with the ewes. Some sheepmen shear only the belly and scrotum before the breeding season.

Care of rams during breeding season. Active rams running with a large number of ewes over a long period will lose condition. One way to insure that they are well cared for is to turn the rams in with ewes only at night, separate them in the morning, and keep them in a corral on a good feed of hay and grain during the day. This system is only practical where the sheep can be brought to a sorting corral every night and morning.

Another practice, more applicable to most sheep ranches, is to turn in only half the rams at one time. After a week or two these rams can be removed, rested, and fed well while the other half of the rams are in with the ewes. By rotating the rams it is possible to keep fresh, well-conditioned rams in with the ewes during the entire breeding season.

Check fertility of the ram. In purebred flocks and in one-ram flocks, it is essential that the ram used be fertile; otherwise a complete lamb-crop failure may result. The most common method of checking on the fertility of the ram is to use a ewe-marking harness or paint the brisket of the ram with a solution of paint pigment in a non-drying oil. Then when the ram breeds the ewe, he will leave a colored mark on her rump. The color of the paint (or of the crayon in the ewe-marking harness) should be changed every 15 days. Start with a light-colored paint or crayon and change to darker colors as the breeding season progresses.

If all or most of the ewes that are marked during the first period are marked again during the second period, it means that the ewes were not settled at the first mating; this throws the fertility of the ram in doubt. Even with highly fertile rams a few ewes may return to service; but if a large proportion have not conceived, the ram should be replaced.

If facilities are available, some sterile rams may be detected early by examining the semen under a miscroscope. After the ram is bred to a ewe, tip the ewe up on her tail and, using a small, smooth spatula, take a drop or two of the semen from the vagina and place it on a slide. Examine the slide immediately under a microscope. There should be large numbers of active, normally shaped sperm.

Artificial insemination. Although the techniques of practicing artificial insemination in sheep have been carefully developed, the amount of labor necessary makes it impractical under farm or ranch conditions. One of the major problems is that heat can be detected in the ewe only by a ram. In addition, ram semen has not yet been frozen without serious loss of viability. Thus only fresh semen is recommended for insemination.

Breeding During Hot Weather

Various experiment stations have found that hot weather is linked to lowered fertility of both the ram and the ewe. The Kentucky station has determined that semen quality and early embryo survival will suffer when temperatures reach 90°F or more.

Many fertilized eggs in the ewe degen-

erate during the early stages of cell division within a very few days of fertilization. The result is loss or resorption of the embryo after which the ewe starts her reproductive cycle again, coming into heat at a later date. This may reoccur several times in a portion of the flock and thus prolong the lambing season. This situation is typical of California's hot valleys where ewes bred during May, June, July, and August tend to lamb from October to February. Observation indicates that no such spread in lambing date exists where ewes are bred in the fall, in coastal areas, or high in the mountains.

To minimize the effects of heat on breeding, you may:

- Move your ewes to coastal areas or high in mountains for breeding where possible.
- Save cooler, better shaded fields or range areas for breeding time.
- Keep rams in cool shade, along waterways or in a well ventilated barn in the daytime and return them to the ewes to breed at night.
- Keep both ewes and rams in cool quarters and turn them out to graze at night.
- Shear rams two to three weeks before breeding.

Breeding ewe lambs

The common practice is to breed ewes for the first time when they are 18 to 19 months old, so they give birth to their first lamb when they are approximately two years of age. Under this system the only return received from the ewe during her first year is her wool clip.

Where a good feed supply is available for the ewe lambs, they can be bred at nine to eleven months of age, so they lamb when they are 14 to 16 months old. For example, a ewe lamb born in November, 1966, might be bred in August, September, or October, 1967, to lamb in January, February, or March, 1968. Size is a better criterion than age in deciding when to breed a ewe lamb. She should weigh at least 80 pounds when bred, preferably 90. These lambs should be well fed continuously to insure steady growth during pregnancy. As lactation is a more severe drain on the ewe than is pregnancy, the yearling ewes should be kept on excellent feed while nursing the lambs. If good pasture is not available, the ewes should receive a grain supplement.

The lambs produced by these young ewes should be weaned young—usually by three months—to allow the ewe to regain condition for the following breeding season. That is, in the above example, lambs should all be weaned by June 15, 1968, so that the ewes can be rebred, to lamb early in the season when they are two years of age.

This practice of breeding ewe lambs is fairly popular in sections of California where a good supply of summer feed is available, particularly in irrigated-pasture areas. Records kept by the Extension Service of cooperatve tests with sheepmen having more than 13,000 ewes indicate that using this system of breeding a lamb crop of from 60 to 85 per cent has been obtained and the average return per ewe bred was $16.60. This practice is not recommended to sheepmen who do not have a plentiful supply of feed for the ewes during the entire season. Extra care and attention are necessary in lambing such ewes.

HORMONES TO INFLUENCE BREEDING

Much research in this country and abroad has investigated the use of hormones to bring ewes into heat during the period when they are not normally cycling, to promote a fertile heat cycle during lactation, to synchronize flocks as to heat cycle, and to increase the incidence of multiple births.

Results to date recently have been summarized by Leon Bush of South Dakota,

providing the basis for part of the succeeding discussion.

A gonadotrophin called PMS, which is an extract of pregnant mare serum, will induce ovulation in ewes not in their normal cycling season. This ovulation frequently is not accompanied by heat. Progesterone administered prior to the PMS will produce heat and ovulation Fertility at the induced heat period in most though not all studies has been low (about 33 per cent), especially during the middle of the period when ewes are normally not cycling.

From 60 to 90 per cent of ewes in lactation have been synchronized in heat cycles by feeding progestins. The heat cycle occurs within four days following cessation of progestin feeding. In some trials none of the ewes conceived, in others the conception rate was low (28 per cent).

Ewes lambing in the fall may be bred while lactating, and most of these can be expected to conceive within 30 to 45 days after lambing. Fall is the normal and most fertile breeding period for sheep.

During the normal breeding season with nonlactating ewes, synchronization of heat with normal fertility is very promising. About 85 to 100 per cent of the ewes can be synchronized and exhibit heat within two to three days following a daily feeding of progestins for a period of 16 days. Conception rate is about normal (60 to 70 per cent). Ewes not showing heat or not conceiving may return to a synchronized estrus in 16 to 18 days. Some experiments report better than 85 per cent conception for the two heat periods, but other trials have been less promising. Lambing will be bunched to a certain extent. Length of gestation may vary a week or more. Although ewes are bred in a two- or three-day period, lambing may vary a week or ten days, with most ewes lambing in a four or five day period.

The use of PMS to increase ovulations per ewe so as to get an increased lamb crop is under study. Current trials show varying results indicating poor control of number of eggs produced. Many ewes are having a large number, and thus too many fetuses may occur. Future work on this subject may prove more productive.

A principal advantage of synchronization is to allow more practical use of artificial insemination. Artificial insemination used on synchronized ewes thus far has not been completely satisfactory. Natural service has resulted in a much higher conception rate.

Thus far the Food and Drug Administration has given clearance for commercial use of two hormone products used to control breeding. The first is Repromix®, used as a feed additive for a period of time to keep ewes out of heat. Withdrawal of the additive promotes synchronization of heat cycling in the ewes. The second product, Cronolone®, is administered in small sponge pessaries which are inserted into the ewes' vaginas. After 12 days, withdrawal of the sponge allows ewes to start cycling in a synchronized manner. Thus far, the efficiency of these products varies widely among flocks and areas. If you are considering these products, get local information from your Farm Advisor. Much research is in progress in this field. Control of heat to allow breeding of animals at will has far reaching importance to the livestock industry.

In the meantime, and until efficient control of heat has been accomplished, producers breeding for early lambs are advised to use breeds noted for an extended breeding season, such as the Rambouillet and Dorset Horn. Where producers raise their own replacements, selection of these from among early born ewe lambs is recommended.

THREE LAMB CROPS IN TWO YEARS

In an attempt to increase the profits of sheep production, producers are trying to

rear more lambs per year. To get two lamb crops in one year does not appear to be feasible with existing strains of U. S. sheep. Most ewes do not show a heat cycle and ovulation for the first two months of lactation. It is also not practical to wean lambs at 30 days of age or less. Ewes that will breed during lactation tend to breed about three months following birth of the lamb.

It does appear possible, however, to breed sheep so they will produce three lamb crops in two years. This may be accomplished in one of two ways. The following schedules are examples.

SCHEME I

Breed	*Lamb*	*Wean*
May, year one	October, year one	January 1–7, year two
January, year two	June, year two	Sept. 1–7, year two
September, year two	February, year three	May 1–7, year three

SCHEME II
for aged ewes

September, year one	February, year two	May 1–7, year two
June, year two	November, year two	February, year three

After weaning in February of year three the aged ewes can be sold for mutton.

Probably the most practical of the multiple lambing schedules possible are those of the type shown in Scheme II. This allows the ewes to be sold for slaughter at the time of year (February) when ewe prices are relatively high. With plentiful feed supplies the lactating period can be extended for old ewes and they can go to slaughter later. With young ewes the animals would not be sold but rebred under a continual system as in Scheme I.

In Scheme I the most fertile lambing—the highest rate of twinning—would result from breeding during September. The scheme allows five months for gestation, and at least two months and up to three months betwen lambing and weaning. Actually, 34 days should be allowed for breeding so as to encompass two heat cycles (averaging 17 days each).

Sheep producers may be doubtful of the practice of weaning lambs at two months of age. Much research has been conducted on early weaning of lambs. The trials indicate that where early weaned lambs are at least 60 days of age, weigh 50 pounds or more, and are consuming at least ¾ pound of creep feed daily, no significant difference in gain can be measured between weaned and unweaned lambs.

Early weaned lambs may be fed in drylot or on pasture with the preweaning creep ration fed for consumption at will. Such lambs not following their mothers have much lower numbers of internal parasites, even when pastured, than lambs on ewes.

Disadvantages of Scheme I

- More annual labor.
- Some of the lambings occur during less favorable climate periods of the year.
- Some of the breeding periods occur at periods when ewes tend to be less fertile and are cycling less. Rams tend to be less fertile in early spring.
- Early weaning will require the feeding of larger amounts of concentrates than with the usual management.

These disadvantages may be minimized by providing shelter against rain and cold or moving to cooler areas for lambing in periods of high temperature. Cool devices can be used under shed conditions for lambing or growing stages.

Rambouillet or Dorset Horn ewes, because of their long heat season, can be adapted to such a scheme more easily than other U. S. breeds.

You may save ewe and ram lambs as replacements from among those ewes breeding most consistently during May; this will increase total lamb crop in subsequent years.

Advantages of Scheme I:

- Opportunity for a substantial increase in number of lambs raised.
- Early weaning will allow more breeding ewes to be kept, because you need not keep ewes on high-quality feed when they are not nursing lambs.

Relatively little is known about the practical application of such schemes. They are tried out by sheep operators in other states. A recent survey of 66 Ohio producers found that 28 operators were conducting a multiple lambing system aimed at three lamb crops in two years. The average flock size was 77 head. The breeding schedule most frequently followed was August–September and April–May on one year and October–November–December the second year, returning to twice a year breeding on the third year. The study recommends that the mating season be restricted to three heat cycles or approximately 60 days. The numbers of lambs produced by ewes at the different matings were not given, but the study concludes that lambing three times in two years offers the potential of a 40 to 50 per cent increase in lamb production.

Any California sheep producer who wishes to try a multiple lambing system should contact his county livestock Farm Advisor. The Agricultural Extenson Service would welcome the opportunity to gather more information on these procedures.

SHEARING, BRANDING, AND HOOF TRIMMING

Shear in the spring, late enough to minimize danger of a cold storm. In California this period will vary from February in the extreme south to July in the mountain areas.

Shearing is generally done by professional shearers, who furnish their own tools and power supply. Usually the sheep owner must provide facilities for penning the sheep, as well as a shearing floor and a sacking stand for the wool; but some crews will also provide the pens.

Tie the fleeces carefully with paper twine and pack them in regular wool bags, which will hold 20 to 40 fleeces with a weight of 250 to 350 pounds. Tags (see p. 51, black wool, and buck wool should be sacked separately from the ewe fleeces. Keep dung locks out of the wool bag.

Sheep, other than ewes nursing lambs, should be kept off feed for a few hours before shearing. Sheep full of lush feed are hard to shear, and this may result in some losses.

Summer shearing. In most of California the usual time for shearing is March or April. Some sheepmen, particularly in Yolo, Solano, and Sonoma counties, shear again in late summer or early fall. This shearing must be done before the nights become too cold in the fall, or you take the chance that your sheep may get pneumonia.

Experimental results show that the actual weight of clean wool produced in twelve months varies little between once-a-year and twice-a-year shearing.

Disadvantages of summer shearing

- Increased cost. Shearing costs will be doubled because the price per head for each shearing is the same whether the ewes are shorn once or twice a year.
- The length of staple of the wool is reduced. The fall clip having been grown for only four to five months will be too short to comb and will sell for a reduced price. The spring clip grown for seven to eight months will also sell for less per pound than a 12-month clip.

Most California sheep are shorn in movable shearing plants consisting of temporary pens. Small electric motors run by a generator are used to power the hand pieces while a temporary canvas shelter furnishes shade. Man provides the power for trampling wool.

In modern shearing plants the electric shearing equipment is housed permanently in movable trailers. The sheep are passed directly through an alleyway running through the trailer. The wool is bagged by a hydraulic packing device.

Advantages of summer shearing

- Ewes that are shorn will thrive better through the winter.
- Fewer ewes are lost from getting down on their backs and being unable to get up. A ewe with a long fleece is forced when wet to carry considerable additional weight.
- Less trouble with fly strike. The ewe that has been summer-shorn is less likely to get dirty around the rear quarters. If ewes are not summer-shorn, they should be tagged before lambing.
- The spring clip will be cleaner. Through late spring and summer sheep will pick up bur clover, foxtail, and other weed seeds that cling to the wool. These seeds irritate the skin and cause discomfort to the sheep. Summer shearing removes these seeds, relieves the sheep of irritation, and results in a spring clip free of seed defect.
- The heat load of the ewes is relieved. By summer shearing in early August, discomfort from high temperatures is reduced. Some sheepmen believe that ewes breed better after the wool is removed, if plenty of nutritious forage is available. More energy is expended to keep warm at night and cool during the day.

Branding. Sheep are commonly branded with the owner's brand. Such a brand is essential for separating sheep, in case of a mixup with others. Only branding fluid that will scour out of the wood should be used. Commercially, wool is scoured in an aqueous solution. Branding fluids which are lanolin-base emulsions are known to be scourable. The brand may be carved out of wood or made of heavy wire or metal that will hold its shape. It should be not over 6 inches in diameter. Larger brands will become so large as to prove unreadable as the wool grows. The brand should be placed on the back of the sheep so that it is easily seen by the operator of a parting gate in a chute.

Careful trimming is necessary to cure foot infections such as the foot rot shown in this picture.

Hoof trimming. Unless sheep are traveling over rocky and gravelly terrain, the feet should be trimmed at least once each year. If the feet are not trimmed the toes grow very long and the wall of the hoof turns in, producing deformed feet. Such untrimmed feet may produce lameness and even permanent weakness and crooked legs and pasterns. Neglected feet often break unevenly and are subject to foot rot and foot abscess. A good practice is to trim the feet of all sheep every fall. The hoofs will be softer after the ground is damp following the first fall rains.

CARE OF EWES FROM BREEDING TO LAMBING

After the ewes are bred, they are usually put on whatever pasture is available. Grain stubble and other crop aftermath are suitable feeds. If ewes are kept continually on irrigated pasture they may become overly fat. On the other hand,

Ewe that has been tagged about the rear and has had wool shorn from the udder to promote cleanliness at lambing and enable the lamb to nurse more easily.

those pastured on native ranges may become too thin. In general, pregnant ewes should not be allowed to lose weight but should gain enough to be in good condition at lambing time.

Beginners may be misled about the condition of ewes at this time of year, because as the wool grows longer they appear to be gaining weight. Their actual condition can be readily determined by catching a few animals and feeling through the wool along the back and ribs to determine the fat covering.

Handle pregnant ewes, especially those three months or more along, as easily as possible in all respects to avoid miscarriages. Passing the band over ditches, through gates, or working them in chutes are operations which must be performed with a minimum of crowding and running. Savage, or fast-working dogs are always bad but here can cause havoc. On the other hand, allow the ewes plenty of exercise and let them range considerably in feeding. This insures that they be strong at lambing time.

Tagging ewes

About one month before lambing, the ewes should be tagged and flanked, and the wool sheared from around the eyes of any animal that may be "wool blind." Tagging consists of shearing the wool from the rear of the udder and between the teats as well as around the anus and vulva. Flanking consists of shearing the wool from the front edge of the hind legs and for a short distance along the flanks and in front of the udder and teats. This insures prompt cleaning off of the ewe after lambing and allows the lamb to find the teats more easily for nursing. It also gets rid of any burs or spines in the wool which rub or scratch the udder when it becomes distended with milk. These operations are particularly important in longer-wooled breeds but recommended for any sheep.

Feed well for health

At least two weeks before lambing place the ewes on lush green pasture if at all economically feasible; this will insure a heavy milk flow at lambing time and also appears to increase the degree of mother love shown for the lamb at birth. At any rate, heavy ewes should have the best feed you can give them—their bodies are under the double strain of providing for the lamb as well as for themselves. Where bloat is a problem, ewes in late pregnancy are particularly subject to it possibly because there is not much room in the abdomen for stomach expansion or merely because they have a greater appetite at this stage of pregnancy.

Lambing paralysis

Heavy ewes (those in late pregnancy) are subject to lambing paralysis (also called pregnancy toxemia, twinning disease, or parturient paralysis), especially if they are on poor bulky feed and kept confined too much. This disease is not found in well-fed range ewes. Give plenty of sufficient exercise even if the animals have to be driven out of the barn or corral and down the road. The affected animals become blind, appear stupid, and tremble. Often the sick ewes are those carrying twins. If the disease is not advanced too far, the animals will recover if drenched or bottled with water and molasses. The remainder of the band may also be fed molasses or grain to avoid lambing paralysis because the disease is correlated with a low carbohydrate diet.

Sorting the ewes before lambing

Before lambing many sheepmen "bag out" the heaviest ewes (separating those that have the largest udders) and keep them in a separate bunch so that they may have more care and shelter. This is particularly important in shed lambing because later-lambing ewes are more active and tend to crowd the heavier ewes and knock them about. Usually it is wise, if the ewes are to be corralled or put in the barn for lambing, to remove all bells from the ewes to minimize noise and disturbance in the band.

Lambing the ewes

Lambing is a term referring to the caring for the ewes at lambing time as well as to the act of giving birth by the ewe. A lamber is a man who has had the specialized knowledge and experience enabling him to properly care for the ewes at this time. If you have a sufficiently large band of ewes that is going to lamb soon and you lack experience in lambing it will pay to hire a good lamber. A good lamber's wages are much higher than those of an ordinary herder, because the work is harder, the hours longer, and more specialized knowledge is required. Yet, a good man can more than pay for his monthly wages in a few days. Many herders are fair or good at lambing, and many are unsuitable.

The equipment needed for lambing consists of a sheep hook, a small pair of blunt-pointed scissors, a pair of sheep shears, at least 100 feet of ¼ inch cotton or hemp rope, a good pocket knife, bottles and nipples, canned milk if a milking goat or cow is not available, iodine, sheep dip or creoline, and some blowfly repellent such as Pinetrel, Smear 62 or K.R.S., as well as any additional veterinary supplies such as penicillin or sulfa tablets if these are to be used. Your local veterinarian can recommend and furnish such remedies.

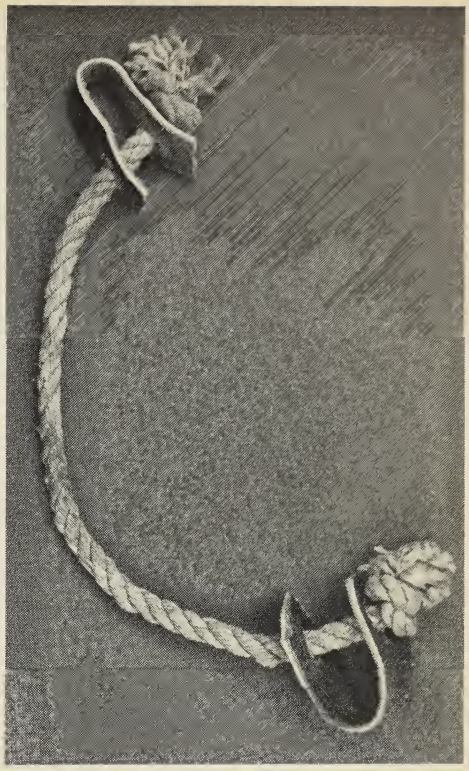
Lambing is done either on the open range, in a shed or corral, or in pastures. The location depends on the climate and your area. The location of the lambing grounds, their arrangement, and the weather also dictate to a large extent how much the average ewe must be handled or disturbed while lambing.

Open Range Lambing

Lambing on the unfenced open range is usually done by the drift or loose lambing method: The ewes in the lambing or "drop" band feed slowly, attended by a herder. As indvidual ewes stop to lamb they are left behind undisturbed for an hour or more. In the evening these ewes are collected in bunches, usually by another man, in the back path of the band. He checks to see that the lambs have nursed, then leaves them alone overnight. In areas where coyotes are around he usually leaves a burning lantern near each little bunch or he may light small brush fires to keep the coyotes away. This is usually but not always successful. In the morning he repeats his performance with the new lambs of the day before and

puts three or four of the small bunches together from the preceding day's drop.

After another day or two each of these bunches may number 100. They are left separate for about one week, and one herder checks on one or two of these bunches. After this they are bunched still more, and finally bands of 500 ewes and their lambs are formed at not less than ten days and usually two weeks of age. This method requires several men. Sometimes as many as six men are in one lambing camp. As bands of 250 and then 500 ewes and lambs are formed, a man will take charge of each of them as his personal band to herd for the season. In the case of large sheep owners, other bands of later-lambing ewes are added to the drop band from time to time so that lambing continues until all have dropped lambs. This method of lambing gives minimum disturbance of ewes and young lambs and, given adequate predator control, plenty of green pasture and water, results in raising a large percentage of the lambs dropped.



Twin hobble as described in the text.

Pasture lambing plan

Lambing in fenced pastures is most easily accomplished by this same general method. Less labor is required because the ewes are fenced in. A larger percentage of lambs can be saved in fenced pastures than on the range because any ewes having trouble lambing are more easily caught and helped. Also, those having dead lambs can be brought in and given a live lamb to rear. The ewes may be moved from one pasture to another once per day, usually in the mornings if they are lambing slowly—perhaps 15 in 24 hours—or twice daily if they are lambing very heavily. One thousand ewes during their heaviest lambing period will not usually exceed 60 ewes lambing in 24 hours, and this will occur only for one or two days. As the ewes are moved from pasture to pasture they are drifted slowly along, allowing the ewes with lambs to fall back and remain in the vacated pasture for 24 hours without more disturbance than is necessary.

Keep twins together

It is usually wise to go through the band before it is moved and mark sets of twins with soft chalk on the back so that they may be easily recognized if they become separated. Hobbles may also be used where the ground is not too uneven or weedy so that hobbled twins will not be entangled. Twin hobbles should not be more than 8 inches long. They can be made from ¼ inch, fairly stiff rope knotted at each end with small soft leather cuffs such as can be made from buckskin or bits of old shoe tongue. These cuffs hold one foot of each lamb and, because they may turn on the rope, act as swivels so that the rope will not twist. The right front foot of one lamb is placed in one cuff and the left front foot

of the other lamb in the second cuff. Lambs pull away from each other at first but quickly learn to walk and even run in these hobbles.

The hobbles may be removed when lambs are three days old. These are the only hobbles that can be recommended; others made of knotted string, rope and other materials, twist badly and may break and be forgotten on the lambs, later making them lame as they grow larger. Never make hobbles longer than 8 inches from cuff to cuff, because with longer ones lambs may jump up on ewes as they are lying down, and as the ewe rises get hung across the back or neck of the ewe, being dragged to death or crippled.

Temporary holding pens

On small pastures remove the twins from the singles and place them in small separate enclosures. Do not put more than five pairs under 24 hours old in any one place.

Observation of the mother and lambs will dictate how soon she may be safely placed in a larger group. Some ewes keep their lambs together and others do not. Young lambs lost even an hour or two from their mothers often go unclaimed. Many sheepmen have extra rolls of twenty rod mesh wire and iron posts which are used to make temporary small pastures at lambing time so that young lambs can be kept in small bunches.

Separate any ewes having difficulty in lambing from the band and place them in small pens where the lamb can be removed manually. Ewes having dead lambs should be caught and penned separately also, together with their dead lambs until they can be given new lambs. Either of the foregoing operations may be performed in the field by a very careful lamber if the ewes are well fed and not overly wild.

In pasture lambing, as on the open range, do not place more than 100 ewes together until their lambs are ten days old. At the age of 1 to 12 days they may be put in bunches of 250 or 300, and at three weeks or more 500 or more may be bunched. The longer the ewes and lambs remain in small groups the better they will do because a ewe can find her lamb with less disturbance and in less time. The ultimate size of the band of ewes and lambs is dictated by feed conditions, but usually 650 is about the maximum number of ewes which should be in one bunch.

Avoid disturbing ewes

Where lambing must be carried out in two or three pastures it may be necessary to move the ewes and young lambs out of the lambing field within an hour or two after they are born and have nursed. This requires much labor on the part of the lamber because each ewe with twins, and also many of the singles, must be moved individually. It disturbs the ewes and lambs a great deal to move them so soon. Avoid any disturbance of a mother and very young lambs whenever possible.

Anyone working with lambing ewes or ewes with very young lambs must be experienced in such matters. An unskilled man creates havoc because of the way he moves and acts, and also because he cannot tell if a certain ewe is having trouble lambing. Any unexperienced man must work with an experienced lamber so he gradually acquires this special knowledge.

Lambing in sheds or corrals

In this system the lambing ewes are placed in large sheds (or barns) or corrals for lambing and are fed from troughs and hayracks or mangers. The shed or corral is usually divided into sections and a certain portion of the band is placed in each enclosure to prevent too many ewes from lambing together and getting their lambs mixed. Where this is not done, the lambs have to be separated out one at a time, slowly and carefully, until each ewe has her proper offspring.

Even when the animals are carefully

Small separate pens keep ewes and their newborn lambs together until they are thoroughly acquainted with each other.

separated, two or more ewes may claim the same lamb and one or more lambs may be without mothers. In such cases one lamb must be arbitrarily given to each ewe and if she does not claim it, she must be tied and penned separately with the lamb until she does.

In sheds separate small pens are usually arranged along one or both sides of each enclosure. During heavy lambing, ewes just before or just after lambing are placed in these pens with their lambs until the lambs are dry and have suckled. After this they may be placed in small groups in other enclosures. Corrals are usually boarded up solidly to act as windbreaks; close-set double fences of wire netting filled with straw may perform the same function.

Pair branding

It is very helpful to brand both the ewe and the lamb with the same number. The ewes with single lambs may be branded with black paint or on the left side, and the ewes with twins with red paint or on the right side. This makes it easy to identify the ewe with her lamb or lambs after they are turned out of the small pens.

Night and day care

During heavy lambing it may be necessary to have a night lamber and a day lamber. The barn is usually lighted by kerosene or gasoline lanterns or electric lights, so the night man is able to care for any ewes having trouble and remove the ewes and young lambs from the band during the night. Under California conditions, for the most part, barn lambing is practiced only during stormy or cold, windy weather; most lambing here is done in pastures or on ranges.

Gentling ewes

In the North Coastal Regon of California, where ranges are very brushy, it is common practice to leave bands of ewes in large fenced pastures and allow them to lamb by themselves with little or no care during that season. At the present prices of feeder or fat lambs it would be well

worthwhile to give the ewes more care and thus help them to rear considerably more lambs and reduce mortality among the ewes. Even in areas where ewes tend to become very wild they may be gentled considerably by the judicious use of a few sacks of corn or barley.

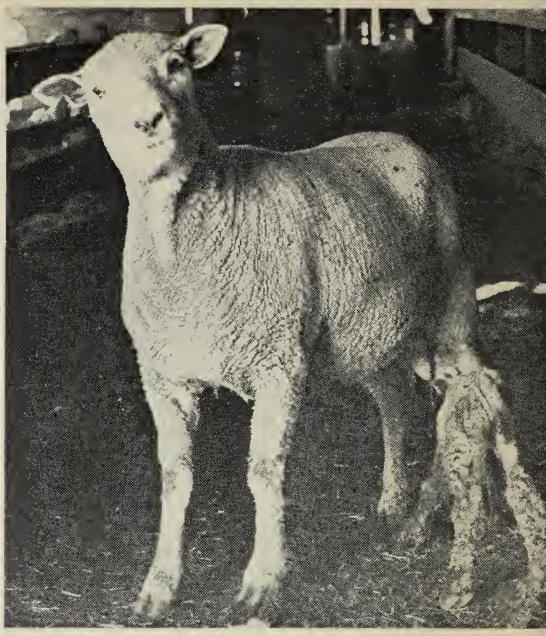
Techniques of lambing

A person engaged in lambing ewes should always carry his sheep hook, a couple of five foot ropes, twin hobbles (if used) or marking chalk, medicine, and a pair of small blunt-nosed scissors.

An experienced lamber always works as slowly as possible with lambing ewes or ewes and young lambs in order not to frighten them. He stops frequently to see if new lambs have nursed; if ewes in the act of lambing are having difficulty; and to note some abnormal appearance or action of the ewe or lamb which might indicate trouble. He should be familiar with his drop band, as the lambing band is called, and check on ewes that have abnormal udders or teats (see below), or perhaps a rupture (which may prevent them from rising after lambing). Observation is all-important and pays good dividends to the sheep owner.

Nursing troubles

Many ewes that lamb normally have abnormal udders or teats which cause the lamb so much trouble nursing that, if this is not noted in time, it may result in death by starvation. This is particularly common among older ewes. The ewe may have a "spoilt bag" in which the udder has no milk because of some former disease or injury; a "hard bag" in which it secretes but a few drops of milk at a time; or may have only one good teat, the other having been cut off in shearing. In the latter case the bad teat is sometimes the smaller of the two and the lamb will nurse it and disregard the larger good one and so starve. Such ewes can be penned separately and their lambs suckled by hand until they learn to choose the good teat.



Ewes with large teats should be penned alone with their lambs and have their lambs suckled by hand until they learn to nurse the abnormal teat.

Spoilt-bag and hard-bag ewes are best sold for slaughter. Mark them immediately, so you can identify them later at culling time. Marking is most quickly and easily accomplished by cutting off both ears close to the head with a sharp knife.

Ewes with "hanging" or pendulous udders may have the teats placed so low that the lamb keeps searching above them for the milk. Other ewes are short-legged and low in the flank so a large long-legged lamb will not lower its head enough to find the teat. Both of these types of ewes must be penned and the lambs suckled until they learn to nurse alone. Large or exceptionally long teats may also cause trouble.

Navel ill

When lambs are born in muddy corrals or barn pens, the navel becomes badly contaminated. This allows disease organisms to enter, causing a crippling or fatal

malady called navel ill. To avoid this, disinfect navels of newborn lambs by dipping the cord into a widemouth bottle of tincture of iodine and then tipping the bottle against the abdomen. Clip off long hanging navels with scissors at about 1½ inches from the abdomen.

"Breaking" the teats

Occasionally the small plug which closes the ewe's teat opening is so firmly in place that the lamb, perhaps weakened by exposure, is unable to nurse. Such ewes should be caught and hand milked for a couple of squirts. This "breaking the teats" should be routine practice whenever the lamber catches a lambing ewe. Where both teats have been cut off at shearing time many lambers try puncturing the teat to make an artificial opening. However, these openings usually heal over soon, and such ewes are better marked and sold as culls. Occasionally, too, a ewe's udder, perhaps from injury or infection, contains blood mixed with the milk. Pen such ewes separately where they may be observed until the milk clears. Sometimes her lamb will sicken and die but a larger, older lamb may be given to her if her milk clears.

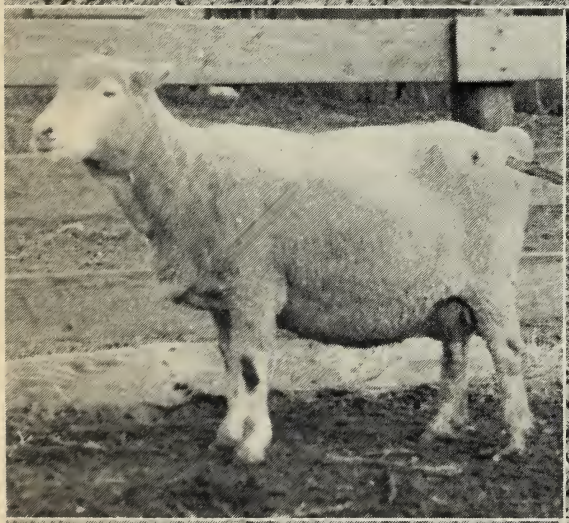
Normal lambing

In the normal lambing act a ewe will begin to bleat and move around a great deal, pawing at the ground to make a slight excavation for a bed. Soon after some straining the fluid-filled membranes ("water bags") will appear externally. Inside the mother the mouth of the uterus, normally very small, has become greatly enlarged to permit passage of the lamb. This enlargement occurs within the last hour or two preceding birth. After the water bags have passed and broken, the lamb will appear usually within thirty minutes. First the front feet, then the nose slightly between and above the feet. During this procedure the ewe will usually be lying down on her side, perhaps bleating with the strain and effort as she alternately breathes and then strains to contract her abdominal muscles and expel the lamb.

As birth proceeds the lamb slides forth, first the head and forelegs and then rather quickly the remainder of the body, all coming out in an upright position. The mother then gets up and, in turning around, stretches and breaks the navel cord which is attached from the lamb to the placenta or afterbirth of the ewe. She begins to lick the lamb with her rough tongue cleansing the wool of its slimy covering and drying and warming the lamb. The lamb, if strong and healthy, should rise within the next few minutes and begin searching for the teat. The afterbirth is passed from a few minutes to several hours later. The fluid which covers the lamb acts both as a shock absorber for the lamb within the mother and an all-important lubricant to facilitate passage to the outside. Certain ewes continue to lick the lamb for some time and cleanse it much more completely than others. They may even bite off the end of the tail and the navel cord.

Assisting in difficult births

The head of the lamb is sometimes so large that the ewe is unable to force it out unassisted. The condition is particularly common when Hampshire rams are used with young or small ewes. In helping ewes in this condition the lamber lays the ewe on her side and grasps the front legs of the lamb, sliding the fingers of the other hand up over the forehead of the lamb. This will facilitate passage of the head if at the same time the legs are pulled slightly downward and outward. The lamb should be extracted entirely, but little by little, giving the ewe a chance to breath and rest slightly inbetween the pulling efforts. If grasped firmly and pulled forcefully from the ewe the uterus may be torn or turned outward (prolapsed) so that it appears externally. This is fairly common in ewes following difficult delivery.



THE BIRTH OF A LAMB

Page 58, top: Ewes in late pregnancy showing enlarged abdomen and filled udder. They are sedate in their actions and should be handled gently.

Center left: As the time of birth approaches, the ewe develops a hollow, high in the flank.

Center right: After pawing a shallow bed, the animal lies down and strains, forcing out the fluid-filled membranes which surround the unborn lamb inside.

Bottom left: The heavy mucus within the membranes acts as a shock absorber for the lamb inside the mother. It also acts as a lubricant to make the birth of the lamb easier. These "water bags" (membranes) commonly break, as shown in the picture. (Note string of mucus hanging from the vulva.) The release of pressure makes the ewe believe that the lamb has been born.

Bottom right: After a short period of straining the nose and forefeet of the lamb appear.

This page, top left: Next, the entire head appears.

Top right: With further straining of the ewe, the lamb slides out. Note remnants of the membranes still clinging to the skin of the newborn.

Center left: As the navel passes through the pelvic arch of the ewe, the navel cord which had furnished oxygen to the lamb within, becomes pinched. This causes the lamb to take its first breath, and it usually shakes its head and coughs to clear its mouth and nostrils of mucus.

Center right: Birth completed, mother and offspring lie resting for a few minutes.

(See next page for continuation.)

(Continued from page 59.)

From top to bottom: The ewe rises to clean the coat of the newborn lamb by licking it with her rough tongue. This tends to warm and dry the lamb.

Within five or ten minutes after birth the lamb is on its feet, ready to nurse. It searches and soon finds the teat.

Full with milk and satisfied, the lamb enjoys the sun after its ordeal.

If the lamb's head and only one foreleg appear, the lamber may pull the lamb essentially as in the preceding case. Sometimes the head only is outside and the forelegs are directed backward or doubled back at the knees. These lambs cannot usually be extracted by pulling the lamb alone, without killing the lamb. The lamber should either slide one hand past the head and grasp at least one front foot to help in the extraction, or should push the head back in little by little so that there is room to insert his hand, then bring out both front legs and the head as in normal birth.

In such instances quick action is necessary. If the ewe is not helped soon the lamb will try to breathe and choke even though the navel cord remains unbroken inside. These lambs are known as chokers or swell heads. As the case progresses, the lamb's head swells greatly and if it cannot be extracted in any other way it may be necessary to sever the head of the lamb with a knife and then reach in and grasp the legs, extracting the lamb. Such ewes should be given a new lamb immediately by slime grafting (see below).

Turning lamb within mother

Occasionally the lambs will be turned and doubled inside the mother in such a way that the loin (lumbar region) of the lamb is forced against the passageway. This is not visible externally but can be ascertained by feeling with the hand. Such a lamb must be turned within the mother so that it may be pulled frontwards (normally) or backwards (breech delivery). In such instances, two small soft cords are often employed to carry in with the hand and loop around the legs or head of the lamb to facilitate removal.

Backward lambing

If the lamb is being born backward it may or may not be born alive without help. Often the ewe will have trouble passing the chest of the lamb and as the

lamb's navel is somewhat pinched in this position and its oxygen supply thus is greatly reduced or cut off it must be extracted quickly so that it can breathe, or it will die. Usually before the ewe is caught, the hind legs of the lamb are visible with the tips of the toes pointing downward. In such instances, the ewe must be caught and helped. Even though some ewes may have their lambs without help when coming backwards the lamb will often smother after emergence as the membranes covering the lamb tend to stay on the head, shutting off the air to the nostrils. These lambs following extraction are usually slow to breathe normally and may be helped by artificial respiration or by blowing strongly into the lamb's mouth to inflate the lungs.

Other examples of abnormal births include those in which two lambs have become wedged in the birth passage of the ewe or those in which the front appears normally but the head is turned back. In all instances every effort must be made to straighten out the lambs and extract them in the normal position.

Dry births

Dry births are those in which the fluid-filled membranes surrounding the lamb inside have burst long before actual birth of the lamb. Here the lubricating fluids have drained out so that the lamb cannot slide forth easily. This condition may result in yet another example of "difficult lambing" or in stillborn or "slink" lambs, usually dead. These cases are very difficult to extract.

Lubricants such as vaseline or egg white may be used to help in cases of dry birth. If the lamb is dead and ill-smelling, it may be extracted piecemeal. The legs often pull off easily. Such dead lambs may have a bloated or fluid filled stomach and will not come out. As an emergency measure, an experienced lamber, holding a smooth, sharply pointed stick inside his hand, may puncture the lamb's stomach, letting the fluid or gas escape and make extraction possible. Great care should be taken that the lamber's fingers cover the point of the stick while it is being inserted so that the uterus of the ewe will not be injured. Afterward the ewe should be douched with an antiseptic solution or may have a uterine suppository inserted in the uterus. Other measures include use of antibiotics given by mouth or by injection. The lamber's hands should be washed in a strong antiseptic immediately.

Ewes are often very sick following such a delivery and should not be given a lamb until they show interest in one. Such ewes often die of infection so every precaution should be followed to help them. Lambs have been saved when they were simply too large to be born by performing a caesarean operation on the ewe but such measures are very rarely necessary and should be used as a last possible resort and only by veterinarians.

Locating ewes having difficulty

Ewes having one of the abnormal conditions noted in the preceding paragraphs stand around and paw in a desultory fashion at the ground, try to lamb for awhile, get up often, and finally just stand with hanging head, usually with a hollow place high in the flank after alternately trying and giving up for two hours or more. Examine such ewes first by inserting your hand to see that the mouth of the uterus is enlarged enough to emit the lamb. If not, let her go for an hour or so until this opening enlarges sufficiently. If you cannot insert your entire hand and touch the lamb inside, the ewe is not yet ready to lamb.

Always insert your hand after a lamb has been extracted to be certain that no more lambs are still inside. Sometimes, especially in older ewes, triplets or even quadruplets are born.

Prolapse of the uterus

Some ewes, particularly following difficult lambing, will be found with the

Retainers for the uterus made from #10 gauge wire. The wire is twisted into the form shown. It should be 8 inches long and 4 inches wide. Ends of wire should point away from the skin surface of the ewe. This device is inserted into the vagina and the loop serves to hold the uterus out of the pelvic canal. Thus, the animal is unable to force the uterus out.

uterus turned inside out and protruding from the genital opening of the ewe as a large red knobby mass. Such ewes should be caught immediately and the uterus carefully washed with cold soapy water or cold water to which a mild antiseptic has been added to cleanse it and also contract it. It may be worked slowly back into the ewe, being careful to bruise it as little as possible. Various methods are in use to keep it in place. Some lambers sew the opening with strong strings, others use small wire devices to insert into the genital opening to keep it in place.

An excellent aid consists in tying a small ¼ inch rope around the flank of the ewe in front of the udder and up over the back. This should be fairly tight so that the ewe can walk and just get up and lie down. This acts as a cinch to keep the ewe from straining, and if the uterus is carefully put back in place it wll tend to hang down inside and will not come out again as long as she cannot strain. The rope may be left for several days to give the swelled uterus time to reduce inside and the inflammation to dissipate, after which it may be removed. Such ewes need antibiotic or other treatment to keep down infection when the uterus is first put back. They should be marked and sold for slaughter, otherwise the same thing may happen another year.

Abnormal lambs

A certain percentage of the lambs born to any large band of ewes will be deformed. Some will be extremely bow-legged, or totally unable to walk; others bow-necked and thus not able to raise the head and nurse; still others will have a short lower jaw, be extremely weak in the back, or have their feet twisted and deformed. Some will be premature or dwarfs—very small and covered with curly coarse wool or hair.

Such lambs, even though they have excellent mothers with a good milk flow, will rarely grow to become large, well-built lambs. It is more humane and also economically sound to kill these lambs immediately upon birth and give the mothers a bummer or orphan lamb.

Cold weather protection

(See section on equipment for shelter structures for young lambs.) Lambs born outdoors in very cold, especially windy weather, will often freeze before they can stand up and nurse. Little can be done to save these lambs without artificial heat of some sort. Many lambers place the cold lambs in boxes on sheep hides or sacking, and leave them near a stove or campfire. A car heater can be used by placing the lamb directly in front of the warm blast of air.

By far the best method of revival is to immerse the lamb up to its neck in a bucket of warm water as hot as your hand can stand it. The lamb can be hung

by the neck directly in the water on a rack made of two long sticks tied together to prevent its drowning. After 20 to 30 minutes of immersion the lambs will usually become more active and may be dried and left near the fire for two to three hours, and bottle-fed preferably on ewe's milk.

A lamb revived by immersion will not be readily accepted by the mother when it is returned to her. Such a lamb appears to have changed in odor so that she does not recognize it. If the lamb is a twin, and the other was not frozen, the revived lamb is better given to another ewe.

Colostrum milk

The colostrum, the first milk of the ewe, contains antibodies, large quantities of vitamin A, and other substances that help the newborn lamb to get a good start. Consequently, every lamb should be given at least one feeding of colostrum milk. Colostrum may be obtained by milking a few ewes with large quantities of milk, and by milking one teat of ewes that have large udders and only single lambs. Excess milk may be frozen, then thawed and used as needed for lambs born to ewes that do not have milk at lambing or for orphan lambs. If the colostrum is in short supply, as little as a tablespoon per lamb mixed with cows' milk or canned milk will furnish the lamb with the necessary antibodies.

Other authors have suggested freezing colostrum from dairy cows at freshening for later feeding to newborn lambs. This cannot be expected to contain all of the antibodies found in colostrum from the ewe. Nevertheless, it appears to have some value.

Blood serum can be collected from sheep at slaughter and left at room temperature (72°F) for five or six hours. The clear serum can be poured off, frozen, and later thawed at room temperature for use as needed. As little as 25 cc (1 ounce) injected under the skin of the newborn lamb will furnish the needed antibodies. It is highly important that aseptic procedures be used in collection and use of this serum.

Mother love

To those working with lambing ewes under varying conditions it soon becomes apparent that the degree of mother love shown by a ewe for her lamb is dependent upon four principal factors: the palatability of the pasture or feed; the condition of the mother; the age of the mother; and the extent to which the ewe has been disturbed during and immediately following lambing.

Yearlings and many two-year-old ewes lambing for the first time appear to like their lambs but often do not clean them off well by licking and are dubious at first about letting them nurse. As long as the lamb is quiet all is serene, but if it tries to nurse, the ewe will jump to one side and butt the lamb, knocking it down. This performance may be repeated for an hour or more until the lamb gives up, freezes, or accidentally seizes the teat in his mouth, and starts to nurse, after which all is well.

Apparently the ewe derives considerable pleasure from the nursing act. Many ewes lambing for the first time must be penned with their lambs until they become accustomed to them. Such lambs should be suckled on the mother by the lamber. Some ewes, particularly yearlings, may have little milk at lambing time but if the lamb is bottle-fed once or twice a day in addition to nursing, the milk flow will usually increase sufficiently to care for the lamb.

Well fed, old ewes are usually good mothers, but if they are not on good feed they will often quit the newborn lambs. This conforms to the first law of nature, self-preservation.

Ewes which are bothered or alarmed during or immediately after lambing will often leave their lambs and may not return. For this reason a lamber should work quietly with as little disturbance as

DIFFICULTIES WITH 'GRANNIES'

Top left: The ewe (left) has just given birth to the lamb. A "granny" (right), though not due to lamb for some time, has all her mothering instincts aroused and would like to steal the lamb.

Top right: First, granny helps the mother clean the newborn.

Bottom left: Next, the granny (left) enjoys having the lamb try to nurse her although she has no milk.

Bottom right: Finally, the mother (left) is successful in warding off the granny long enough so her lamb can start nursing on her own full udder. In some instances, particularly with young, inexperienced mothers, grannies are able to steal lambs which ultimately die of starvation.

possible. Avoid having dogs, cats, or chickens around a lambing barn or corral because they alarm the ewes.

One danger among lambing ewes is a superabundance of mothering instinct, known as "grannying." These ewes, even in very early pregnancy, may persist in adopting or stealing a young lamb, often butting its own mother away. Unless retrieved, the stolen lamb ultimately starves. Many such grannies are, however, in late pregnancy and will lamb in a few hours or few days. Where feasible, place such a ewe in a separate enclosure until she lambs so she will not continually try to steal other ewes' twins or singles. If grannies are very close to lambing they may be given a lamb, and when their own is born they will rear twins. Occasionally, however, they will quit the adopted lamb after their own is born.

Moving ewes and newborn lambs

When it is necessary to move a ewe and a very young lamb a short distance as into another corral or through a gate, and the pair refuses to be driven or the lamb cannot walk, the lamber should grasp the lamb by the front legs and carry it, meanwhile bleating to imitate the lamb. Unless the ewe is very gentle, it is often necessary to let the lamb down and stand it on its feet, moving back a short distance to allow the ewe to come up and smell the lamb, thus identifying

When it is necessary to move the ewe and her newborn, the lamb should be carried by both forelegs, hanging low to the ground. Bleating like a newborn lamb and walking slowly are helpful in getting the mother to follow.

it as her own. A sheep hook is often used to catch the lamb below the chest cavity and carry it low down on the ground so that it may be easily seen by the mother. In this manner most ewes will follow easily.

Keep ewes and lambs together

If lambs are moved in a bunch, never crowd them together more than necessary because this tends to mix the ewes and lambs up and pandemonium will reign until all are properly paired off again. It is usually better to allow the animals to drift slowly of their own accord. If young lambs are poked with a hook or stick they will not turn away but almost always turn back toward the driver. When crossing water or muddy ditches, the driver must work slowly and easily so as not to crowd young lambs and knock them down in water or mud. Many ewes will disown their lambs if they get muddy or very wet because the natural scent of the lamb is temporarily lost or covered up.

In moving lambs one week or more of age, driving is sometimes facilitated by the use of a series of cans strung on a wire loop, which is shaken by the driver to scare the lambs along. Such an instrument is known as a "dog." The use of a real dog is usually a disadvantage here unless he is carefully kept back from the bunch so that individual ewes are not continually fighting him.

Blindness in young lambs

In almost every large band some lambs are born with a condition known as entropion: The lower eyelid is turned in so that the eyelashes rub against the eye and cause weepy eyes and blindness. Various methods are used to correct this condition. Some operators slit the lower eyelid or cut part of it away. Others stitch the eyelid down with a needle and thread so as to hold it open. A small blunt-nosed pair of scissors can be used to cut off a small piece of skin just below the edge of the eyelid so that the skin is pinched or sheared off in an area about ½ inch long and ¼ inch wide, causing very little bleeding. As the wound heals, the scar tissue thus formed shrinks and pulls the eyelid away from the eye, re-

Lambs two or more days old can be moved a considerable distance with their mothers by driving them slowly in a loose group along the roadway. Dogs should be kept well in back, away from the flock.

lieving the condition. Examine lambs carefully for the first couple of days as they are being moved or handled and correct inverted eyelids immediately. They may cause total blindness within a few days.

Grafting

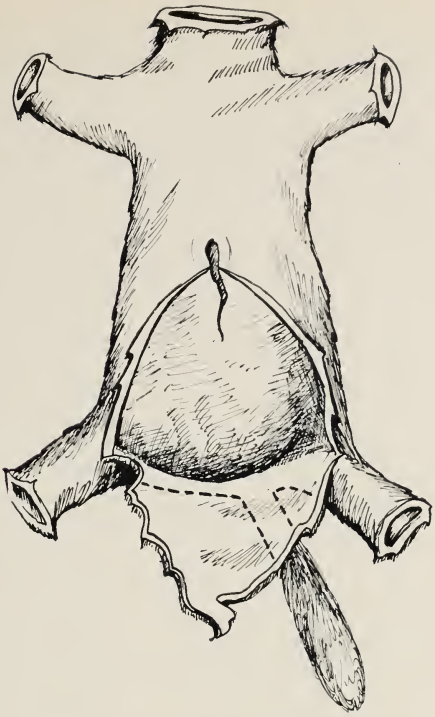
Grafting is the process whereby a ewe with a dead lamb can be made to adopt a motherless lamb or bummer. The dead lamb may be newborn or even several months of age but must have died only recently so that the ewe still has sufficient milk and desires a lamb. A careful lamber will perform many grafts in a single lambing season and, by making every qualified ewe raise a lamb, raise his lambing percentage high above those men who allow their sheep to run loose without care during the lambing season. Grafting over a period of years may easily make the difference between profit or loss in the business.

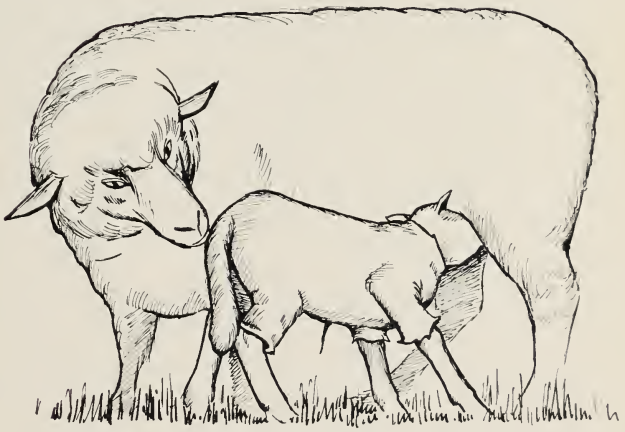
Ewes with dead lambs

Such ewes will usually stand by the lamb bleating or nuzzling it from time to time. If such a ewe is caught she may be hooked by the front leg or low down on the hind leg so as not to injure the enlarged udder. Some ewes are extremely wild and suspicious, especially when out alone away from the band and are difficult to catch with a hook. In such cases a 30 to 35 foot $\frac{1}{4}$–$\frac{3}{8}$ inch rope may be used to catch the ewe. Lay a loop on the ground immediately in front of the dead lamb. Then move back from the loop, paying out the rope as you go. Tie the end of the rope to the sheep hook. As the ewe approaches to smell the lamb, she will step into the noose and the hook can be raised quickly to catch her by one or both front feet. This may save rounding up the entire band to catch one single ewe. You may also use this method to catch ewes and young lambs, by first catching and tying down the young lamb, and use it as bait.

Hide grafting

Skin or hide grafting is done by skinning the dead lamb as soon as possible after it is found, and dressing the bummer in the extra hide. With gentle ewes on good pasture, a careful lamber may do it in the field. The beginner had best place the ewe in a small pen so that she cannot run away.





Top left: Hide grafting is best accomplished by skinning in the manner illustrated so that a triangular flap of skin is loosened to hang down at the rear of the grafted orphan. After cutting off the fore and rear legs at the knee and hock joints, the hind leg may be doubled at the stifle joint so that the cuff shown on the hock may be slipped over the end of the leg. The tail can be severed at the base and the hide slipped forward over the head to come off fleshside out as with a person removing a slip-over sweater.

Top right: As the second step, the skin is severed from around the neck of the dead lamb and again turned fleshside in. It is now ready to go on the orphan.

Bottom: Note that the rear of the orphan is totally covered by the pelt of the dead lamb, the principal opening of the skin being hidden below. Now the mother of the dead lamb, searching for identification by odor, detects only that of her own young. The orphan should be tied down in the same location where the dead lamb was found for 5 or 10 minutes after being dressed in the skin. This will allow the new mother to become acquainted with the lamb and guard against an unnatural display of activity.

Skinning dead lamb

Several different methods of skinning the dead lamb are used. Some operators skin as you would any carcass and afterward they sew the hide together with needle and thread to almost cover the bummer lamb. Others split the hide up the inside of the hind legs and across the crotch and then peel the hide forward over the body, the way small fur-bearing animals are skinned for market. In this case the ears and even the eyes of the new lamb may be covered with the hide.

In the author's experience, the best way is an adaptation of the latter method. In skinning the dead lamb, cut off the head first and then the front legs at the knee and the hind legs at the hock joint. Turn the lamb upside down on the ground, make a long cut down the inner front surface of the hind legs to the belly, turning forward on the sides of the belly to the navel. Leave a cuff on the hock which later serves to enclose the hock joint of the bummer lamb. Next skin back toward the tail the triangular piece of skin (sketch top right on page 67) in the crotch and rear belly between the two cuts. At this point in the operation the hind legs should be slightly bent and the still intact cuff may be slipped off from the hock joint on each leg. The tail of the dead lamb is severed from the body and left on the hide. The entire hide is then slipped forward over the body much as a woman removes her dress. The hide should all be in one piece and no cuts are necessary around the front legs or neck. This hide then may be rolled flesh side out in dry dirt or chaff to absorb excess moisture.

Dressing bummer in hide of dead lamb

The bummer lamb used should be as nearly as possible the same size as the dead lamb though considerable variation may be allowed. The bummer is dressed in the hide and given to the ewe. Because the triangular flap of hide from the crotch and rear belly, mentioned before, hangs down over the tail and rear end of the bummer, the ewe smells only the hide. It is very important that this hide completely cover the live lamb at least to the hocks. If the dead lamb was covered with birth slime it is well to rub some of this on the head and legs of the live lamb. If this is not possible, slime from the rear end of the mother or blood or manure from the dead lamb may be rubbed on. A ewe identifies a newborn lamb by odor alone and the entire idea of hide grafting is based upon disguising the odor of the new lamb with that of the dead one.

Tie down active bummers

If the bummer lamb is very active, tie it down when giving it to the ewe to avoid its jumping up and butting at her udder instead of nursing immediately. You may release it in five to ten minutes after the ewe has smelled and mothered it on the ground. Remove the remains of the dead lamb when you go away so the ewe doesn't find the dead carcass and realize the switch. The ewe will usually take a graft if it is carefully done in this way, unless her lamb has been dead a day or two and she shows no interest in it.

Ewes on poor pasture and with poor milk flow are very difficult to graft. If the mother likes the new lamb but will not allow it to nurse she should be tied by the head with a short rope so that she has a hard time smelling the lamb and the lamb should be suckled. The bummer should be hungry so that it will nurse. If the ewe butts the lamb away and shows no visible affection for it, you may tie a rope around her belly fairly tight and then to a board on the pen slightly higher than her back so that she cannot lie down and must allow the lamb to nurse.

Remove hide as soon as object is accomplished

—namely, as soon as decay has progressed sufficiently so that the bummer

has taken on the odor of decay. At normal winter temperatures this takes three to five days, in warmer climates only 24 hours. When flies are prevalent, keep a close watch on the grafted lamb to see that it harbors no eggs or maggots. In the Imperial Valley it is often advisable to dry the hide in the sun for a few minutes before putting it on the bummer so that it will not be so attractive to screw worms. As soon as the mother's milk has passed through the lamb the graft usually is complete and the hide can be removed from the lamb. It is a good idea, if there is the least doubt about the matter, to leave the ewe in a small pasture with perhaps a few other ewes and lambs so that if she quits the bummer again she may be easily caught and penned with him again.

Double graft possible

If a ewe has dead twins and a plentiful supply of milk, a double graft may sometimes be successful where many bummers are available. On occasion it is possible to split the hide of a very large dead lamb lengthwise and successfully graft two small lambs. Usually, however, you will do well to make the ewe take one lamb. When a ewe has one dead and one live lamb, a graft is rarely successful.

Grafting without the hide

Ewes which have recently lambed but do not care for their lambs alive or dead may be recognized among the pregnant ewes by one or more of the following characteristics: She will usually bleat a great deal; she should have a hollow indentation high in the flank when viewed from either side (this is less prominent in extremely fat ewes); and she should show some trace, at least, of the blood or slime associated with lambing around the tail, genital opening or rear of the udder. Ewes not remaining near their dead lambs among a band of ewes and older lambs may be recognized the next day or later by the tight and turgid udder and by the fact that she does not search for her lamb when the band is suddenly disturbed.

The longer such a ewe goes without grafting, the more difficult it is to make her take a lamb. Where the dead lamb is too far gone in decay or the mother shows no affection for it, a graft may be made without the hide though this is usually more difficult. Where lambs are killed by predators the hide is rarely of any use because the ewe usually shows no affection for the dead lamb.

Where grafting is done without the hide, the ewe is tied by the neck in a small pen and a rope tied around her middle as described above. Unless the lamb is very strong it may have to be suckled on the mother several times per day. It is therefore desirable to use the oldest, strongest bummers for this type of graft because they are less likely to get trampled or kicked by the ewe. Such ewes may have to be penned for as long as two weeks before they will accept the lambs. Usually, however, three or four days are sufficient. Where a ewe is kept penned for any length of time, her milk supply tends to go down, especially if she dislikes her lamb. Such ewes should be fed the finest, leafiest hay available several times a day, and given a good feed of grain each day, with water before her at all times. They should also be freed from their ropes at least once in 24 hours to allow them to rest.

If a ewe absolutely refuses to accept the lamb, tying a dog beside the pen may help because she will stamp at the dog continually and thus tend to protect her lamb. At times merely changing her to another pen in a different part of the barn will make her accept the lamb.

Grafting by changing odors

Because ewes with young lambs identify them by their odor, various methods have been used to change the odor of orphans to make them more acceptable to the new mother.

At least one product available in a pressure spray can be sprayed on the lamb and on the nostrils of the ewe. This has been used with varying success according to popular reports.

Some sheepmen advise rubbing or spraying the ewe's nostrils with common nosedrops as used by humans, with kerosene, or various other substances that will temporarily destroy the sense of smell in the ewe. Again, popular reports vary as to the efficiency of such measures.

Slime grafting

In instances where the lamber pulls a dead lamb from a ewe, a graft may be made on the spot by rubbing a bummer in the birth slime from the mother or that on the dead lamb before the ewe has a chance to smell the dead lamb. Tie the bummer down for a few minutes before letting it get up and nurse, so it acts more like a newborn lamb. The ewe is held down while the lamb is being rubbed with slime and then the tied lamb is dragged around in front of her so that she may start licking it. When the lamber leaves, he should take the dead lamb with him so the mother does not find it. If another person is not available to bring a bummer when needed, the ewe may be tied down for a short interval until the bummer is brought. In all cases, however, the faster the graft can be made the better.

Twinning bummers

Where an excess of young bummers is at hand and many ewes are lambing, a good lamber can graft several lambs in a few hours by twinning them. In this process a ewe with a milk supply sufficient to maintain twins is caught as she starts to lamb and placed in a pen. The lamb is then extracted manually and a bummer, if she did not contain twins, is rubbed in the slime and given to her at the same time as the new lamb. It is advisable to tie the bummer down for a few minutes so both lambs act more or less the same. Use only the youngest bummers for twinning because they should not be overly strong and appear different from the other lamb. The bummers should also be approximately the same size as the ewe's own lamb so as not to take more than his share of the milk. A careful worker may accomplish twinning in the field as well as in the pen. Where ewes without lambs are available and no bummers are at hand, you may use for grafts any weak twins that are mismates in size or lambs whose mothers' lack milk.

Many lambs would starve if grafts are not used

Although grafting is messy and distasteful, it is necessary because without it many lambs would starve. Grafting also means a considerable sum of money to the sheepman because it provides the only way for many of his ewes to rear lambs. Bummer lambs, at the usual price of fresh or condensed milk, are expensive luxuries to raise by hand and rarely if ever make as fat and smooth lambs as those which get their mothers' milk.

When lambing season is over, only the dries remain—ewes that did not lamb or lost lambs and could not be grafted for lack of milk. Cull these ewes heavily, keeping only young ewes with no apparent defects, selling the others for market immediately. This will represent a considerable saving in money spent for pasture or feed because the ewes raising lambs will not be culled until the lambs are sold some 4½ to 5 months later.

Fly strike

Fly strike or infestation of sheep by maggots may be severe at lambing time, especially when lambs are born in warm weather or in warm winter areas such as the Imperial Valley. In such places it is sometimes necessary to dip the navel of the newborn lamb in some blow-fly repellent-killer mixture such as Smear 62 or K.R.S. This also guards against navel ill of young lambs and other disease which may enter the body through the navel

cord. Screw worms will often lay eggs on a young lamb's navel and it will die from this 48 to 72 hours after birth. The genital opening of the ewe may also show egg clutches of this fly, and ewes should be carefully examined several hours after lambing for the white egg masses which can usually be detected with the naked eye at 10 to 15 feet. The maggots of the screw worm, if allowed to go uncared for, will cause a severe swelling of the vulva of the ewe and eat into the tissue causing death in a few days. Such animals should be caught and doctored immediately.

Burn carcasses

Dead lambs, afterbirths, dead ewes, and other carcass material, that is left around lambing pastures, corrals, or barns greatly increase the fly hazard and increase the danger of infections. Such material should be removed, and burned or deeply buried. A pile of old automobile tires is good to have around a lambing barn, to be used in burning carcasses.

Raising orphan lambs

Lambs for which no ewe is available may be fed on milk from goats or cows or on a milk substitute. They are easily taught to drink from a nursing bottle with a lamb nipple, or they may be taught to drink from a pan. Warm the milk to body temperature while the lamb is small. Cold milk can be used after the first two to three days but is not recommended during cold weather. Milk should be clean and all utensils carefully cleaned and sterilized to prevent digestive upsets.

Ewe's milk is more concentrated than cow's milk. It contains about 19.2 per cent dry matter, as compared to about 12.8 per cent dry matter in cow's milk. Although lambs will grow on cow's milk, they grow faster if the milk is fortified with 5 per cent sugar to give the lamb a more concentrated feed. If cow's milk is not available, dilute ordinary canned milk about half and half with water. Powdered milk may be reconstituted for this purpose. A high-fat content commercial milk replacer mix would probably be the least costly milk substitute. An antibiotic can be added to the milk to decrease scours and other digestive upsets.

Keep orphan lambs in a dry, clean place. A lamb brooder (described above for chilled lambs) will help get such lambs started during cold weather. Give them an opportunity to get exercise and sunshine as they grow older.

One of the commonest mistakes made in rearing orphan lambs is overfeeding, which may result in the animal's death. Keep young lambs hungry for the first few days. Although it is difficult to suggest definite amounts of milk because of variation in size and vigor, the following schedule is generally satisfactory.

The first two days—feed 2 to 3 ounces at least four times a day.

The second two days—increase the feeding by 1 or 2 ounces, fed four times a day.

The next week—feed 4 to 6 ounces four times a day.

The week after that—feed 6 to 8 ounces four times a day.

Then gradually change the lamb over to three feedings a day of one pint per feeding. As it grows older, it may safely take two quarts a day given in two or three feedings. Lambs will vary in their milk consumption, and the attendant must be the judge.

After six weeks, skim milk, if necessary, may be substituted for whole milk, but the lambs will gain better on whole milk. They should be fed milk until they are at least three months old.

Lambs will soon begin to eat hay and grain (at two or three weeks of age). A small amount of bright alfalfa hay should be kept before them at all times. The grain mixture may consist of any of the common farm grains. Calf meals are often used with good results.

Give the lambs free access to pasture at an early age.

Special instruments may be used to shear off the tail. Removal of tail helps keep the hind quarters of the lamb clean.

Docking and castrating lambs

Tails and testicles may be removed from the ram lambs by any one of several methods. Dock and castrate lambs on a bright, sunny day, after the lambs are old and strong enough to withstand the shock. In general, the older a lamb is at marking time, the more seriously the operation will affect it. However, it is better to mark lambs later rather than under muddy or wet conditions. If clean pasture is available, place the lambs on it after marking.

As in all surgery, sanitation is essential. Clean all instruments at the beginning and dip them in disinfectant (1 tablespoon lysol to 1 pint of water) after each use.

Docking. Cut off the tail about one inch from the body or between the second and third joints from the root of the tail. A convenient index is where the two folds of skin on either side of the anus leave the tail. Four methods of docking are in use.

The tail may be removed by simply cutting it off with a sharp knife. This method is quick and simple, and no special equipment is needed. The wound will heal rather quickly. The main disadvantage is that the lamb will lose a considerable amount of blood from the main artery of the tail. Occasionally a lamb will bleed to death. The older and heavier the lamb, the greater is this danger.

Another method of removing the tail is to cut it with a dull, hot iron. Slip tail under a board covered with tin so that the lamb will not be burned by the hot iron. Heat the iron to a dark red color. If too hot, it will cut through too quickly to sear the artery. The reason for the hot iron is that searing the tail will stop most of the blood loss. The disadvantages of this method are that a means of heating the iron at docking time is needed, and that a burn heals slowly.

A third method of docking is to crush the tail with special tongs called burdizzos. The tail is then cut off by passing a knife inside the closed blades. The crushing effect of the burdizzo will stop some of the blood loss sustained when the tail is cut off with a knife.

A comparatively new method is to place on the tail a special rubber band, which shuts off the circulation. As a result, the tail will drop off within a couple of weeks. The advantages of this method are no blood is lost by the lamb,

The botton half of the scrotum is sheared off, exposing the testicles. These are removed carefully, effectively castrating the lamb.

The number of tails left after docking the lambs in a flock indicates the number of lambs present on that date.

and one man can handle the operation. On the other hand, tetanus infection has been encountered on several farms where sheep are kept around corrals after the rings are applied.

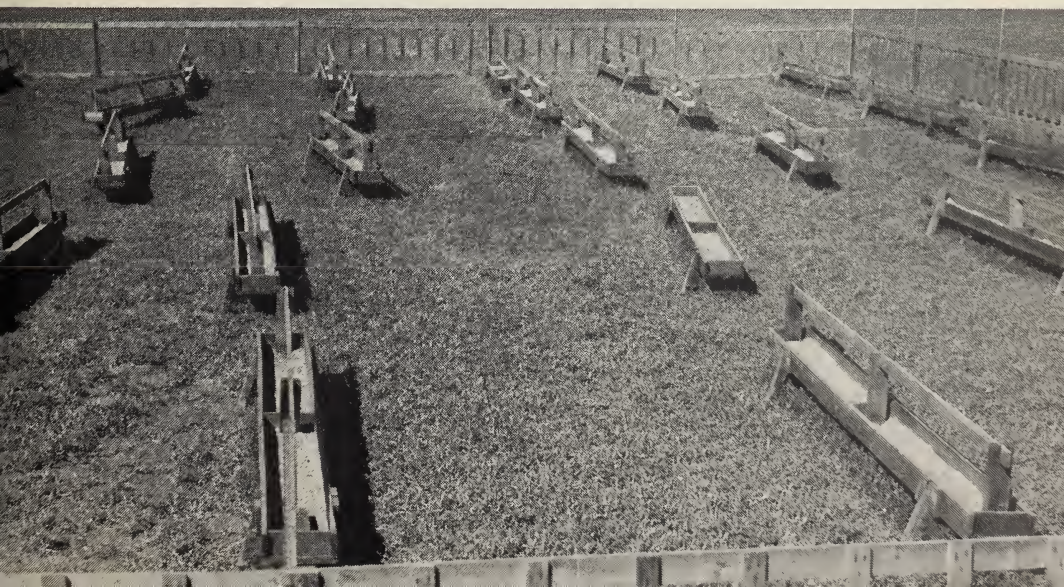
Castrating. The ram lambs may be emasculated by several methods, including surgery, whereby the lower half of the scrotum is cut off and the testicles pulled out without cutting the cords. The testicles may be pulled out by the shepherd's gripping them with his teeth, by grasping them with his thumb and forefinger, or by the use of special castrating shears, which have a serrated edge for grasping the testicles. When a tool or the fingers are used, they should be disinfected frequently. The main disadvantage of the surgical method is that lambs will occasionally die from hemorrhage or infection.

Two types of bloodless castration may be used. In the first type, rubber bands are applied with a specal instrument. Be careful that both testicles are below the band. In this case the scrotum and testicles both atrophy and drop off. Tetanus infection is rare following use of rubber rings on the scrotum. Apparently there is less chance of contamination of this site than on the tail.

The second bloodless method is the use of the burdizzo to crush the cord above the testicle without cutting into the scrotum. If properly crushed, the testicle will resorb but the scrotum is intact. The main objection to this method is that occasionally the shepherd will miss one of the cords and the testicle will continue to develop. There is also danger of crushing too low, leaving testicular tissue that will continue to develop. When the burdizzo is used too high, the urethra may be crushed and the lamb will die.

If flies are a problem when lambs are docked or castrated, place a fly repellent on and around the wound and watch the lambs closely for fly strike.

Creep troughs should be filled once a day, and the creep located in a dry, well-drained area easily accessible to the lambs.



Creep-feeding the lambs

Lambs will start eating hay and grain at two to three weeks of age. Their gain will be increased if they have an opportunity to obtain grain in addition to the ewe's milk. A "creep" is an area fenced so that the lambs can enter but the ewes cannot. The openings in a creep panel are usually about 8 inches wide and about 15 to 18 inches high. Place hay as well as grain in the creep in order to get the lambs started on the extra feed. After a few days when grain consumption has started, remove the hay.

Twins and lateborn singles make better use of the creep supplement than do early singles. This is because twins have greater need for the supplement. If not supplemented, they grow slower than singles. Lateborn lambs are usually reared under conditions when feed quality is decreasing. A creep feed will keep rate of gain high .

Ohio investigators have found that twins and singles will gain about ¼ lb more per day if creep fed and will reach market 51 days earlier. They will eat 1½ lbs of creep daily from 10–120 days of age (¼ lb at 3 weeks and 3 lbs at weaning). Before weaning they make 1 lb of gain on 3 lbs of feed.

Eye trouble from foxtails

As the native feed begins to dry, lambs are likely to pick up the awns of grasses (particularly foxtails) in their eyes. Lambs having wool around their eyes especially suffer in this respect. The awn must be removed by rolling back the eyelid and plucking out the beard; otherwise the lamb will become blind. Any lamb with a draining eye should be caught and the eye examined for foreign material. Injured eyes may be treated with medicine obtained from a veterinarian.

Weaning

Many lambs are sold at the time they are taken from the ewes. Others such as ewe lambs kept for replacements, purebred lambs, and feeder lambs should be weaned at 4½ to 5 months. Ram lambs, particularly of the whiteface breeds, may have to be weaned earlier to avoid some of the ewes being bred out of season. Ewe lambs and ram lambs should be separated at 4 to 5 months.

After weaning, give the lambs the best feed available to keep them growing. Place the ewes on scant feed for a short period and their milk flow will cease in a few days without any other treatment.

Culling the breeding ewes

Soon after weaning time go through the ewes carefully and cull out those that have previously been marked as having a spoiled udder or as being unable for any other reason to raise a lamb. Also cull the ewes that did not lamb; and those that did not raise a lamb for two seasons.

Check the mouth and teeth of each ewe. Ewes with undershot or overshot jaws or with broken mouths should be sold. Where possible, notch the ear of each crop of ewe lambs with a different notch. This will help you to know the age of each ewe. An ideal program is to sell all ewes by the time they have produced five crops of lambs and are approximately 6½ years of age. Although some ewes will show little effect of age up to ten years, most ewes will begin to decline in wool production and vigor after six to seven years. Sheep of the mutton breeds will show the effect of age earlier than will sheep of the fine-wool breeds.

Water

Under most California conditions sheep should have access to fresh, clean water daily. During cool, moist weather, when there is dew on the feed in the mornings, the sheep need to be watered less often—depending on the amount of dew. Daily water consumption per sheep varies from one quart to more than a gallon.

Spring lambs ready for slaughter.

Shade

Sheep will use shade during warm weather wherever it is available. Most sheepmen attempt to provide adequate shade for the flock during breeding in a warm season. Shade is usually not provided, however, for lambs being fattened on irrigated pasture. Most pasture feeders believe that the lambs eat more and have less trouble with bloat and fly strike when shade is not available.

Marketing

Most sheep producers in California sell or wean their lambs when the majority weigh 90 pounds or more and are ready for slaughter, or when the feed available becomes too dry for them to continue putting on good gains. Which of these two situations arises first will depend on the locality and the weather during the particular season. Lambs that are not fat "off the ewe" may be sold as feeders, or the owner may place them on irrigated pasture if he has it.

The bulk of the California spring lambs are marketed in April and May. Fat lambs may be disposed of in several ways: (1) sold direct to local butchers, (2) sold to country buyers representing packers and livestock-marketing organizations, (3) shipped to stockyards such as South San Francisco, Los Angeles, and Stockton, to be sold by a marketing organization or a commission firm, or (4) sold through livestock auctions located throughout the state.

Many lambs are contracted for by the buyers in advance of delivery. Such contracts specify the conditions of purchase: that is, a "fat contract" means that the buyer takes only lambs he considers ready for immediate slaughter. Other contracts agree to take all lambs over a certain weight (for example, 60 pounds) on a certain date, or to take so many head of lambs on a certain date.

When only part of the lambs are fat, the seller may sell only the "fats" and keep the feeders to sell separately, but more commonly he will sell all the lambs to a buyer or dealer. The buyer sorts the

lambs, sending the "fats" to market, and placing the feeders on irrigated pasture or in a feedlot until fat enough to kill.

FATTENING FEEDER LAMBS

Feeder lambs are those which because of lack of condition, low body weight, or both, are not ready for immediate slaughter. These lambs are unsuitable to the packer because the dressing percentage, yield of carcass weight over live weight purchased, is low, the carcasses lack sufficient finish to grade high, and commonly have so little outside finish that they will not keep or ship well. Many will not reach the 42–57 pound weight range most desired by retail outlets in the western states.

Such lambs are usually purchased by feeder operators from producers and fed in a variety of ways to gain the necessary finish and weight before marketing.

Sources of profit in feeding lambs

Feeders are usually purchased by the pound on a live weight basis. Purchase weights are full live weights minus 3 to 4 per cent, deducted for fill (weight of feed eaten) or live weights taken after a 12 hour overnight stand without feed or water. When a pencil shrink is deducted from full weights, 3 percent is deducted for spring lambs on natural grass pasture or range, and 4 per cent for those on irrigated pasture. Weaned lambs are subject to a 4 per cent shrink. These percentage deductions may be lowered depending on local conditions such as distance lambs are trailed in gathering off a range, in going to scales, time spent sorting, distance traveled by truck and feed conditions in pastures where the lambs originated. Where lambs are wet when weighed as after rainfall a greater shrink may be deducted.

Depending on supply and demand as well as weight, condition and quality of lambs, feeders may range from the same price per pound as paid for fat lambs to several cents less per pound. Commonly the buyer hopes to buy feeders for at least 2¢ per pound cheaper than the slaughter market. This difference, the margin, is the difference between feeder and slaughter market for the weight of lamb purchased.

Sources of profit in lamb feeding are margin on weight purchased minus weight of fleece, wool shorn from the lambs (value over wool cost at purchase), and value of gain over cost of gain on the weight increase resulting

	80 - 4 (wool)	=	76 pounds	
			.20 per pound (purchase cost)	
			$15.20 lamb cost	
	4 pounds wool × 20¢ per pound (purchase cost) = $.80 wool cost			
Margin	80 - 4 (wool)	=	76 pounds	
			.02 (margin between purchase and selling price)	
			$ 1.52	Gross Profit $1.52
Wool	4 pounds × 40¢ per pound selling price = $ 1.60			
			– .80	
			$ .80	.80
Gain	20 pounds × 22¢ per pound = $ 4.40			4.40
	TOTAL GROSS PROFIT			$6.72

from the feeding period. For example, a feeder lamb weighing 80 pounds is purchased for 20¢ per pound. On arrival 4 pounds of wool were shorn from the lamb. It was fed for 60 days and sold for 22¢ per pound at 96 pounds live weight. The wool was sold for 40¢ per pound.

Not deducted is cost of gain in feed, labor, depreciation and other costs such as interest, taxes, transportation, commissions, veterinary services, death loss, etc. Cost of shearing, 60¢ per head, consumes most of the gross profit for wool.

After deduction of all costs most feeder operators consider themselves lucky to make a net profit of $1.50–$2.00 for each lamb fed. For this reason operators whose sole business is fattening lambs usually feed 4,000 or more lambs a year.

Because it is difficult to estimate the exact level of the fat lamb market two to four months after purchase of the feeder, lamb feeding is quite speculative. Long-term success in this field requires excellent managerial ability in keeping costs at a minimum, gains at a maximum and ability to buy and sell carefully.

Average daily gains of weaned lambs on feed commonly vary from .2 to .4 (average .3) pounds per head per day, depending on health and quality of the lambs, and rations and method of feeding.

As a rule lambs purchased at 60 pounds require four months to finish at 100 pounds, those of 70 pounds require three months, and heavier animals correspondingly shorter times.

Large-scale thin lambs tend to reach market weight before reaching market finish. Such lambs are commonly marketed at 110 to 125 pounds live weight and if the supply is large may not find a ready sale.

Lambs fed to yearling age tend to be overweight and perhaps overfat. Ewe lambs at 12 months of age usually will not show the breakjoint in the carcass at slaughter though wethers may reach 14 months before showing the spool joint characteristic of older sheep.

Ewe lambs fatten faster but daily gains are slightly lower than for wethers. Few yearlings are fattened for market; they gain well but should be purchased at light weights and smaller size for feeding purposes, lest they reach exorbitant slaughter weights. The final market value per pound is less for yearlings than for lambs. Old ewes (culled for age) are rarely fed, even for a short time, before slaughter because the value of the gain is no more than 25 to 30 per cent that of lambs, and usually is not worth the cost of feeding.

It is important to buy feeder lambs

Good feeders should be thrifty in appearance and show some fleshiness, with evidence of good breeding. These lambs weigh about 75 pounds each and would sell as medium-weight feeders.

Well-bred white-faced feeders can be expected to make excellent gains if they are thrifty. These lambs weigh about 88 pounds each.

which are healthy and from areas where lambs have a previous history of doing well on feed in your locality. Foot rot, pneumonia, liver fluke, and stomach worms are serious problems in affected groups of lambs.

Feeder lambs can be purchased at localities of origin, directly from the ranch, at auction sales, or through commission firms or dealers who maintain a buying service at a small charge per head.

They are shipped by truck or rail. Shrinkage or weight loss in transit is variable but tends to be greater for lighter and thinner lambs than for fatter or heavier kinds. The first weight loss is water from the body and a portion of the stomach and intestinal contents or fill. This shrinkage is quickly made up at the destination by the lambs. Any additional shrinkage represents actual body weight loss (tissue shrink) and this must be replaced by subsequent gain. In general, sheepmen expect an actual body weight loss over and above fill of at least 4 per cent for 1,000 miles of shipment or a total shrink, fill included, of about 8 per cent.

Shearing feeders

When weather permits, feeder lambs are usually shorn within a few days after arrival at their destination. Trials indicate that shorn lambs gain faster, and in warm weather tend to be free of fly strike, are more active, more comfortable, and less bulky to handle in flocks than unshorn ones. Shorn lambs also appear more trim and attractive in sales. The expected fleece weight is roughly 5 pounds per 100 pounds live weight of lamb up to the age of five or six months. However, older lambs will usually shear more with those of seven to eight months in medium- and coarse-wooled breeds having fleeces of perhaps 7 pounds per hundredweight of lamb.

Pasture feeding

In California most feeder lambs are fattened on pasture, resulting in cheaper gains than those from drylot feeding. The feed is usually alfalfa during the winter season in the Imperial Valley area and on irrigated (permanent) pasture, usually ladino clover or birdsfoot trefoil, in the Sacramento Valley during the summer season. Other types of pasture are used such as crop aftermath including vegetable waste, grain stubble, and a small amount of beet tops.

Various arrangements are made for feeding. The owner of the lambs most commonly leases the pasture by the season or year or, particularly in the Imperial Valley, may pay 3¢ to 5¢ per head per day, the price being determined by supply and demand. A few feeder operators own the pasture land fed, others feed at an agreed price per pound of gain with an agreement as to splitting the

death loss. In the past this price has varied from 17¢ to 20¢ per pound of gain. Permanent pasture is usually fenced; temporary fencing (made of coils of wire netting and steel posts) is used for alfalfa and much of the crop waste.

Feeder lambs shipped in, either by truck or train, should be watered, given a feed of dry hay, and allowed to rest before being turned in to irrigated pasture. If there is any possibility that the lambs may be carrying many internal parasites, they should be drenched before being turned into the fresh pasture.

The irrigated pasture should be subdivided into small fields so that the lambs may be moved to fresh feed every few days. Lambs will make faster gains and pastures will produce more feed if each pasture is given a minimum of three weeks' growing period between grazings.

Healthy, sound lambs make excellent spring and early summer gains on irrigated pasture. The gains tend to decrease in warm areas during midsummer and increase again toward fall until rainfall and muddy conditions, with high water content of forage growth, slow gains.

Lambs are put on irrigated pasture as a succession of "fills." The early fill starting in April in the Sacramento Valley includes the feeder end of early San Joaquin and later Sacramento Valley spring lambs. These weigh commonly 80 to 88 pounds and are scheduled to be marketed by June 15–July 1. A second fill, composed of light lambs 65 to 75 pounds from the north coast range and Sacramento Valley, may be used as replacements for the first and be marketed by September 15–November 1 to finish the season. An alternative is to put on heavy lambs, usually from the Sacramento Valley, Sierra-Nevadas or Humboldt County, for the second fill, weighing perhaps 85 pounds and market them by August 15–September 1. With this procedure a third fill of heavy lambs can then be fed to finish by November 1.

Thus, the lamb feeder has a choice of feeding two fills of light lambs or three fills of heavy lambs in about the same total period of time. Where a desirable margin is available between feeder and fat prices the three-fill system is superior. This system also saves the feeder operator the trouble of having to predict the price level of fat lambs so far ahead.

The stocking rate for irrigated pasture varies with age and density of stand of plant growth in the pasture, and with temperature. The Sacramento Valley has a tremendous surge of growth in the spring so that pastures have much forage by April. Feeder lambs on any volume are not available before that date.

The practice is to stock pastures with ten–fifteen lambs per acre on good stands as soon as possible and start selling the heaviest lambs to reduce the load within six weeks. By June the rate is reduced to eight to ten lambs per acre until August. Then the rate is further reduced to six to eight lambs, these are further reduced by selling, so that by November no more than one to three lambs per acre are left to pass the winter. These are commonly sold by March 1–15 the following year.

The summer stocking rate on good pasture averages about eight lambs per acre. Older stands with much grass and less legume content are stocked lower, poor stands averaging perhaps six lambs per acre. One- to three-year old stands are superior for feed production. Growers recognize a high spring growth rate in forage, followed by a summer lag during the hot weather, a slight surge in growth in early fall, followed by a gradual decrease in growth when temperatures decline.

Supplementing on pasture. Lambs will reach choice slaughter grade when grazing on good irrigated pasture without receiving any supplemental feed. Hay as a supplement to pasture will reduce the incidence of scouring, particularly early or late in the season, when the pasture forage is watery and low in dry matter.

Trials conducted on the use of grain to supplement good irrigated pasture have shown that, while the gains may be increased slightly, the practice is not economical. Later in the season it may be profitable to supplement the lambs in order to get them to the desired slaughter weight before the pasture is exhausted.

FEEDING LAMBS ON PASTURE AS A SOILING CROP

Some interest is developing in cutting the pasture crop with a forage harvester and hauling it green to lambs in a dry lot. This practice is still in the experimental stage but preliminary trials have been disappointing.

Feedlot fattening

Very few lambs in California are fed in drylot. Occasionally, however, a lamb feeder who uses the pasture feeding method will place a portion of his lambs in drylot during periods when heavy rainfall or lack of forage growth make pasture conditions unsuitable for feeding. This commonly happens in the fall in years when winter arrives before all pasture lambs have reached slaughter condition. Although feedlot gains are more expensive than pasture gains it may be imperative to speed up gains in order to reach market sooner.

Lambs to be fattened in a feedlot should be started on feed with a ration consisting mainly of good hay. The grain mixture is gradually increased until the lambs are on full feed. Lamb-fattening rations are usually about half grain and half hay (see also bottom table on page 35). A series of tests at Kansas State College showed that the gains were largest and the feed was utilized most efficiently when the ration was 45 per cent concentrates and 55 per cent roughage. When rapid gains are desired, you may increase the concentrates up to as much as 60 per cent of the ration. However, as indicated in the next paragraph, you must use care in giving such highly concentrated feeds.

Lambs fed large amounts of grain in the feedlot are subject to overeating disease, also known as enterotoxemia. Although this may be prevented by limiting the amount of concentrated feed, the gains are thereby also lessened. A vaccine against this disorder is available. The bacterin or toxoid should be used as a preventive, and the antitoxin employed to stop an outbreak in a group of lambs on feed. These vaccines should be used only under the supervision of a veterinarian. Enterotoxemia may also be encountered in lambs and even in ewes on excellent pastures.

Both hand-feeding and self-feeding methods are used in feeding lambs. Hand feeding—feeding the hay and grain separately at each feeding—has the advantage because you can vary the amount and proportion of hay and grain according to the appetite and appearance of the lambs. However, you must exercise considerable skill in feeding the lambs; also with handfeeding, labor costs are higher. It is wise, therefore, to adopt a program of self-feeding—where the grain and hay are mixed and the lambs eat all of the mixture they will consume—and a standard mix can be fed once the lambs are on full feed. Sample feedlot rations for lambs are shown on page 35.

Depending on the feeds used and the relative proportion of grain and hay fed, lambs will require from 8 to 12 pounds of feed to produce a pound of gain. The average daily gain is usually about one-third of a pound per day but may vary from .2 to .4 pound per lamb per day.

The feeds most commonly used for fattening lambs in the feedlot in California are barley, molasses, dried beet pulp, oats, corn, cottonseed meal, and alfalfa hay. Barley as the only concentrate is not entirely satisfactory for lambs in that they have a tendency to "go off feed." This is mostly a problem with light-

Here is a view of one of the few feedlots that have been used to fatten lambs by feeding pellets. 30,000 lambs were on feed in these facilities. Those in the foreground are ready for slaughter. Most California lambs are finished on pasture where gains are more economical.

weight lambs of 75 pounds or less. A mixture containing about one-third beet pulp or oats is easier to feed.

Pelleted rations

In recent years a large number of trials have been conducted on the use of pelleted rations in lamb feeding. In pelleting the entire ration is mixed, finely ground, and forced through dies to make a hard pellet varying in diameter as desired. For lamb feeding 3/8 to 1/2 inch pellets are used, while for large lambs, yearlings, or breeding ewes pellets are usually up to 3/4 inch in diameter. Comparisons of pelleted and non-pelleted rations show that the greatest advantage from feeding a ration in pelleted form was found where coarse, rough hays are used in the ration and where roughage content in the ration is approximately 30 per cent.

PRICE TO BE PAID FOR PELLETING HAY*

Price of baled hay	Price to be paid for pelleting if waste eliminated is		
	10%	*20%*	*30%*
$20.00	$2.20	$5.00	$ 8.57
25.00	2.50	6.25	10.72
30.00	3.33	7.50	12.86
35.00	3.88	8.75	15.00
40.00	4.44	10.00	17.14

* Transportation costs of hay to and from the mill need to be considered in addition to grinding and pelleting costs.

Advantages. Pellets require less storage space than whole or mixed chopped rations, are more easily fed, lend themselves to mechanized handling and self-feeding, provide for even consumption of ration ingredients and cut down waste. Average daily gains of lambs on pelleted rations have been higher than for the same feeds fed in other forms (usually 20 per cent higher). Less feed is needed per pound of gain. When lambs consume pellets of the less bulky, finely ground feeds, gains and efficiency of gains are increased. The reason for these increases are these: The rate of passage of the feed through the digestive tract is increased. This brings about an increase in daily feed consumption. Because a certain proportion of the feed intake of an animal is used for maintaining its current weight, increasing feed consumption allows a larger proportion of the intake to be used for production (increase in lean,

fat, bone, wool, milk, or activity). Consequently, animals that consume more, gain more. The feed going into gain thus is a larger proportion of the feed intake.

Disadvantages. Animals fed only pellets will not ruminate as much as those on less finely ground rations. Lambs on pellets will eat bedding and may chew on soft wood. A thickening of the wall of the rumen has been noted in pellet-fed sheep. The condition is called parakeratosis. Thus far, no ill effects have been associated with the foregoing behavior or with rumen changes in fattening lambs. Where breeding ewes have been fed solely on pellets in drylot for long periods, their teeth have grown overly long. The principal disadvantages of pellet feeding has been cost of purchased pellets or cost of pelleting home-grown feeds. Unless a pelleting mill is located close by, hauling home-grown feed to and from the mill can add to the cost.

Cost. Pellet feeding of finely ground hay greatly reduces the waste associated with feeding long hay. This waste is greater for coarse and weedy hay than for the more expensive fine-stemmed product. The table on page 81 contains information from Meyer (1960) and illustrates the influence of percentage wasted and hay cost on the price that could be paid for pelleted hay.

Composition. Pellets of varied composition are available from commercial sources or can be made to order. Research indicates that 30 per cent concentrates is about the upper limit for maximum gains; intake and gains sometimes decrease when higher concentrate rations are pelleted.

A common formula for a commercial lamb fattening pellet in California is 70 per cent alfalfa hay, 1 per cent trace mineralized salt, 2 per cent molasses, and 27 per cent barley. Sometimes this formula is changed to include 65 per cent alfalfa and 5 per cent beet pulp to increase palatability slightly.

Feed additives in pellets. Antibiotics such as aureomycin or terramycin are sometimes added at the rate of 8 to 10 milligrams per pound of ration to reduce losses from enterotoxemia and reduce effects of low-level infectious disease. In the latter instance these compounds appear to be most effective where fed to lambs with a history of chronic disease.

If di-ethyl-stilbestrol is to be fed to lambs rather than implanted, the Food and Drug Administration specifies the dosage rate at 2 milligrams per head per day. This, for pellet-fed lambs, would be about .5 to .6 milligrams per pound of ration. The hormone must be withdrawn from the feeding at least 48 hours before slaughter.

Bedding for barn feeding

Because much of California normally has considerable winter rainfall, lambs fed in sheds or barns are best kept continuously under shelter, to avoid muddy corrals. This keeps animals from tracking in mud and carrying in moisture on their fleeces. The shelters should be well ventilated, to promote dispersal of ammonia fumes and moisture within the shed. Watering facilities should be inside also.

Allow 8 to 10 square feet of pen space per lamb, bedded with straw, sawdust, or other material to absorb moisture. Straw or poor-quality volunteer hay can be used by scattering intact flakes from bales at 6 foot intervals throughout pens twice per week. Be careful to place these flakes each time in a different spot: lambs moving around will spread this bedding with their feet. As little as two 80 pound bales of straw per week will serve to bed a shed of 5,000 square feet if the shelter is bedded continually from the start of the feeding period and lambs are kept inside except for dry weather.

Water

A clean source of water is critical for lambs being fattened. Drain and clean the trough at least once a week to main-

tain water quality. This is particularly important when the trough is near the feeding area because the water supply is likely to be contaminated by forage carried on the faces and lips of lambs coming to drink. During warm weather, shade over the trough and a deep trough will keep water cool. A ten foot trough, easily accessible, will water up to 1,000 lambs under pasture conditions. For drylot feeding at least twice this trough space should be furnished.

Death loss

With good management, reasonable sanitation, and the purchase of healthy feeder lambs, the expected death loss in lamb feeding is 1 to 2 per cent. It is important to vaccinate for enterotoxemia twice if this is a common problem. Bluetongue vaccine should be administered to summer and fall fed lambs. Prompt isolation and treatment of diseased or suspect animals with the aid of a good veterinarian will keep losses at a minimum.

Hormone implants for fattening lambs

Two different hormone products have been cleared by the Food and Drug Administration as implants for fattening lambs. Synovex is the trade name of one implant composed of progesterone and estradiol benzoate. These are used at a ratio and dosage rate of 25 milligrams of progesterone and 2.5 milligrams of estradiol per lamb. A second hormone preparation is Stilbestrol which is a synthetic compound with properties characteristic of a female hormone. The compound has the chemical name di-ethyl-stilbestrol. It is cleared for use at a dosage rate of 3 milligrams per lamb. Both these products tend to increase rate of gain in lambs, with some increase in feed efficiency.

Carcasses of treated lambs tend to be somewhat lower in fat content but higher in lean. Many trials with these products have shown fairly consistent results if lambs are fed fully adequate amounts of high-quality feed either as drylot rations or on good pasture.

Rate of gain has commonly increased 10 to 15 per cent. Implanted blackface lambs have gained more than whitefaces and wethers more than ewe lambs. These hormones are not recommended for ewe lambs to be kept for breeding.

Use of either of these products will contribute to your profit if used as recommended with lambs on good feed. In the past, undesirable side effects such as rectal prolapse, sexual excitement, ossification of the breakjoint, and difficulty in removing pelts from slaughtered lambs have been traced to overdosage of the compounds.

More recently, in certain areas of Humboldt County where range lambs nursing their mothers have been implanted and where they have been pastured on burned-over range, some incidence of rectal prolapse has been noted. The explanation of this is not clear. Growers in this area are advised to work closely with their Farm Advisor if planning to use implants on lambs.

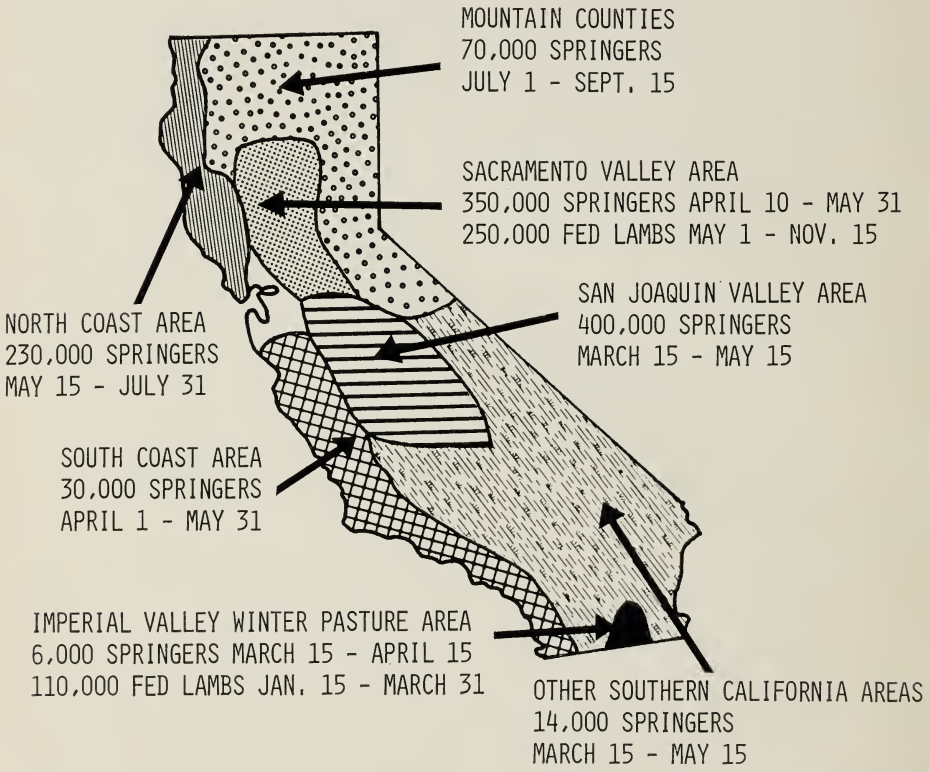
LAMB FROM PRODUCER TO CONSUMER

The flow to market. Packing companies buy lambs from spring lamb producers and feeder operators mostly by direct purchase through their regional buyers. A few lambs are purchased from livestock auctions and grower pools. Some sales result from contracts made in advance, others are made immediately before actual delivery. In addition, packers maintain a supply of lambs on feed during at least part of the year, which enables the company to continue slaughter during short periods when other market lambs are not easily available or not reasonably priced.

California spring or milk slaughter lambs sold directly off their mothers come to market during March to August in certain rather well defined "runs." The map

MAJOR LAMB PRODUCING AREAS AND PERIODS OF MARKETING IN CALIFORNIA 1967[1]

TOTAL LAMB CROP 1,111,000
TOTAL FED LAMBS 360,000 AS INDICATED
+ A POSSIBLE 90,000 ELSEWHERE



[1]THESE FIGURES AND DATES OF MOVEMENT ARE BASED ON AVAILABLE DATA FROM THE TRADE AND ESTIMATES BASED ON DATA FROM THE CALIFORNIA CROP AND LIVESTOCK REPORTING SERVICE (ADAPTED FROM CARPENTER 1959)

above shows the areas of the state from which they originate and the approximate size of the run. The delivery date varies by area, depending on climate and growing season in that part of the state.

Fed lambs mostly from the Sacramento Valley pasture fattening operations come to market from May through October. The state supply then drops until January–April when the Imperial Valley fed lambs reach market. A few Sacramento Valley lambs also go to market at this time. These are animals that have been held over the winter on pasture because they did not finish in the fall. They are known to the trade as "old croppers."

Imports. Early California fed lambs originate within the state as feeders from spring lamb marketing areas noted in the map on page 84. As California feeders diminish in number, feeder lambs are purchased in Oregon, Nevada, and Idaho for Sacramento Valley feeder operators. Imperial Valley winter fed lambs almost all are imported from Montana, Idaho, Wyoming, Utah, Texas, and New Mexico. These are shipped to Imperial Valley to go on feed during October to December.

During late summer, fall, and winter, milk lambs and later fed lambs are shipped into California for immediate slaughter from Oregon, Nevada, Idaho and Utah, and a few from Arizona.

Spring lamb supplies from each area are thus supplemented with out-of-state springers and fed lambs either from within or out of state to maintain an even flow of lamb to market, thus enabling retailers to have lamb available to consumers throughout the year.

Exports. California lambs are usually not shipped out of state for slaughter except for a relatively short period during the spring months. At this time, abundant local supplies plus high prices in eastern states may make it profitable to ship long distances. Similarly, slaughter lamb carcasses may be shipped east at the same time. California dressed lamb may go as far as New York. A small volume of early feeder lambs may also move to feeder operators in the Midwest during spring.

California prices fluctuate because of seasonal demand, variation in regional climate and feed supplies, and current market prices of lambs in other states.

SLAUGHTER

In the slaughtering operation, lambs are first stunned with electric current, bled by severing the jugular vein in the throat, then hung on shackles by one hind leg to bleed. The carcasses then pass along a moving track where they are skinned, disemboweled, washed with a high pressure spray, and inspected by federal and/or state veterinarians for health purposes. Condemned carcasses or parts, as well as offal and skins are sent to other quarters for further processing.

The inspected, clean but still warm carcasses next pass to a succession of cooling rooms where they are cooled to 37°F. A weight loss of from 1.5 to 2 per cent in carcass weight between hot and cold weights occurs during cooling. This cooler shrink is largely from evaporation and drip loss, and is greater for thin than for fat lambs.

After 24 to 48 hours, the carcasses are graded by USDA graders and stamped U. S. Prime, Choice, Good, Utility or Cull. The grade specifications are based on conformation, quality and maturity.

- Conformation refers to the overall shape of the carcass, preference being given to thicker carcasses with well developed legs and loins.
- Quality refers to factors, shown by the carcass, that denote the eating quality of meat: degree of feathering or fat streaking between the ribs, fat streaking within the flank, color of fat and of lean, and firmness of the carcass.
- Maturity of the carcass is estimated by color and width of rib bones and dryness and porosity of the break joint (see photo on page 87). The mature carcass will show a higher degree of feathering and other quality indications.

One March, 1968, dual grading of lamb carcasses went into effect on an optional basis. Under this system federal graders assign the regular USDA grade as noted above. This is termed the quality grade. In addition, graders give each carcass a yield grade.

The yield grade is an estimate of the yield of boneless, closely trimmed, retail cuts from the leg, loin, hotel rack and

shoulder. The five yield grades and percentage yield of retail cuts represented by each are listed below.

Yield grade	*Yield of cuts*
No. 1	47.3 per cent and over
No. 2	45.5 to 47.2 per cent
No. 3	43.7 to 45.4 per cent
No. 4	41.9 to 43.6 per cent
No. 5	Less than 41.9 per cent

Yield grading of the entire ovine carcass or side is based on the following formula: yield grade = 1.66 – (0.05 × leg conformation grade code) + (0.25 × per cent kidney and pelvic fat) + (6.66 × adjusted fat thickness over the rib eye in inches). Since this formula usually results in a fractional yield grade, this fractional portion is dropped. Thus, a calculated yield grade of 3.9 becomes a final yield grade 3.

In practice, a preliminary yield grade for a carcass is determined from a single measurement (by probe for intact carcasses) of fat thickness over the center of the rib eye perpendicular to the outside surface between the 12th and 13th ribs. This fat thickness measurement is adjusted for any variations-from-normal fat distribution including principally the external fat on such parts as the rump, shoulder, breast, flank, cod or udder, and the intermuscular fat in the body wall. Body wall thickness is measured by probing 5 inches laterally from the middle of the backbone between the 12th and 13th ribs.

The preliminary yield grade is next adjusted for per cent kidney and pelvic fat. Here for each per cent kidney and pelvic fat more than 3.5 per cent, .25 of a grade is added to the preliminary yield grade. Subtract for less than 3.5 per cent.

Finally for each one third of a grade that the conformation of the legs exceeds average Choice, subtract .05 of a grade from the preliminary yield grade. Add a similar amount where conformation is less than average Choice.

The result of these adjustments is the final yield grade.

Within 24 to 48 hours from slaughter, carcasses are purchased by retail outlets or jobbers and move on to the consumer. Jobbers purchase carcasses, break them into parts, and sell various parts to retail outlets including restaurants who wish to purchase only chops, leg roasts and other specific cuts.

No special effort is made to age lamb as in beef. The delay because of cooling, transport, storage, and cutting and trimming at the retail level allows several days' lapse between slaughter and consumption.

Specialty meats include such items as tongue and cheek meat, brains, sweetbreads, liver, heart and kidneys. Kidneys are sold in retail shops; they are purchased with the carcass by the retailer. The other variety meats are sold separately by packers but some at least are sold by most retailers, depending on local demand.

By-products from lamb slaughter. By-products from lamb slaughter have a variety of uses. Longer lamb pelts are processed in pulleries where the wool is removed and sold separately. The skin is used in glues and soft leather products such as chamois. Shorter pelts are tanned to make coats, linings, slippers, flight suits, and buffering devices.

Rendering plants which are often separately owned from packing companies make animal feed, fertilizer, and edible and inedible fats from most of the offal. The latter go into soaps or a large variety of industrial chemicals.

Various glands from the animal are used to manufacture hormones and other substances important in human medicine.

Blood is used as a source of animal feed, fertilizer, and as a spreader for insect sprays.

Casings for ground meat products are made from cleaned portions of the intestines which also are a source of sutures and of glue. Bones are used in glues. The

At 12 months of age or slightly later, ossification occurs between the round spool-like joint and the lower end of the cannon bone. This is visible on the end of the four legs of the lamb or mutton carcass. The figure on the left is from a yearling; that on the right from a lamb. Both ewes and rams mature faster in relation to bone growth than do wethers. Therefore, ewes tend to show the spool joint at 12 months while some wethers may break at the line of ossification as late as 14 months of age. This joint in lambs is referred to as the break joint.

mineral portion of bone makes fertilizer and animal feed.

Thus, as in other animal slaughter, almost nothing of the animal goes to waste but finds some further use to humans.

Cutting and trimming. The lamb carcass is cut somewhat differently depending on locality and region. The chart on page 89 show the most common method. After reduction of the carcass into primal or wholesale cuts, the retailer trims these as necessary and further divides them into roasts, chops, stew meats, and meats for grinding. The latter may be further processed and perhaps blended with other meats before sale.

Yearlings are slaughtered and sold similarly to lamb but are graded as yearling by the USDA graders and are sold at a lower price than lamb by the packer. Only a small number of yearlings are slaughtered annually in California. Yearlings and older sheep are identified in the carcass by a spool joint on the front cannon bones (see photo on this page) rather than the break joint as in lambs. A dry break joint also indicates yearlings. Yearlings may be graded prime, but as mutton rather than lamb.

Mature sheep. Ewes and rams culled from breeding flocks are slaughtered similarly to lambs but the meat is stronger in flavor and less tender than lamb or yearling. Inspection for health purposes is just as strict for all classes of sheep as in other livestock.

Mature mutton is not graded higher than U.S. Choice. Mutton from older animals is rarely sold as such on the California market with the exception of some large trim ewe carcasses known in the trade as "block cutters." This meat is sold in some restaurants and in foreign sections of large cities where it is in good demand.

Most ewe and ram carcasses are boned and the edible meat used in processing of meats and meat blends found in soups,

baby foods, and ground meat products. Many of these are highly flavored, and thus the identity of the various meat ingredients is lost to the consumer.

THE LAMB CARCASS

In recent years competition by plant oils and synthetic products has greatly decreased demand for animal fats in soaps, shortenings, oils and greases for both consumer and industrial use. Also, obesity as a public health problem for humans has influenced the consumer to prefer leaner cuts in meat animals. Fat which must be removed by retailers in trimming meat cuts for sale has little value.

This situation has stimulated research in lambs as well as other meat animals in an effort to find economical and efficient methods of breeding and management to produce low-fat, meaty lamb carcasses.

All segments of the marketing chain prefer certain characteristics in the carcass most favorable to their operations. These traits may conflict in certain respects with the needs of other segments.

Growers want the heaviest lamb they can sell because their animals are sold by the pound. In weight and in degree of finish they have to satisfy the packers who want lambs weighing between 90 and 105 pounds live weight and with sufficient fatness to grade U.S. Choice, and which dress out or yield a high percentage of carcass weight over live weight as purchased. Good spring lambs in large lots commonly yield between 52 and 54 per cent of live weight, while comparable fed lambs yield 50 to 52 per cent of live weight.

Packers prefer to slaughter the heaviest and fattest lambs possible because many of their costs are on a per-head basis. Heavier lambs tend, therefore, to have lower slaughter costs per pound sold. Fatter lambs tend to yield a larger percentage as carcass weight. The packer, then, is limited on specifications of lambs purchased to the weight and degree of fatness desired by the retailer. A thick meaty appearance of the carcass is also desired.

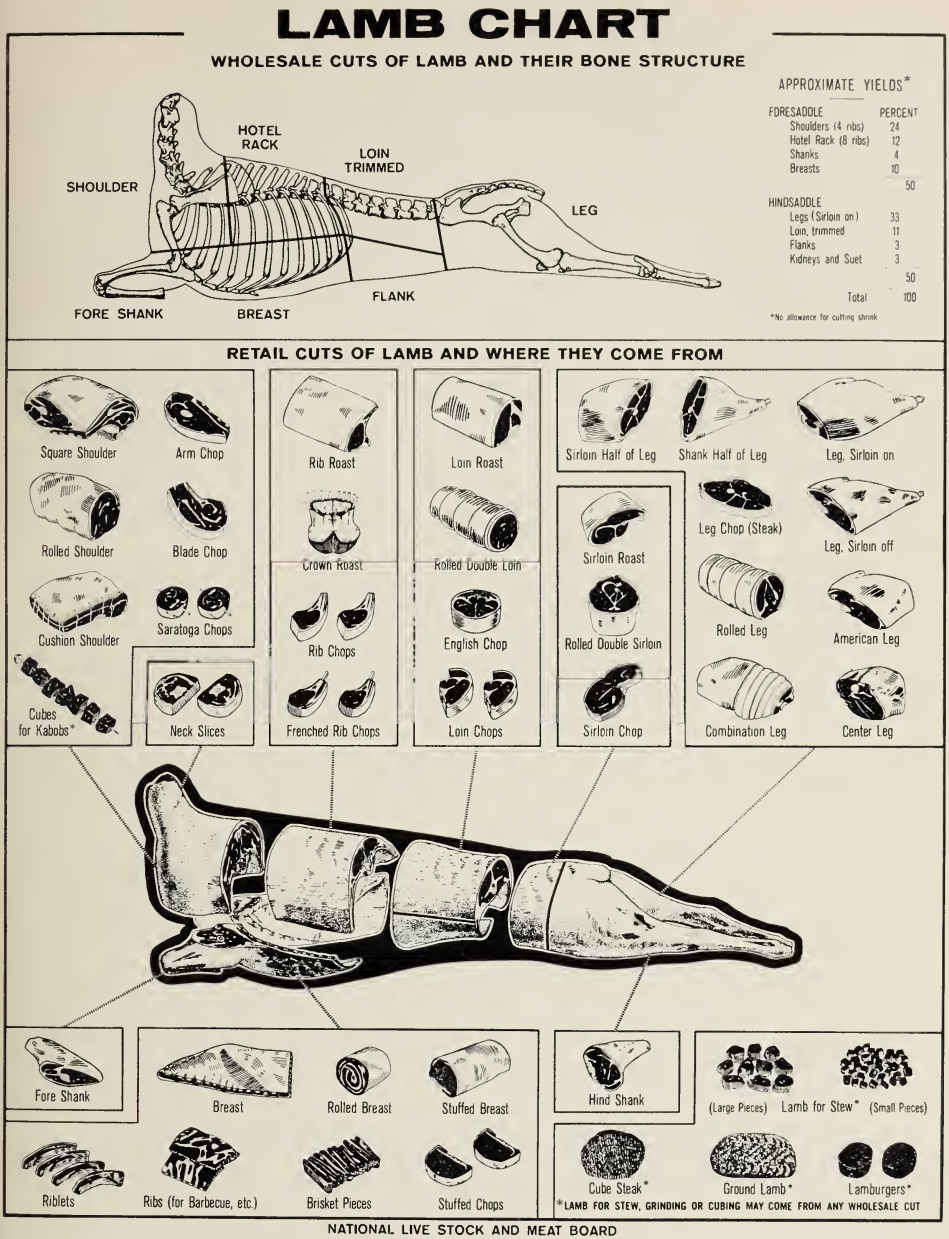
One other factor is important in regard to degree of fatness of lamb carcasses: the minimum degree of fat cover necessary to reduce moisture and quality losses during shipment. Although it is known that large areas of lean exposed to air contribute to evaporation loss and that thin, soft carcasses do not keep as well as fatter, firm carcasses, the exact degree of minimum necessary fat cover has not yet been established. In practice, the trade does not ship carcasses long distances unless well covered and firm.

Retailers costs also tend to be on a per-head basis because storage, labor of cutting and trimming, and display costs are less per pound of salable meat on heavy than on light carcasses. However, heavy carcasses tend to be fatter and thus, to result in more waste as trim loss. Retailers must also limit carcass weight purchased to a range that will not result in chops or roasts too large for purchase by the average consumer. Large cuts sell well to the restaurant trade but not to most housewives. Retailers also want lamb with consumer appeal—white color of fat, bright pink color of lean, and meaty appearance. Loin and rib chops should show a large loin eye to appeal to the housewife. In addition, if lamb is to continue to have appeal to housewives, it should have a minimum of waste and be tender and flavorsome when cooked.

Throughout the marketing chain it is the desires of the consumer which set the final standards for lamb. Other segments of the meat industry must find ways of producing lambs to meet these consumer desires.

Standards for carcass merit in lamb

The standards for lamb listed on pages 90 and 91 have been recommended by members of Western Regional Project



Extremely well-muscled lambs and those that have not been over-finished will have a higher percentage of carcass weight in the major closely trimmed cuts. The industry is engaged in selection procedures to further improve carcass quality over the fine lambs produced today. Illustration courtesy of the National Live Stock and Meat Board from Lessons On Meat.

W-61, Development of Selection Criteria for the Genetic Improvement of Carcass Merit in Sheep.

Carcass merit is an elusive term particularly in view of the fact that the definition may be different according to whether it is made in reference to the producer, packer, or consumer.

However, it seems reasonable to assume that specifications must be designed to result in a product which will satisfy the consumer.

The lamb carcass is composed of bone, lean and fat. Modern selection and management methods offer opportunities to change the latter two. A maximum amount of lean and minimum amount of fat is desired. Lean is the primary requirement for the consumer while a small amount of fat is necessary to insure eating and keeping qualities.

Carcass merit may be defined as the desirability of a carcass from the standpoint of production, marketing and consumption. Level of merit may be determined by the degree to which a carcass approaches or surpasses the standards for a highly desirable lamb carcass as indicated below.

LAMB CARCASS STANDARDS FOR HIGH MERIT

Item	*Standard*
(1) Carcass weight:	50 pounds, range 45–55. Carcasses above this weight range are desirable as long as the trade will accept them without penalty.
(2) Carcass grade:	USDA Choice or higher
(3) A single fat thickness measurement over center of loin eye between the 12th and 13th ribs (average measurement from the two sides):	Preferably $\frac{3}{32}$–$\frac{3}{16}$ inch, not over $\frac{7}{32}$ inch.
(4) Kidney and kidney fat:	Not over 2.5 per cent of chilled carcass weight.
(5) Loin eye area per 50 lb carcass weight. (Cut at right angles between the 12th and 13th ribs. Refers to *Longissimus dorsi area* only—not the entire lean surface in the cut):	2.4 square inches or more
(6) Closely trimmed leg (long cut American style, trimmed to within $\frac{7}{32}$ inch of fat). A thick wide leg is desirable. It should be moderately plump, heavy muscled with length and fullness in the region of the sirloin:	30 per cent or more of total carcass
(7) a. Preferred retail cuts (square cut shoulder, rack, loin and legs, trimmed to within $\frac{7}{32}$ inch fat cover):	70 per cent or more of total carcass
(7) b. Trimmed preferred retail cuts but with boned shoulder and neck:	62 per cent or more of total carcass
(8) Dressing (chilled carcass weight divided by shrunk live weight):	50 per cent or more of total carcass

(9) Distribution of fat cover:	Uniform, with discrimination against excessive cover over the rump and inadequate cover over legs and shoulders
(10) Tenderness:	Generally acceptable in lambs. Warner-Bratzler shear readings using ½ inch cores of the cooked *Longissimus dorsi* muscle should not exceed 6 lbs.

PERFORMANCE GOALS ON PER DAY OF AGE BASIS

(1) Carcass weight:	0.4 pound
(2) a. Preferred retail cuts (square cut shoulder, rack, loin and legs, trimmed to within 7/32 inch of fat):	0.28 pound
(2) b. Trimmed preferred retail cuts but with boned shoulder and neck;	0.25 pound
(3) Loin eye area:	0.02 square inch

Further research is needed to confirm these tentative standards. Such investigations might include studies of the optimum fat covering and distribution, body composition and dressing percentage, proportion of bone, possible changes in proportion of different cuts, color of fat, color of lean, palatability factors, and the relative independent effects of age and weight on carcass characteristics.

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To simplify the information, it is sometimes necessary to use trade names of products or equipment. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

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