Alberta Sheep Production Manual

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FOREWORD AND ACKNOWLEDGEMENTS

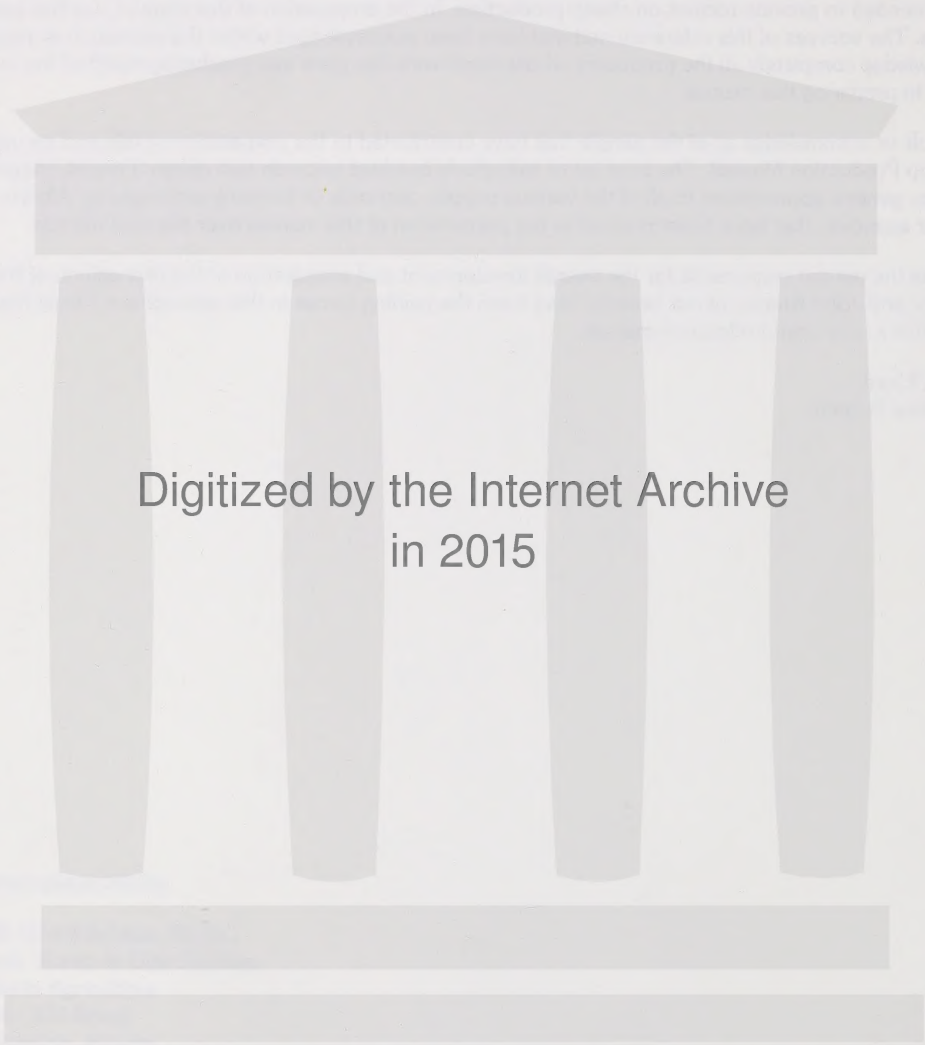
The Alberta Sheep Production Manual was first published in 1977. A second edition was published in 1977 and a third in 1978. This new edition is the first major update since that time. The previous editions of this manual have been well received by producers, prospective producers and students. I am sure that this new edition will be equally well received.

This manual has been written primarily to provide information and general principles of sheep management and diseases of sheep. It is not intended to provide recipes on sheep production. In the preparation of this manual, use has been made of current literature. The sources of this reference material have been acknowledged within the manual. It is impossible, however, to acknowledge completely all the producers whose hard work has gone into producing much of the knowledge that has been used in preparing this manual.

Similarly, it is difficult to acknowledge all of the people that have contributed to the preparation of this and previous editions of the Sheep Production Manual. The total list of individuals involved exceeds two dozen. I would, therefore, prefer to express my general appreciation to all of the various people, currently or formerly employed by Alberta Agriculture or other agencies, that have been involved in the preparation of this manual over the past decade.

Dr. John Taylor was the person responsible for the overall development and preparation of the first edition of this manual. Don Scheer and John Knapp, of our branch, have been the guiding forces in this new edition. I trust that you will agree that the result is a very useful reference manual.

Ron Weisenburger, Head
Beef Cattle and Sheep Branch



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ALBERTA SHEEP PRODUCTION MANUAL

INTRODUCTION

Most authorities agree that the sheep numbers in Canada can be increased with little danger of overproduction. Canadians consume six or seven times more wool and ten to twelve times more lamb than is produced in Canada.

The soil and climatic conditions in Alberta are favorable to the raising of sheep. Sheep enterprises have been profitable where the animals were intelligently fed and cared for. Sheep production is especially suited to the recognized farming areas and to districts where soil fertility problems exist. While it is true that the scavenging qualities of sheep may be over-emphasized, at the same time, it must be recognized that as a means of utilizing the vegetation on waste places, summerfallow and stubble fields, sheep have an advantage over other classes of farm animals. That the flock will return a tidy revenue and help keep the farm clean is not a mere conjecture. One needs only to consider the enthusiasm of farmers who own flocks of varying sizes to appreciate that sheep constitute a vital part of the general farm scheme.

A large capital investment is not required to become established in the sheep business. More mature animals can be purchased with a given amount of money and the rate of natural increase is greater than that for other kinds of livestock except swine. This means that, with a comparatively small initial investment, it is possible in a few years to establish a farm flock of reasonable size.

Before establishing a flock, a person should determine what type of operation he wishes to pursue. This decision will be influenced by several factors, including environmental, financial and personal objectives.

TYPES OF ENTERPRISES

There are basically four different types of sheep farming that can be pursued.

Purebred Sheep Production

Purebreds are raised to produce foundation breeding stock and the progeny are usually sold as registered lambs or yearlings. Because you will be competing with breeders who are well established, you will have to raise progeny that are better. Your feeding, care, disease prevention and fitting for shows and purebred sheep consignment sales must be more diligent. Your buildings and yards must be neat and well kept to attract prospective buyers.

Performance testing is a must, enabling you to identify the most productive and the most rapid gaining sheep in your flock. This is the information that many prospective ram and ewe buyers are looking for.

Crossbred Ewe Production

Crossbreeding of sheep has been practised for years in Britain, Australia, and New Zealand. A crossbred ewe is the progeny of two or more identified breeds or lines. Organized crossbreeding here is fairly new, especially on a large scale, because a reliable supply of foundation ewes is not available. It is acknowledged that a two or three-way crossbred ewe will produce more surviving lambs at weaning time. An opportunity exists for the production of crossbred ewes for commercial flocks.

Commercial Lamb Production

This is the most common sheep farming practice. Many sheepmen are now using a three-way crossing system to produce commercial lambs. A good (crossbred) ewe is bred to a ram of a third identified breed or line. The ram may have any face color, but it must sire thrifty, early maturing lambs. This limits the selection mainly to the Down breeds (e.g. Suffolk and Hampshire).

Feedlot Lamb Production

Unfinished lambs weighing between 23 kg (50 lb) and 32 kg (70 lb) are purchased, confined, and finished on hay and grain and marketed when they reach 50 kg (110 lb). Silage feed with a protein supplement can also be used successfully. This permits a reduction in feeding costs, provided the silage facilities can be used by some other livestock enterprise. Feeder lambs are commonly purchased in the fall and sold during the winter.

FARM MANAGEMENT PRINCIPLES AND FINANCING THE SHEEP ENTERPRISE

According to the experts, management is the job of making decisions and acting on them. It is a process involving several individual and clearly defined steps which are as follows:

1. Observe the present situation - ACCOUNTS
2. Locate problem areas - ANALYSIS
3. Look for possible solutions - ALTERNATIVES
4. Select the best ones - ASSESSMENT
5. Put them into effect - ACTION
6. Bear the consequences and evaluate - ACCEPTANCE

The six A's of Good Farm Management

Good management is the making and acting on decisions so that the goals of the manager can be achieved as fully as possible with the resources available. While most managers go through the above steps subconsciously, their management can usually be improved by consciously laying out the steps outlined above so that no parts of it are overlooked. Many managers only get as far as step 44. They spend a great deal of their time making grandiose plans which are never executed. They are often called dreamers. Others start at the action stage without any decision making or preplanning. We all know what happens to them. Still others are afraid of accepting the risk and consequences of making and carrying out their own decisions. They seldom become managers and usually end up working for someone else. So all of the above Six Steps are essential for good managers or entrepreneurs. A weak link anywhere in this management chain can have drastic results on the outcome of the efforts of a farm manager.

Farm entrepreneurs (persons who organize and manage a business undertaking, assuming the risk for the sake of profit or gain) usually have limited resources of land, labor and capital which they hope to transform into products such as crops, lamb, beef or pork through good organization and management. They hope that their value will be greater than that of the resources being contributed, thus resulting in a gain which will help achieve the overall objectives. While these objectives might consist of such items as power, prestige, and social status, profit is usually an overriding one if they are to stay in business and not go bankrupt.

Types of Farming Decisions

Several major types of decisions must be made by farm operators. These are shown in Figure 1.

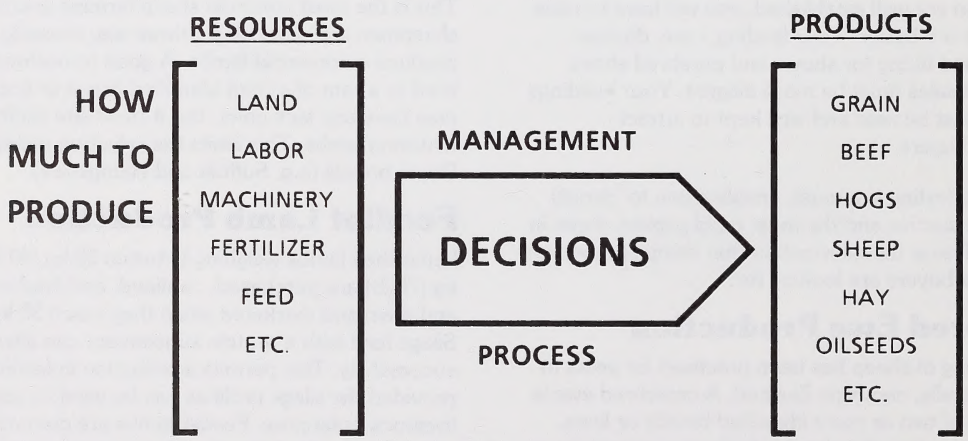


Figure 1. General types of farm management decisions to be made in a farm operation.

These major types of decision categories are:

- What to produce (enterprise combinations)
- How to produce (least cost resource mix)
- How much to produce (farming intensity)

Examples of each type of decision follow:

What to Produce (enterprise combinations)

Farm operators do a lot of head scratching to arrive at a set of enterprises which are best for their particular farm and goals. The answer will differ for each farm. Several types of enterprise relationships exist. These are:

Competitive - more production in one enterprise can be achieved only by reducing production in another. For example, wheat and barley.

Complementary - more production in one enterprise automatically increases production in another. Examples are: alfalfa and grain in grey wooded soil zones or hogs following cattle in the feedlot.

Supplementary - more production in one enterprise can be achieved with no effect on the production in another. Examples are: feeding lambs or beef or keeping a cow herd to use up surplus resources left over from the main enterprise. Such resources might be off season labor, equipment, stubble aftermath , or a coulee or slough that has not been grazed.

The supplementary relationship is, and has been, particularly important for the sheep enterprise. Many are supplementary enterprises on existing crop farms. Indications are that expansion in the sheep industry in Alberta can occur in this manner. This is why sheep numbers tend to exist as nonspecialized enterprises in grain and diversified farming areas of the province.

While supplementary aspects have, and will continue to be powerful factors for possible expansion of the sheep enterprise in Alberta, the competitive enterprise relationship is now also entering the picture. In this situation, a farmer commits to sheep production some of the resources which are already being used for another enterprise, such as cash grain production. Thus, in the last few years, there have been many examples of intensive sheep operations where production occurs under confined or semi-confined conditions with highly capitalized facilities. Here, farmers are betting that the greatly increased productivity through new and improved sheep production technology will more than offset income from the enterprise or enterprises which the sheep replace.

Whether a highly specialized sheep farm can compete under these conditions where it must stand on its own for all of the input costs, plus enough extra to offset loss in profits from replaced enterprises, is a question still open to speculation. A number of aggressive farmers are trying it now in Alberta, and some will likely make a success of it. Their success will depend considerably on the rate at which new sheep breeds, equipment, marketing methods and facilities and other new sheep technology is developed and adopted.

How to produce (least cost resource mix)

The typical farm operator also spends a great amount of time deciding how to achieve a "least cost" input mix in producing a given quantity of output. For example, they are concerned about the labor-machinery ratio which will get the job done at minimum cost. Also, in livestock feeding, they have a large range of ration choices from grain intensive to roughage intensive mixtures. The least cost choice will depend on the relative costs of roughage and grain. Some resources can be substituted for each other on a constant unit basis (barley and wheat for feed) while others can be substituted imperfectly (such as hay and grain for feed). In other words, the effectiveness of hay will depend on the proportion of hay in the hay-grain ration. The more hay in the ration, the more poorly it can be substituted for grain.

Thus, many decisions on least cost resource combinations are hard to make for lack of information about the way in which resources can be substituted or replaced by each other. The sheep feeder's final decision on a least cost ration will, however, depend on the relative costs of different feeds.

How Much to Produce (farming intensity)

Last, but not least, a farm operator must make decisions about how much of a product to produce from the farm plant, or in other words, how intensively to operate. How much fertilizer should be used? How heavy should lambs be when sold, or how much effort and money should be put into a ewe flock and how big should it be? These are all decisions concerning problems of intensity. When lamb prices are high, it will of course pay to operate more intensively, aiming for a bigger lamb crop per ewe or a heavier lamb leaving the feedlot.

The Need for Physical and Financial Data

In analyzing the proposed sheep operation, producers will first ask, "Will my sheep enterprise pay its way?"

Secondly, they will ask "If not, why not?". The first question relies mainly on FINANCIAL calculations while the second requires PHYSICAL data about the proposed flock. The questions should uncover weak and strong factors in management. Furthermore, in planning the operation of the sheep business, the producer needs to know not only prices and costs, but also physical information e.g. technical relationships in terms of quantities of inputs and amounts of expected lamb and wool output.

The physical researcher and the economist rely heavily on each other in bringing useful information to farm decision makers. The relationship can be likened to the house shown in Figure 2. Physical and technical information make up the necessary foundation, economic principles the walls, while the manager ties the whole package together with the roof.

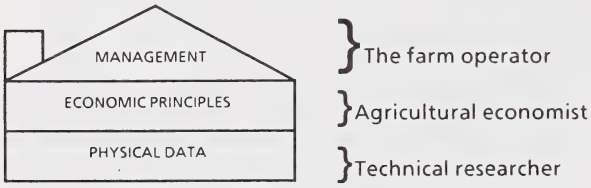


Figure 2. Relationship between physical and economic data in the management process.

Financing the Sheep Enterprise

Once you determine, through projections, that sheep production will provide you with a profit, it still may not be feasible to borrow the funds. You must look very closely at the amount of money you require, and when you will be able to repay it. To do this, set up a cash flow for the next 3, 4 or 5 years (Table 1).

Table 1. Cash Flow Projection

	YEARS			
Flock Data	**1**	**2**	**3**	**4**
Ewes to lamb	400	480	520	520
Lamb crop	520	624	676	676
Replacements	170	148	117	117
Lambs for sale	350	476	559	559
Cull ewes	70	84	91	91
Death loss, ewes	20	24	26	26
Cash Inflow	**Dollars**			
Lambs @ $42.50	14,875	20,230	23,757	23,757
Cull ewes @ $13.00	910	1,092	1,183	1,183
Wool @ $3.00/ewe	1,200	1,440	1,560	1,560
Total cash inflow	16,985	22,762	26,500	26,500
Previous year balance	0	-2,947	-1,096	+2,988
Cash Outflow				
Operating Cash Expense	11,872	14,246	15,434	15,434
Principal & interest on term debt ($26,000 - 5 years)	8,060	7,488	6,916	6,344
Interest on Operating Loan	-	177	66	-
Capital Purchases	-	-	-	3,000
Total Cash Outflow	19,932	21,911	22,416	24,778
Net Deficit or Surplus	-2,947	-1,096	2,988	4,710

Table 1 illustrates a situation where a prospective sheep producer purchases 400 ewes with borrowed funds. The first years result in a deficit, which means that some additional source of income will be required to get past those first years. Cash flow differs from a budget in that the cash flow is concerned with what you expect to sell, which may not be the same as what you expect to produce, particularly when you are increasing your flock. **Cash flow indicates whether or not you will be able to meet your debt commitments, and is used to determine what amounts of operating credit you will require.**

Both the Budget and Cash Flow should be discussed very closely with your banker to determine the amount and terms of the loan required in keeping with repayment capacity. Plans do not always go quite as smoothly as we project and expect. Thus, your ability to withstand setbacks is something that you should look at closely. **Your risk bearing ability is critical**, particularly when you are entering a new operation with which you are not familiar. As a rule of thumb, the greater the interest or equity you have in a business, the greater will be your risk bearing ability. This is shown in Table 2.

Table 2. Equity vs Risk Bearing Ability

	PER CENT EQUITY			
	100	**75**	**50**	**25**
1. Owned capital used in the business	$30,000	$30,000	$30,000	$ 30,000
2. Borrowed capital used	—	$10,000	$30,000	$ 90,000
3. Total capital	$30,000	$40,000	$60,000	$120,000
Situation I - plus 10% return in investment				
4. Gross returns	$3,000	$4,000	$6,000	$12,000
5. Cost of borrowed capital (8%)	—	$ 800	$2,400	$ 7,200
6. Net return on capital used	$3,000	$3,200	$3,600	$ 4,800
Situation II - minus 10% return on investment				
7. Gross loss	$3,000	$4,000	$6,000	$12,000
8. Cost of borrowed capital (8%)	—	$ 800	$2,400	$ 7,200
9. Total loss	$3,000	$4,800	$8,400	$19,200
10. Rate of loss on owned capital	10%	16%	28%	64%

Credit provides a valuable tool for increasing income, but like many other tools, it can cut two ways. Properly used, it contributes to a larger income. Unwisely used, it is a threat to the financial future of the business. Tools which are dangerous, such as circular power saws, have a guard to protect the user. Your risk bearing ability is your guard when using credit.

Your financial requirements can generally be met once you and your banker have determined that your proposal meets the requirements, i.e.

- profitable returns
- adequate repayment ability
- risk bearing ability
- capable management.

You may have need for a number of different types of credit. There are four distinct types of loans:

- operating credit
- breeding stock
- machinery and equipment
- buildings and land.

The first, **operating credit**, refers to funds obtained for the purchase of items which will be used up during the year's program. Examples of this in the sheep business would be: feed, drugs, feeder lamb purchases and so on. Operating loans are for a one year term and are paid out from the sale of lambs. The second category, **breeding stock**, might be for a four or five year term. The repayment of the breeding stock should come from net income originating from the sale of offspring. Outside income may allow quicker repayment, but this would be determined from the Cash Flow. The third category, **machinery and equipment**, is also an intermediate term loan, and should be repaid from depreciation reserve. **Buildings and land**, included in the last category, are long term proposals and their financing should be repaid from profits. One of the "no-no's" of financial management is the use of operating credit for the purchase or construction of long term investments, such as corrals, buildings, fences and so on. If operating money is used, a severe shortage of day-to-day funds can result. However, by going through the procedure outlined, i.e. properly analyzing the needs of the business, the appropriate type of credit will be evident.

Once you have set up a line of credit, you have established an agreement between yourself and your lender. Your lender has agreed to provide a certain amount of money under certain terms and conditions; you, the borrower, agree to use that money for the purpose for which it was granted, and repay it within the schedule established. We all know, of course, that changes in plans are often warranted because of changing conditions. It is important to discuss changes with your banker prior to making them to ensure that the proper amount and terms of credit can be made available.

BREEDS OF SHEEP

The Columbia Breed
The Columbia breed was developed by the United States Department of Agriculture as a true breeding type to replace crossbreeding on the range.

While they were originally developed for range conditions, they have proved admirably adaptable to lush grasses and farm flock management. Their heavy wool clip, hardy fast growing lambs, open faces, and ease of handling are characteristics appreciated by all practical sheep producers.

The Columbia is large, with maximum size of rams running from 113 kg (250 lb) to 159 kg (350 lb) and ewes from 77 kg (170 lb) to 113 (250 lb).

The fleece is a medium-wool type, half blood to quarter blood. Not more than two grades are acceptable on the same animal. Fleece weight on the ewes is 4.5 kg (10 lb) to 7 kg (16 lb) and has a medium to light shrink.

Columbia have always been known as a wool breed, but with the Columbia lambs cutting out desirable carcasses, they are definitely a true dual purpose sheep.

North Country Cheviot
The Cheviot is a hardy breed of sheep, able to thrive on poor pastures and hilly country. It is a deep-bodied, well-proportioned sheep, which matures early and fattens readily. Mature rams weigh 79 kg (175 lb) to 91 kg (200 lb) and ewes 57 kg (125 lb) to 73 kg (160 lb).

If the breed is used for crossing, attention should be paid to the quality of the wool, because much of the Cheviot wool is harsh and dry and inclined to contain kemp. In view of its hardiness, activity, good lactation and ability to thrive on rough pasture, the Cheviot should be well adapted for eastern coastal provinces in Canada.

Dorset
The Dorset is medium sized sheep by today's standards, having good body length and muscle conformation and producing a desirable carcass for today's market. Dorset ewes weigh from 68.0 kg (150 lb) to 79 kg (175 lb) at maturity; rams should weigh from 95 kg (210 lb) to 113 kg (250 lb) at maturity. Some outstanding stud rams of the present time weigh in the area of 125 kg (275 lb).

In general, the body conformation of a good Dorset should be of the prime lamb type, with a long tall body and legs well placed on the four corners. Along with the long tall body, good muscle conformation in loin, rump and down through the leg is imperative.

As is the case in any breed, there are defects that one should be aware of and should avoid in selecting breeding stock. Defects to keep in mind are: sickle hocks, cow hocks, weak pasterns, postlegs, or any characteristic which would make the animal off type from the accepted standards of appearance.

The Dorset crosses well with most of the other breeds and the desired early breeding habit and good milking qualities will carry into the cross-bred ewe. Cross-bred Dorset-Hampshire, -Shropshire, -Suffolk ewes will breed months earlier, as a rule, than the purebred Hampshire, Shropshire or Suffolk. They will raise two sets of lambs a year, but this practice may require extra care of the ewe flock. Three lamb crops in two years is being practised in many flocks.

Finnsheep
The Finnsheep (Finnish Landrace) is markedly different from any breed presently used in Canada. In its native Finland, this breed typically produces 2 to 4 lambs per pregnancy. By contrast, domestic Canadian breeds usually produce 1 to 2 lambs per pregnancy.

Heritability among our domestic breeds for fertility is too low to give the rate of progress needed for immediate improvement. The importation of the Finnsheep into this country, therefore, with the unique qualities of high ovulation rate and low embryo mortality, may provide this needed impetus.

Among North American breeds, the Finnsheep might be classed on the lower side of medium in body weight. The typical color is white, with the face, ears and legs completely wool free. The tail is characteristically about 15 cm (6 in.) long and covered by very short wool. About 1 per cent of the lambs are black, and reddish lambs sometimes appear. Ewes are polled. Ram lambs may develop scurs but less than 5 per cent remain scurred into adulthood.

Fleeces from Finnsheep have been classed as "Western Canada domestic, semi-bright" with 50 to 60 per cent grading "quarter staple" and the balance evenly divided between "three-eights staple" and "low one-quarter staple". Fibre length is generally 10.2 cm (4 in.) to 15.2 cm (6 in.). Mature ewes shear fleeces weighing 1.8 kg (4 lb) to 2.3 kg (6 lb).

Half-Finn lambs tend to have less fat on the outside of the carcass but have somewhat more on the kidney. Carcass lean per day of age relates to that of other breeds in

much the same way as does growth rate - greater than Dorsets, less than Suffolks and about the same as several other common breeds.

Finn-Dorset cross ewes are well established as out-of-season lambers but it remains to be established just what proportion of the Finn population has an extended breeding cycle. A number of purebred Finn ewes have been observed to lamb in the summer after having lambed in the previous winter.

Milk production in Finn ewes is very good, but probably does not exceed that of other ewes of similar size. Finns have exceptionally strong udders with a relatively low incidence of udder breakdown.

Hampshire
This is one of the more popular breeds of sheep in Alberta. They are fairly large in size; rams attain weights of 113 kg (250 lb) to 136 kg (300 lb), ewes reaching 79 kg (175 lb) or more. They are fairly lowset, blocky and compact with good strength of bone. The fleece weight will average around 3.5 kg (8 lb) and should grade medium to low medium staple. The wool covering extends well over the forehead and on to the cheeks. Greater extension of wool over the face is undesirable as it leads to wool blindness. The ear is quite large, black in color, and the same is true of the face and legs. While pink skins are desirable, blue skins are not uncommon. Some breeders believe that the black fibres in the wool are associated with the dark skin. Hampshire ewes are prolific and good milkers.

Hampshires and their crosses produce satisfactory market lambs as they mature and finish at a desirable weight and yield carcasses well developed in the regions of high priced cuts.

Lincoln
This is the largest and heaviest of all the British breeds. Mature rams weigh from 109 kg (240 lb) to 145 (320 lb) and ewes 104 (230 lb) to 118 kg (260 lb). Originating in the English lowlands, the breed requires heavy agricultural land and an abundance of good feed. The lambs grow fast, but are usually too heavy to meet today's market requirements. The Lincoln is a true wool sheep and carries a large fleece of long stapled, coarse lustrous wool, and in an average flock, will cut a fleece of 5 kg (12 lb) to 6 kg (14 lb).

Rambouillet
Rambouillets do well on the western ranges. They are strong, vigorous animals with mature rams weighing from 91 kg (200 lb) to 118 (260 lb) and ewes up to 91 kg (200 lb). The ewes are not as prolific as some other breeds, however, range operators prefer to have a good lamb that will travel with the ewe. The lambs do not finish as quickly as the down breeds and quite often they are shipped to eastern Canada to be finished in their feedlots. Numerous breeders breed their ewes to down rams so that they can produce a more desirable carcass.

The Rambouillet produces a very good fleece with long dense fibres, which are very fine in diameter. The average Rambouillet produces around 5.4 kg (12 lb) of wool which sells for top prices. Their wool is used in the production of top quality woolen cloth.

Romnelet
Mr. R.C. Harvey, of Lethbridge, Alberta, developed the Romnelet sheep by breeding Rambouillet rams to Romney ewes. However, he did not register the breed and, soon after completing the development of the breed, he sold his flock.

In 1935, producers in the area asked the federal government to continue work with the breed, as they realized its potential. The official development of the breed was finished in 1961 at the Experimental Farm at Manyberries, Alberta, when the breed was registered under The Livestock Pedigree Act.

The breed has a very good herding instinct and is a good rustler. They are not noted for their rate of gain, however, they do mature earlier than the Rambouillet. The wool grade is Canada three-eighths to one-half staple.

Romney (Romney Marsh or Kent)
The breed, because of its association for generations with the swampy lands of Kent and its general hardiness, is found more suitable than most breeds for use in areas of high rainfall. The Romney may be regarded as a general purpose sheep. The meat is of good quality and somewhat resembles the flesh of the Downs breeds. The wool is fairly fine and of average-medium crossbred type producing Canada one-quarter staple to Canada three-eighths.

The Romney is rugged and low set with mature rams weighing from 100 kg (220 lb) to 118 kg (260 lb) and ewes 82 kg (180 lb) to 95 kg (210 lb). The lambs from a Romney finish more readily than lambs of other long-wooled breeds, as they are sturdy, grow fast and suckle well.

Suffolk
The Suffolk is one of the most popular breeds of sheep in the farm flocks of Western Canada. It is a fairly large, thick bodied, fleshy, fairly low-set breed and the meat is fine grained and of good quality. Suffolk lambs grow

rapidly and can be fattened for market at a weight well within the range to make choice carcasses.

The wool covering is not extensive; the head and legs from knee and hock down are free from wool and the belly is inclined to be bare. The hair is black. The wool is only medium in length, fair in compactness and quality, with fleeces weighing between 3 kg (6 lb) and 4 kg (8 lb), and grading medium to low medium staple. Black fibres in the wool constitute one of the major criticisms.

Suffolks are hardy, active and good travellers, which make them well adapted for Western Canadian conditions. They have been used extensively for cross-breeding in both farms and range flocks. Suffolk ewes make excellent mothers, being good milkers and producing a fairly large number of twins and triplets. Suffolk rams weigh between 102 kg (225 lb) and 125 kg (275 lb), while many ewes reach 77 kg (170 lb) to 91 kg (200 lb) when mature.

SELECTION OF BREEDING STOCK

Since the type of enterprise and breed of sheep have been determined, it is time to select the animals to use in the operation.

Decisions To Be Made Before Buying

Individually and collectively, producers in the industry have to make money. It follows then that sheep should be selected and bought on the basis of economically important traits or characteristics, not on the basis of frills. Ability to grow and gain efficiently is more important than size or color of the ear; other traits, such as wool quality and quantity should get some emphasis too.

Buyers should confine their purchases to breeds known to be adapted to the environment to which they and their progeny will be subjected.

What an animal looks like results from its genetic makeup which is inherited, and the environment to which it has been subjected. There are some sale sheep that would look pretty average if they hadn't been especially well fed and trimmed. A sheep doesn't pass on its looks (phenotype) to its progeny, only its genes (genotype).

Genetically, an individual carries 50 per cent of the genes of each parent, 25 per cent of the genes of the grandparents and 12.5 per cent of the genes of the great grandparents. Buyers should recognize that an individual is not very closely related to its ancestors. In reading sale catalogues and pedigrees and listening to the auctioneer, remember this fact. Just because a sale ram's grandsire topped a previous sale, doesn't really say much about the merit or value of the grandson (or the high seller for that matter).

the selection pressure that is applied and the heritability for the trait. A scientific fact is that as the number of traits selected for is increased, the progress made on any one is diluted.

The more factual, objective information that breeders can provide buyers on individual rams or ewes the better. An individual animal's own record and that of his contemporaries should give buyers objective information and predict breeding value.

Where Can You Purchase Breeding Stock

Breeding stock are usually obtained from one of the following:

- ram sales or public auctions
- private treaty
- raised from within flock.

Decide on which flocks you plan to visit or which sales to attend. Large consignment sales provide the prospective buyer with the opportunity to compare sheep from many breeders at one location. Buy from reputable breeders who are known to be doing a good job of production and who will supply a breeder's guarantee for the animals they sell. Patronize those who are sheep breeders in the truest sense, and are making real progress in improving the quality and performance of their sheep.

Inspecting the Sheep

Before purchasing the sheep, catch a few of the animals so that you can have a close inspection of them.

Use the right method to catch and handle sheep in order to save energy and time, but also to prevent injury and discomfort to the animals.

When animals are corralled in a small pen, catching can be most effectively done by grasping the flank, as less struggling on the part of the animal is experienced. There is a tendency on the part of inexperienced producers to grasp the animal by the wool. This is a careless practice, often causing serious bruises, and should be discouraged.

A sheep is most easily led by holding the animal under the jaw with one hand and pressing the end of the dock with

the other. Pulling by the head or neck causes the animal to struggle and resist being led.

Sheep are placed on their rumps for udder inspection or other purposes. Many methods can be used to place sheep on their rumps. For ewes too heavy to lift, a simple way is to place the left arm around the front of the animal and pass the right hand under the body to grasp the hind leg on the far side. By pulling steadily on the leg and raising the forepart of the body, the animal is most easily brought to the desired position.

Characteristics to be Looked for in Selecting Animals

When making selections, consider the following points:

Growthiness (size for age): Select rapid gaining sheep that meet your other standards. Rapid gaining animals usually make the most efficient use of feed and can be marketed at a younger age. A slow growing lamb is not as profitable as a fast growing lamb. Set your goal to have twin lambs weighing at least 32 kg (70 lb) and single lambs weighing at least 36 kg (80 lb) at 90 days of age (when creep fed), then select breeding stock with the gaining ability to produce such lambs.

Soundness: *Feet and legs* - When their feet are well trimmed, sheep should be able to stand squarely on them. Select sheep that have short, strong pasterns and straight legs with plenty of width between them. Crooked legs and weak pasterns can decrease an animal's ability to move and perform normally and can decrease its years of reproductive usefulness.

Mouth - The age of sheep up to four years can be easily determined by examining the teeth. The mouths of sheep are equipped with a full set of 24 molar teeth on both upper and lower jaws, for the mastication and grinding of food. In addition, four pair (8) of incisor teeth are provided along the front of the lower jaw, which together with the lips and upper gum, enable the sheep to gather and cut off each mouthful of grass. The incisor teeth have been called "nippers", which in itself describes their use. It is the incisor teeth that are examined to determine age.

At about three weeks of age, lambs usually possess a full set of 8 incisor milk teeth. These are smaller and narrower than the permanent incisors which can be readily determined by their size. Permanent incisors are longer and broader than the milk teeth.

Each succeeding year, an additional pair of milk teeth are replaced by permanent ones in regular order, so that when sheep are four years of age, a full set of eight permanent incisors will be found.

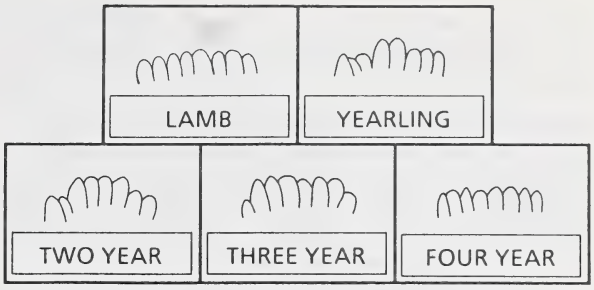


Figure 3. The above illustration indicates how the teeth appear at different ages:

After four years of age, there is a tendency for the teeth either to wear down until they become like stumps, or loosen and fall out. It is, therefore, impossible to tell exactly the age of sheep after they are four years of age. If one or more incisors are missing in mature animals, they are called "broken mouthed", or if all incisors are missing, the term "gummer" is applied.

Sheep that have been well cared for and properly fed will often maintain a full mouth until they are seven to nine years of age, while range sheep or poorly cared for sheep that have suffered many periods of food shortage and exposure to severe weather begin to lose their teeth at five to six years of age. As soon as sheep become "broken mouthed" their usefulness is much impaired.

Udder - If ewes have produced at least one lamb crop, check their udders to be sure that both teats are present and functional and that there are no lumps or hard areas.

Conformation: The ideal conformation probably varies from one breed to another. However, there are times when you can find as much variation between animals of the same breed as you can between different breeds. In general, a sheep with good conformation has the following qualities:

— wide chest
— smooth shoulders
— fullness throughout the heart area and the spring of ribs
— long body, with major emphasis on length from the last rib to the dock
— wide and straight top
— long, wide and level rump
— deep, thick, and full leg of lamb, and
— overall balance (blending together of body parts)

Condition of Birth (single, twin or triplet): Your first choice should always be ewes of multiple birth. Progress can be made in increasing

lamb percentage by selecting for twinning. Under Alberta conditions, a good set of twins is more profitable than a good single lamb.

Previous Performance: When you buy breeding stock, get all of the information you can - such factors as weight at 90 days and weight at one year of age. Find out the performance of the progeny, if any. Also check the performance of sires and dams. Some breeders have carcass information available, so check on this also.

Substance (amount of bone): Select heavy boned sheep. In general, heavy boned animals do better than fine boned ones.

Wool: Select heavy shearing sheep that have dense, uniform, high quality fleeces, with no dark fibres. This is one factor that is often neglected in sheep selection but should not be since wool makes a sizeable contribution to the gross income of a sheep enterprise.

Age: Select the younger ewes because they have more productive years ahead than older ewes. Even though yearlings cost more than older ewes, their cost per lamb produced is usually less. Yearling ewes have more productive years ahead of them; they have sounder udders, and a lower death loss. Ewes generally reach peak productivity at four to six years of age.

Sex Character: Ewes should look feminine and rams masculine.

Breed Type: Breed type is an important consideration in purebred livestock. Without it, breed identity is lost. Even though breed type is important, do not get carried away to the point where you forget all else. It needs to be appraised along with other factors listed here.

Fertility: Fertility can really only be judged by the performance of the animal. It is one of the most important traits that can be selected for and, in most flocks, there is much room for improvement.

Semen tests can be used on rams to determine if they are fertile. However, semen tests are limited in availability and, to date, have not been considered practical for large commercial operations. These tests, if available, can be useful in eliminating sterile rams or rams of questionable breeding ability. Hopefully, in the future, new developments in semen evaluation will allow more extensive and effective use of semen testing of rams. Meanwhile, the logical approach is to consider general health and soundness as clues to fertility.

Buying Decisions

Do not get caught up in the atmosphere of the auction and the auctioneer's chant. Stay cool, remembering why you are there and for what purpose. When bidding, always watch the auctioneer. Make your bids sure and deliberate but not too quickly.

For the producer with limited funds, the most difficult task when buying sheep at auctions is to actually get the individual decided on. Several sheep are usually selected with a priority rating, but these are not always sold in the order that allows for making easy decisions.

Frequently we end up buying sheep we do not rank very high. At the time they were going for fairly reasonable prices but after they were purchased, you were left with not enough money to bid on the sheep you wanted. If you are going to buy sheep, buy the ones you want and be prepared to pay for them.

SHEEP FACILITIES

One of the common lamb production techniques now being practised is that of breeding the ewe flock in late summer to lamb in winter. This system requires enough housing to save the newborn lambs during sub-zero temperatures. Additional facilities are required to reduce the operator's labor to an acceptable level during lambing and in periods when available labor is required by the other farm enterprises. For example, it is generally not possible to provide 24 hour a day supervision of the flock during lambing to prevent newborn lambs from getting chilled or mis-mothered.

Facilities required for this purpose involve housing for the before, during and after lambing periods, convenient feeding and watering systems, working corrals for sorting, treating, etc. as well as a sufficient number of pens to provide the flexibility necessary, especially at lambing time.

Housing

Traditionally, open front sheds have been used to house sheep in semi-confinement. A simple open side or open-end pole shed serves very adequately to house the ewe flock up until lambing begins. Ideally, the shed should be large enough to provide approximately 1.4 m^2 (15 sq ft) for each pregnant ewe although this area may be reduced under ideal conditions.

The amount of shed space and the number of cross-partitions required is greater at lambing because of the need to sort the flock into manageable size groups. The quality of housing must also be increased during lambing to provide sufficient protection for the lambs. For small and medium size flocks, it is satisfactory to temporarily close in a portion of the shed for the claiming pen and hardening areas. A 1.2 m (4 ft) high panel at the bottom with polyethylene covered frames hinged at the top give the necessary protection while still admitting light. The section housing ewes about to lamb should also be easily closed at night and during severe weather conditions.

In larger flocks, it is generally necessary to synchronize breeding so that manageable sized groups of ewes lamb over successive two or three week intervals. The lambing centre is then designed to handle only the number of ewes in each group and can be designed as a more specialized unit with a controlled environment. One technique is to use a relatively large pen with a movable cross-partition which separates the ewes with lambs from those that haven't lambed. Disease control is much more difficult in a central lambing unit, particularly those diseases carried with the manure or afterbirth. Lambing buildings must be cleaned and disinfected thoroughly between lambings which is difficult if bedding is being used in a cold building. Slatted floors of wood, concrete, or galvanized expanded metal mesh can be used in warm buildings to provide long term manure storage out of contact with the sheep. Slot openings in the lambing area must be small enough to prevent lambs from getting their feet caught. In addition to cleaner conditions, slatted floors reduce the building area required per head, eliminate bedding costs, reduce labor requirements, control internal parasites and contribute to sheep comfort in hot weather. On the other hand, the building must be insulated, heated and properly ventilated to eliminate manure freezing on the slats and cold drafts coming up from under the slats. It is also necessary to feed a ration which has been processed enough not to plug the slats around the feeders. Slatted floors work very well for finishing lambs where even in hot weather they can be stocked at 0.4 m^2 (4 sq ft) per head, provided they are given sufficient ventilation either by mechanical or natural means.

Ventilation

Sheep are similar to all other animals in that their bodies give off large amounts of heat and moisture. The amount of heat and moisture produced depends on a number of factors such as air temperature and velocity, humidity, animal size and activity, and level of feeding. Ventilation is basically a problem of removing excess moisture or heat from the building without creating drafty conditions.

Open noninsulated sheds are relatively easy to ventilate by allowing sufficient air to pass through the building to remove the moisture produced by the sheep. Generally sufficient air flow to control condensation will hold the inside shed temperature down to 5° - 8°C (10° - 15°F) above outside air temperature. With single sloped open front sheds, it is recommended that one leave a 10 - 13 cm (4 - 5 in.) slot open at the top of the rear wall which ideally should include some adjustment for varying weather conditions. A ventilation opening must also be left in the front if the shed is temporarily closed in. In addition to providing the needed air movement for ventilation purposes, this air coming through the shed will reduce the swirling effect of wind and snow coming over the roof and will move the expected snow drift farther away from the front of the shed. This slot will admit some snow if the shed is exposed to severe snow drifting and therefore it is necessary to protect the shed as well as all outside facilities with shelterbelts, snow fences, etc. Sheds with double sloped roofs require similar openings and if the shed is closed at the front or open only at one end, it requires, in addition to the adjustable opening

under each eave, a continuous 7.6 cm (3 in.) slot opening down the ridge. Heat will, however, be required in the lambing, claiming and hardening areas. This supplementary heat can be supplied and thermostatically controlled with the use of gas or electric radiant heaters. Electric heat lamps create a greater fire hazard and should only be used if installed and protected in a manner approved by the Electrical Protection Branch of the Department of Labour. Heat in the form of radiation does not heat the air, only the objects it shines on and therefore it is advantageous to use a number of small units to provide uniform heating at the floor level. As the air is not heated directly with radiant heaters, it is not necessary to have a well insulated building, however, heaters of this type are not normally vented and because they release moisture inside the building, proper ventilation is even more important.

Environmentally controlled, total confinement buildings are not nearly as common yet for sheep as for some other types of livestock. This is probably because of the thermo-regulatory capacity of the sheep's fleece which in addition to an animal's natural ability to acclimatize serves to keep a sheep comfortable over a wide temperature range. However, limited research has shown that sheep produce and perform better, and require less feed if raised under ideal environmental conditions. Naturally, the investment in environmental control facilities must be balanced against the expected increased returns. The point at which additional expenditures will not sufficiently increase returns will differ between parts of the province, between sheep of different ages, and between operators. Labor and feed costs must also be considered.

The comfort zone of a ewe is probably within the range of 7° - 24°C with 13°C considered optimum. Because of the higher level of feeding, the comfort zone of feeder lambs is about 3°C lower. Newborn lambs, until they are dry, require a temperature of 24° - 27°C. A ewe or ram on a maintenance ration and under average conditions gives off about 0.08 kilowatts of body heat per hour and a fattening lamb about 0.10 kilowatts per hour. In the winter, this heat is used to help keep an environmentally controlled building warm, however, during extreme weather and especially if the animal density in the building is low, this amount of heat will not be sufficient to make up for the heat lost out through the structure plus the heat necessary to warm the cold incoming ventilation air. Supplementary heat from various fuels (natural gas, L.P.G., coal) can be added in various ways to make up the total heat requirement. The common forced air furnace or hanging space heater may be poor alternatives because of corrosion and chimney backdrafting. In a number of circumstances, hot water heating is good because of the ease and efficiency with which heat can be distributed over a large area or to a number of areas requiring various amounts of heat at different times, while complementing, not interfering with the ventilation air system.

As with any type of livestock, it is important to hold the humidity down in a total confinement building. The preferred relative humidity is 60%, although a range of 50% to 75% is acceptable. A sheep breathes into the air approximately 763 kg (1.68 lb) of water per day. Therefore, 100 sheep will give off nearly 77 L (17 gal) of water per day which must be removed from inside the building. The amount of moisture the air is capable of holding is directly related to the air temperature and, therefore, winter ventilation is basically a problem of removing the warm moist inside air and replacing it with cold dry outside air.

The following three conditions or a combination of them will cause condensation or sweating in a building:

- Condensation or fogging within the building will develop if the relative humidity in the building goes above about 80% as a result of too little dry air being brought in by the ventilation system.
- If the supplementary heating capacity is insufficient, the required air exchange rate will cool the inside air temperature, and because the relative humidity is temperature dependent, the relative humidity will rise with condensation resulting.
- If the structure is not adequately insulated, the inside surfaces of exterior parts of the building will be cold and inside air coming in contact with any cold surface may cool below its dew point temperature, resulting in condensation.

In any environmentally controlled building, the recommended insulation is R20 in the walls and R20 above the ceiling. Concrete foundations should have 5 cm (2 in.) of rigid polystrene applied to the exterior and suitably protected.

A polyethylene vapor barrier must always be placed on the warm side of the insulation to prevent water vapor from moving into the insulation and condensing. Condensation in the walls or ceiling will reduce the effectiveness of the insulation and will eventually cause the structure to deteriorate.

Feeding Systems

The choice of types of feed to be used and method of feeding greatly affect the layout of a partial confinement sheep operation. The sheep operation must complement

the existing or proposed method of storing, processing and handling of forage in particular. Generally, the most efficient system for smaller flocks is to store the feed at the feeding site, especially small hay bales which can be hand fed during the winter without the need to start a tractor. This probably requires a number of stacks at the desired feeding locations.

For optimum feeding at lambing time, it is necessary to divide the flock into several groups, i.e. ewes that haven't as yet lambed, ewes with first lambs, singles, twins, etc. This requires a system with a great deal of flexibility.

If equipment is required to handle feed such as silage or large bales, then the storage area can be at the most appropriate location with the use of portable, stationary or fenceline feeders. Mature ewes require 46 cm (18 in.) to 51 cm (20 in.) of feeder space per head for limit feeding. With perimeter fenceline feeding, it becomes difficult to have sufficient feeder space for more than two pens running out from a shed unless the location permits a semi-circular arrangement of pie shaped pens.

Self-feeding a hammered ration to lambs or ewes during late gestation or lactation has been a successful practice. The feeders should be located so as to make filling as easy as possible.

Because it is generally necessary to feed a few pounds of grain per ewe just before lambing and during lactation, a convenient system is required to serve several pens during the busy lambing period. This can be accomplished by hand feeding in portable feeders or more conveniently with a mechanical bunk feeder, especially for larger operations. The feeder can be located for common use with access from all the pens or can be placed over a divided bunk between two pens. A number of mechanical bunk feeders of the auger, chain, belt or vibrating design are on the market, however, most of these commercial units are of heavy construction and are too expensive to handle the relatively small amounts of grain required for the ewe operation. If the time and shop facilities are available, it is possible to build a small inexpensive auger feeder of the "roll-over tube" type or commercial 15 cm (6 in.) units can be purchased.

For total confinement sheep operations inside feeding is generally mechanized with the use of conveyors and mechanical bunk feeders. Another suitable system is the use of inside drive-through feed alleys similar to outside fenceline feeding. This system requires about 4.7 m (10 ft) of building width for the feed alley and the pens must be relatively narrow to match the feeder length with the number of head held in each pen. If slatted floors are being used, the feed must be chopped finely enough so the slots will not be plugged with spilled feed.

Water Systems

Most farms have a pressurized water system for household and livestock use, which when well planned, can automatically water a large number of sheep at various locations. The watering system should be designed with a capacity of 9 - 14 L (2-3 gal) per sheep per day for the existing flock and including any possible future expansion. There are two peak demand periods, morning and afternoon, consequently the system should be designed to provide half the volume of water required per day in two one-hour periods. Automatic waterers continually accessible in semi-confinement lots help to alleviate or extend these peak demand periods. However, if a flock is out on pasture and all come in together for water, a reserve storage system may have to be installed if there is insufficient capacity in the watering system. Buried farm yard water lines, which are generally series 75 plastic pipe, should never be less than 2.5 cm (1 in.) in diameter and preferably 3.2 cm (1.25 in.) for most operations, even if the present well is of low capacity. For future expansion, it is generally cheapest to branch off or extend the present lines which must be able to handle the increased flow rate. In 2.5 cm (1 in.) diameter plastic pipe, a flow rate of 22.7 L per minute (5 gpm) will result in a pressure drop of about 1 psi for every 30.3 metres (100 ft) of level line. Also 1 psi will be lost for every 0.70 m (2.3 ft) increase in elevation from the pump to the discharge location, valves, couplings, etc., will cause additional friction loss. Water lines should be buried at least 2.4 m (8 ft) deep under pens where the snow cover will be tramped down. If this is not possible, the line should be protected with a frost box or installed through a larger diameter pipe to provide an insulating air space around the pipe. Remember it is never safe to work in an 2.4 m (8 ft) deep trench unless the sides have been adequately shored or back-sloped. To decrease the possibility of freezing, the riser pipe at the waterer should come up through a 10.2 cm (4 in.) pipe and for extra insurance can be wrapped with a heating cable. The 10.2 cm (4 in.) pipe should come up into the waterer as far as possible and no insulation should be placed around the riser pipe as it tends to get wet and freeze. Automatic waterers can be heated electrically or with gas, and should be equipped with an adjustable thermostat. Waterers must also be C.S.A. approved, well insulated, easily cleaned, and properly grounded. Waterers should be installed on a pad of concrete about 2.4 m (8 ft) square, depending on the size of the waterer. Because the earth settles along water line trenches, the concrete should be poured the second year with a temporary plank pad used the first year. To

further reduce the possibility of cracking, reinforcing mesh should be used in the concrete.

Handling Facilities

Good handling facilities will reduce the labor and stress involved when working or treating sheep. Working corrals should be as simple in design as possible, yet should allow for easy and efficient operation. The first step in designing handling facilities is to decide exactly what operations must be performed, i.e. sorting, spraying, drenching, loading, weighing and the number of sheep the facilities must handle now and in the future. Generally, handling facilities are composed of the required number of sorting and holding pens arranged around a crowding pen, working chute and loading chute. The crowding area is necessary to get the sheep into the working chute in single file with the least amount of stress on both the sheep and operator. This pen must hold a sufficient number of sheep to fill the working chute and is generally built with one side being an extension of the working chute fence and the other tapering down at about 30°. The entrance to the working chute should be placed so as to make the sheep think they are escaping back to the main flock and it should never require the sheep to face into the sun. Also, sheep should never be worked down hill. Sheep tend to follow others that disappear in front of them and therefore the curved or dog-leg working chute is often used.

The working chute should be between 36 cm (14 in.) and 46 cm (18 in.) wide and 76 cm (30 in.) and 91 cm (36 in.) high depending on the size of sheep to be handled, although panels can be hung inside the chute to reduce its width for lambs. Some operators find lambs will crowd into the wider chute presenting no handling problems. If a foot bath is built into the chute, it should be at least as wide as the chute so the sheep cannot step up on the edge. Copper sulphate is very corrosive to metal and therefore the foot bath trough should be constructed of wood or concrete. Several cutting gates should be built into the working chute for sorting. A scale can be placed in the chute, however, it should be portable so that it can be removed during routine handling. Spraying has almost eliminated the need for a dip tank to be built into facilities.

The loading chute must first of all be accessible by a cattle liner which requires a relatively level, well drained area protected from winter snow drifting. The loading chute should be long enough to provide a 1:4 slope and should be adjustable in height to handle double-decker trucks. Electricity should be available at the handling facilities for light and operating electrical equipment. For the greatest effect, yard lights here and in other areas should be mercury vapor dusk-to-dawn lamps located at least 6 m (20 ft) from a building or feed stack and about 8 m (25 ft) from the ground.

Location

Once the general list of facilities required has been determined and before any construction begins, it is necessary to take a very critical look at the farm yard. It is time well spent to sit down with a large sheet of squared paper and approximately scale out the size and location of all existing facilities which will not be moved in the near future, and lay out, again to scale, various arrangements for your proposed new facilities. Be sure to show major drainage patterns which cannot be altered, existing shelterbelts and location of the well, water lines, transformer pole, etc.

A site must be selected which most importantly has good drainage or can be drained without excessive costs. Ideally, the site should have a southerly slope of about 3 per cent - 5 per cent which is a drop to the south of 1 -1.5 m (3-5 ft) per 31 m (100 ft). This is seldom available around an existing farmstead, but slopes in other directions can generally be taken advantage of with a little forethought. If some earth moving is required, it can usually be done quite easily before construction begins and will become very difficult as more and more facilities are added. It is not necessary to make the entire location flat, in fact, it is not wise to do so, however, it must be realized that we receive an annual total precipitation of from 33 cm (13 in.) (Brooks and Fort Vermilion) to 58 cm (23 in.) (Rocky Mountain House and Turner Valley) and that this water must be channelled away from the yard and facilities in a controlled manner.

It must also be remembered that it is against the law to allow any contaminated water to drain from your property into any body of water or water course, and it may therefore be necessary to dig a catch basin to hold run-off until it can be disposed of on dry ground. Eavestroughing should be provided on all double sloped roofs to decrease the amount of water running through the pens. If drainage is bad and cannot be improved, provide additional space per head in the pens and use more concrete around waterers, feeders, alleys and other high traffic areas.

The site should also offer as much protection as possible from storm winds and the resulting snow drifting. Until adequate shelterbelts can be established, porous wind break fences can be very effective for protecting livestock housing, feeding and bedding areas. Snow drifting is very dependent on wind velocity and therefore, if the wind speed is decreased by a fence, the snow being carried will form a drift just down wind from a porous fence. It is therefore necessary to remove the snow from the wind about 46 m (150 ft) upwind with a snow fence, 50 per cent open board fence, shrubs, etc., and then use a high 20 per cent porous windbreak fence to protect the

livestock facilities. More information can be obtained by requesting publication Agdex 711.1 *Snow and Wind Control for Farmstead and Feedlot* from Alberta Agriculture.

Summer winds should also be considered to avoid creating an odor nuisance at your own residence or that of your neighbors. Alberta Health regulations require that minimum distances be maintained between confinement livestock facilities and urban centres, public places, country residences and surface water. During the past few years, the government through a number of departments and agencies such as Health, Environment, Highways, Labour, Regional Planning Commissions and local governments, has passed various regulations concerning the location and operation of livestock facilities including sheep operations. Alberta Agriculture in cooperation with Alberta Environment has published a *Confinement Livestock Facilities Waste Management Code of Practice* Agdex 400/27-1 in an effort to provide a technical base upon which livestock operators can develop without causing undue environmental impact. In conjunction with this Code of Practice, a voluntary "Certificate of Compliance" program has been instituted through which the regional agricultural engineer will assist in ensuring that existing or proposed operations comply with sound waste management and pollution control techniques and as well, meet all existing regulations. Evidence of this through the certificate and awareness of your operation by planners will transfer much of the responsibility to the developers, should your operations be encroached upon by nonagricultural activities.

When considering a site, it is necessary that water and electricity be available within a reasonable distance. The site must also be accessible by livestock trucks and feed handling equipment on a year-round basis.

More specific assistance with the various aspects of sheep facility design and layout is available from Alberta Agriculture regional agricultural engineers who can be contacted by your local district agriculturist.

SHEEP MANAGEMENT

General Management of the Flock

The natural habits of sheep facilitate their treatment as a flock. They are gregarious and a flock of sheep will travel well if certain principles of herding are observed. Sheep habitually face the wind when grazing and generally stay in small groups in the pasture. These habits considerably facilitate gathering and herding sheep.

When sheep are driven into the wind, they walk freely and easily and will cover long distances in a day. On the other hand, when driven with the wind, as is so often necessary, they are inclined to become sulky and may even refuse to move unless great care is taken. To avoid this, the flock should be kept spread out and dogs should not be allowed to work along the side or in the lead of the flock, as any sudden fright from either place will cause the sheep to run together and then refuse to move forward. In any case, the individuals in the flock must have room to walk and pick at any feed that they care to when being driven. Considerable heat is generated in the centre of a compact flock of travelling sheep during hot weather and it is therefore necessary to keep the flock spread out to avoid sheep in the centre becoming distressed.

Breeding of the Flock

The time of breeding sheep varies in the different areas. The rams should be placed with the ewes at a certain definite time of the year, depending on whether a fall or spring lambing is desired.

The proportion of rams to use is usually two to three per cent. The number depends largely upon the age, condition and breed of ram. Young rams are, on the whole, more active than older rams and age must be taken into consideration when deciding the number to use. The rams should be in good condition when they are turned in with the ewes, and they should be carefully examined to see that they are sound in every way. It may be even necessary to remove the wool from the belly of the ram if he has a long staple of wool. Special attention should be paid to the feet, which may need trimming.

It is a good plan to yard the ewes with the rams overnight a few times during the mating period. In order to see that the rams are doing service, apply a raddle to the belly or brisket, so that they leave evidence on the ewes of their activity. Rams are prone to fight when turned in with the ewes, and the injuries which they inflict on each other can, to some extent, be minimized by cutting back the horns and even dehorning.

It has been shown that if vasectomized teasers are introduced into the ewe flock two weeks before the rams are put in, a great number of ewes conceive within a few weeks.

Disposition to Breed

How long the rams should be allowed to remain with the ewes depends upon the breed of sheep and the

environmental conditions. The usual time is six to eight weeks.

During the breeding season, estrus or sexual heat appears about every 17 days and lasts 12 to 14 hours, sometimes longer. Most ewes do not come into estrus regularly the whole year round. This is particularly marked in British breeds whose breeding season is usually restricted to the fall and winter months. The British breeds seem to be most prolific during their third and fourth heats.

Age of Ewe and Ram

As a general rule, the best age at which to first mate the ewes with the rams is 18 months, however, with the early maturing breeds used in Alberta, most can be bred at seven months when they are weighing over 46 kg (100 lb). The period of gestation being approximately five months (147 to 152 days), the lambs will be dropped when the ewes are about one year old. The ram may be used at one to two years of age, depending on the breed and his general development. He should not be used too young, as he is liable to be checked in growth.

Trouble is often experienced at lambing time when ewes are mated to big-framed rams. In crossbreeding, therefore, it is advisable to use older ewes. Such ewes, because of their development, have less trouble at lambing time and in addition, they are better mothers than the younger ewes.

Increasing Lambing Percentage

The Ewe

- Examine the udders of all ewes prior to mating and discard ewes with defective udders, abnormally large teats or blocked teats, because even if the ewes do produce a healthy lamb, the chances of the lamb's survival are reduced.
- Cull ewes that have failed to rear lambs to market in two successive mating seasons.
- Flush the ewes by increasing their nutrition before introducing the rams. Check the condition of the ewes by feeling over their loin.
- Use a vasectomized ram in the flock before introducing rams.
- Ensure that the mating season is long enough to give all ewes at least two chances of mating - six weeks is desirable.

The Ram

Several factors are responsible for poor quality semen and hence affect reproduction.

- High atmospheric temperature, such as are experienced in hot summers. Optimum fertility, therefore, cannot be expected if mating takes place during or shortly after very hot weather.
- Fevers caused by abscesses or infected wounds, conditions such as foot rot and foot abscess and even severe exercise in hot months can cause reduced fertility. The semen soon returns to normal except in severe cases where it takes some time for the ram to regain his fertility.
- Deficient nutrition, especially a deficiency of Vitamin A affects the quality of semen. Vitamin A, normally derived from green feed is necessary for optimum fertility. Rams deprived of Vitamin A are likely to become sterile within three months.
- Diseases and abnormalities of the reproductive organs will affect the semen and cause temporary or permanent sterility.

Pregnancy Diagnosis For Sheep

It is commonly thought that much of the loss due to failure of ewes to lamb can be ascribed to some condition or malfunction of the ewe herself. Recent evidence suggests that this is not necessarily so. Overworking of the ram could be a more likely cause. Also, the fall-off in the nutrition of the ewes in the weeks immediately following conception is said to result in the starvation and resorption of a significant number of fetuses. In either event, a systematic diagnosis of the condition of the ewe and whether she is carrying a live fetus or not would seem to be most useful in determining whether to remove her from the flock.

Several ways have been suggested for diagnosing pregnancy early in term. These generally rely on depth or echo probing with a high frequency sound (ultrasonic) beam.

Palpating the Abdomen*

By merely palpating the abdomen of ewes, it is possible to tell whether or not an animal is pregnant. This diagnosis can be made during the last 1 or 2 months of pregnancy.

The speed of handling enables this technique to be used on large flocks. It is envisaged that a husbandry procedure of this type could be particularly valuable to producers running sheep under extensive or semi-extensive grazing conditions.

Technique

No special restraining apparatus is used, the assistant merely holds the ewe in a sitting position resembling the

* ***Palpating the Abdomen*** *by M.S. Pratt and P.S. Hopkins, Husbandry Research Branch, Queensland Agricultural Department.*

belly-blow at shearing. The operator then presses one hand against the left side of the ewe's abdomen and palpates the lower abdominal area of the right side with the fingertips.

By pressing the fingers against the lower abdomen, the lamb is felt as a floating body which is pushed away and then located as it returns to the fingertips of the palpating hand.

This procedure was adopted since most unborn lambs could be most easily located on the right side, presumably because the rumen contents tend to push the reproductive tract towards this position.

The presence of an unborn lamb can be detected during the last 2 months of pregnancy, and the ease of diagnosis increases as the stage of pregnancy advances. The body condition of the animal also influences the ease of palpation. Ewes in average condition are easier to diagnose than those that are fat.

Withholding feed and water for 12 to 24 hours before diagnosis increases the ease of this procedure when the animals are more forward in body condition. There is, however, a slight risk of pregnancy toxaemia under these circumstances.

This procedure was 80 per cent accurate when the ewes were 3 months pregnant, accuracies of 85 per cent to 95 per cent were consistently obtained during the last 6 weeks of pregnancy.

The major limitation to the speed of operation is the rate at which the assistants can catch and hold the ewes. An experienced operator can handle 200 sheep an hour. Benefits of pregnancy testing are:

- Culling Non-pregnant Ewes. This would enable a producer to run the pregnant animals in the most favorable paddocks and, if required, drought fodder need be provided only for the in-lamb ewes.

  If pregnancy diagnosis were undertaken in flocks at a time when most of the ewes were 90 to 125 days pregnant, this would offer the operator a chance of attaining a high degree of accuracy, avoid handling near birth and give the producer ample time to adopt preferential management practices designed to minimize ewe and lamb death rates.

- To Increase the Number of Lambs Born. Pregnancy diagnosis could be used to advantage where a farmer wished to rejoin the nonpregnant portion of the flock approximately 3 to 4 months after mating had begun.

- For Culling Barren Ewes. By applying pregnancy diagnosis as an annual management practice, non pregnant ewes could be identified by tagging. If the same animals were again judged nonpregnant in the following year, they could be classified as barren and culled.

The Doppler

This machine translates the inaudible heartbeats of the unborn lamb into sounds audible and readily interpreted by the human ear. Pregnancy has been established as early as 26 days after mating, but for the most accurate consistent results, it is more desirable to take readings at 6 weeks, when it has been shown to be 98 to 99 per cent accurate.

It takes about a minute to check out a ewe after the examiner has acquired experience - somewhat longer in the case of nonpregnant ewes where the examiner will want to do a little exploring to make sure there is no fetus present. Any person can detect pregnancy the first time the instrument is used, provided the ewe is in fact pregnant.

Lambing

Management of Ewes

As the lambing season approaches, the ewes should be carefully watched. They should not be too fat or too low in condition. The ewes should definitely not be forced into condition just prior to lambing, however, they should be on a rising plane of nutrition.

The ewes have worked five months to produce this crop of lambs; you wouldn't want to lose any part of it. The key is vigilance. If the lambing band is out of doors, check on the area with binoculars to spot "down" ewes. If they are indoors, use your flashlight in dark or crowded corners that they might seek to lamb in.

Have plenty of short 1.2-1.5 m (4-5 ft) hurdles ready. They are practically indispensible to prevent the mismothering that might otherwise occur during the first critical days of a lamb's life. Penning the mother and her lambs together gives them a chance to become acquainted, and it gives the shepherd a chance to make sure things are going all right.

Immediately after birth, clear mucous from the lamb's nostrils and make sure it is breathing. Then place it under or close to its mother's nose. If she is not too feverish, she will begin to lick it and in doing so, identify it as her own. This is called "owning", an essential link for their successful future behavior. Check both nipples of the ewe to make sure they are unplugged and have milk. See that

she nudges her lamb toward them and trains it to get its first meal of that all-important antibody-charged first milk or colostrum. Now, most of the immediate task is done. Withhold grain for the first 24 hours, but give the ewe a small bucket of clean water with the chill taken off. Limit her feed to first class fine, leafy hay. Next day, begin graining - 0.45 kg (1 lb) a day for ewes with single lambs, 0.9 kg (2 lb) for ewes with twins. If the ewe has little or no milk, give her some grain and plenty of water the first day to try to bring her into milk.

Throughout those first days, check frequently to make sure the lambs are all nursing. When in doubt, do a little prodding and helping. If they don't seem to be getting enough, pick them up and train them to accept occasional help - snacks from a bottle, using a formula based on the new high-fat milk replacers that are designed especially for lambs.

A Checklist of Lambing Basic Needs

(1) *Propylene glycol* - For treatment of pregnancy toxemia, watch for ewes appearing tired, or lazy about getting up or moving before lambing.

(2) *Lambing pens* - Pen up ewes and lambs for a day or so, particularly ewes with twins.

(3) *Heat lamps* - Very helpful for weak or orphan lambs.

(4) *K-Y jelly or other lubricant* - A necessity in helping a ewe to lamb.

(5) *Iodine* - To disinfect navel.

(6) *Twine* - To use on those elusive feet in difficult delivery.

(7) *Penicillin, 5 or 10 mL hypodermic syringe and No. 20 needles* - For treatment of pneumonia, navel ill in lambs or after difficult delivery for ewe.

(8) *Uterine boluses* - For retained afterbirth. Insert deep in uterus using glove.

(9) *Vitamin E and selenium* - Injectable or bolus, preventive or treatment if While Muscle Disease is a problem.

(10) *Colostrum from sheep or cow (kept frozen)* - A 'must' for weak or orphan lambs.

(11) *Bottle and nipples*- For orphans or those weaker ones that need a boost.

(12) *Mastitis ointment* - Also good for weepy eyes.

(13) Thermometer - Normal sheep temperature 38.9 to 40.0 °C (102 to 104 °F).

(14) Scour remedy.

(15) *Paint brands* - For identification. Put the same number on ewe and her lambs.

(16) *Scales* - For weighing lambs at birth (and at sale time).

(17) *Lambing sheets* - For records.

(18) *Plastic gloves* - A.I. gloves.

(19) Ear Tags.

Obstetrics in the Sheep Barn and Profitable Sheep*

Losing a lamb means twelve months of ewe cost wasted. If you realize what is happening and know what to do when a ewe shows signs of giving birth to her lamb, you can save a good percentage of the lambs and even ewes in some cases.

Most herders or lambers do not believe in letting a ewe strain for hours before investigating her to determine the position of the lamb. If she has passed the first "water bag" and does not give birth to her young within a half hour or less, she should be caught, thrown and examined.

There are two or three basic situations in lamb delivery. If you know how to handle these situations, you'll be successful in most variations of lamb birth. Here are the main variations and how to handle them.

Case 1: Tight Delivery

This is a normal birth, but owing to lamb size or the tightness of the ewe, the lamb probably would die before delivery.

Stand over the ewe, facing the tail. Draw one leg of the lamb to an extended position. Then, while drawing lightly on this leg with the left hand, work the ewe's skin back over the crown (forehead) of the lamb's head with the right hand. Next, span the neck with the right hand and draw the lamb forward an inch or two, still pulling the foreleg with the left hand. Now it is safe to extend the second leg. Complete delivery by drawing both legs and neck.

** By L.J. Kortan, Dakota Farmer*

You'll be tempted to extend both legs at first, however, in this position, the thicker part of the legs come opposite the crown of the head. Delivery then is more difficult and unnecessarily hard on the ewe. (See Case 5).

Case 2: Foreleg Turned Back

This position is like a normal birth except one foreleg is turned back. If it is the right leg, lay the ewe on her right side. Now the backward leg is uppermost. Take the same position as in Case 1. Extend the one foreleg, work skin over the head, and draw the lamb an inch or so.

Now the shoulder of the backward leg will be caught behind the upperside of the V-shaped bones (pelvic bones) of the ewe. Twist the lamb and pull at the same time. This is done by drawing the leg out and upward, and the head out and downward. After a jerk is felt as the shoulder slips past the pelvic bones, only a straight pull is necessary.

If the lamb's left leg is turned back, lay the ewe on her left side. Always keep the backward leg uppermost. It is important to learn this method, as it can simplify other cases.

It sometimes happens that the lamb is pushed back into the ewe in order to catch the other leg and the head drops out of the pelvic girdle and getting it started right again becomes very difficult. Getting the head started into the pelvis again is very difficult. (See Case 5).

Case 3: No Feet Showing

If only the head is out, feel to see if one or both legs are doubled back at the knee. It's easy to hook them with the finger. When no legs are felt, both must be doubled back from the shoulder. If the head is of normal size, push it back again through the bones. Slip the fingers along the neck and over the shoulder, hook the leg and draw it forward.

Now, straighten the leg at the knee joint, pressing the fingers and thumb. The leg should now be drawn a little to bring the foot through the bones. Straighten the head and work it carefully through the bones.

Now that the head is out, draw the leg and proceed as in Case 2.

Case 4: The Big Lamb

If the ewe can't deliver a big lamb because of construction at the pelvic bones, it is often because the lamb's head is not lying with its crown against the ewe's spine. It is difficult to straighten if the ewe is on her side with the lamb's head twisted upwards.

Remedy: Turn ewe over with lamb's head down. If both legs are through, turn one leg back and the lamb now should come easily. Proceed as in Case 2.

Often a big-headed and big-shouldered lamb presented properly (front feet alongside his nose) cannot be ejected easily by the ewe, even by a strong fat one. Thin, old and weak ewes many times will need help. In this case, one leg at a time should be stretched out and then both pulled together by one hand, while the first two fingers of the other hand are slipped up the lamb's forehead and in back of its ears, stretching the lips of the vulva. This method may require considerable strength, but usually will slip the lamb out. It is a good practice to let the ewe expel the lamb once its shoulders are out, or at least to pull it out slowly and then place it immediately at her head where she can clean it. If she is not inclined immediately to clean and recognize it, forcing her muzzle into the warm lamb will start her.

In pulling a big-shouldered lamb, it will be found much easier to pull the left or right of a straight pull. A straight pull places the two shoulder blades exactly opposite each other and at their widest, so that they must be squeezed severely to allow them to enter and pass through the pelvic girdle. By bending and twisting the lamb, as the pull is made, the shoulder-blade positions will be altered so that they can pass through more easily.

Case 5: No Head Showing

The head often is turned along the ribs if only forefeet are showing. Lay ewe on her side so the lamb's head is uppermost. Push lamb back far enough to straighten the neck and get the head lined up with the ewe's backbone. It is now like Case 1.

This can be a most difficult operation, though, and you might want some other ideas. With the legs extended through the pelvic girdle, it is next to impossible many times to straighten out the neck and get the head to pass through. If it starts through and a pull is made on the legs, the usual occurrence is that the head slips back into its original position (or down toward the ewe's udder), and persistent, but unsuccessful attempts get more and more irksome. In this case, string nooses should be slipped over each ankle and the leg should be folded back into the womb - of course, making sure enough string protrudes. Then, with the lamb's shoulders no longer in the way at the inner mouth of the pelvic girdle, it is possible to draw the head up into the pelvis within the palm of the hand and to bring the front legs along by pulling on the string.

To assist in drawing the head out, if it cannot be guided in the palm of the hand, a piece of baling wire will be very useful. This wire should preferably be rather heavy and of

course, unrusted. Bend a length of wire at its middle and form a noose a little bigger than will slip over the head of the foetus, twisting the wire to form such a loop. This loop may then be carried into the uterus (in the palm) and fitted over the lamb's head with the twisted part under the lamb's chin and the loop in back of the lamb's ears. Then, when the front legs are pulled by the strings, the head will be guided, chin up, into the pelvis by pulling on the wire. Care should be taken in fitting the noose over the lamb's head. Be sure, before pulling, that it has not caught a fold of the uterine wall, for this might cause rupture of the uterus and loss of the ewe. The wire should be resorted to immediately if it is found at all difficult to guide the head into the pelvis.

Some lambs are so large in relation to the pelvic passageway that even this method of guiding the forepart of the lamb cannot effect birth. The combination of the large chest, the large head and the straightened-out front legs of the lamb is too much. It is then necessary to turn the lamb around inside the uterus and to remove it, tail first (or hind legs first). This is usually quite possible, although it is sometimes difficult to turn the lamb. Assistants may raise the rear end of the ewe to allow the operator to find and secure the hind legs.

The removal of a lamb by such an operation should be followed by an injection of penicillin for the ewe, unless the operator is sure that no serious abrasion or tearing of the uterine wall has occurred.

It is most important that an early decision be made about the probably eventual removal of the lamb, so that entering of the vaginal tract which destroys natural lubrication and tears the uterine wall be held to a minimum.

Case 6: Hind Feet First
It's easy to draw the hind legs out, but then the lamb usually sticks. Avoid breaking ribs. Swing legs from side to side while pulling. After the lamb's ribs are exposed, it is easy to get the lamb away. Clear fluid quickly from the lamb's nose to avoid drowning.

Case 7: Tail Shows
Push lamb back through pelvic bones until you feel the hock joint of the hind leg. Hook fingers over the leg and straighten it with the thumb. Draw the foot up through the bones. Do the same with the other leg. Proceed as in Case 6.

Case 8: Lying Across
Sometimes the lamb is lying across the entrance to the pelvic bones. Only the back can be felt. Push the lamb back to enable you to feel which way the lamb is lying. If head and forelegs are nearest the bones, push lamb back and deliver as in Case 4. Otherwise, deliver hind feet first as in Case 6.

Case 9: Twins Coming Together
Two to four feet may be coming together. Only feet will be beyond pelvic bones, a complication usually resulting from the first lamb being sideways.

First, locate the legs and head belonging to one lamb. Do this by pushing lambs back far enough to allow the hand to track out a leg. Put a string on the leg to avoid a mixup.

Push the second lamb back and deliver the first. In some cases, it may be safer to push the second leg back and deliver as in Case 2.

Deliver lambs quickly. Deliver easiest lamb first.

Case 10: Twins with One Coming Hind Feet First
Once you are sure of the hind feet, it's usually easier to lamb the reversed one first. Hold hind feet and push back the head and forefeet.In twin cases, the shepherd must judge which lamb will be the easiest to get first. Much depends on the lamb's position.

Natural birth is still best. Do not pull any lamb unless the ewe is in distress. If the ewe has strained for an hour and no part of the lamb appears or if a problem is evident, enter and assist the ewe.

When pulling, always pull outward and slightly downward. Time your pull to coincide with the ewe's efforts, which occur at intervals.

Before entering a ewe's reproductive tract, trim your fingernails short and wash your hands in a disinfectant. Lubricate your hands with raw linseed oil or light mineral oil.

Adoption of Orphan Lambs

If you have an orphan lamb - find a ewe beginning to lamb that looks like she will have a single lamb and a good milk supply. Watch her closely. Get a pail of warm water and have it ready. **This is important.** Pen the ewe as soon as she is lambing. Put the orphan in the pail of warm water. Get it well soaked. Dip warm water with your hand on its head so that there is no dry wool at all. Tie the orphan lamb's legs so that it cannot get up, then place it underneath the lamb being born. Take the ewe's own lamb as it comes out. With your hand, strip it of all the juice you can from its legs and tail and rub these juices onto the orphan. Rub the two lambs together and give

both lambs to the ewe, placing them under her nose to smell, lick off and own. In about twenty minutes or so, when the ewe's lamb can stand up, untie the orphan's legs so that it too can get up. The adoption is complete. Heat lamps can be used to dry off the lambs.

One method of getting a ewe to raise both twins when she only wants to raise one is to put the ewe in a pen and take the lambs away from her. When you figure it is about time for the lambs to eat, release the rejected one first and let it nurse, then (after a short time) let the other one in. After a few times of doing this, the ewe readily accepts both of them.

Make-Do Colostrum

During the first 24-36 hours of life, the newborn lamb can absorb antibodies from ewe colostrum that will help protect it from all the viruses and bacteria the ewe has ever been exposed to. The shepherd's job is to see that each newborn lamb gets its share of ewe colostrum, if that is not available, use cow colostrum which is rich and creamy. If you can't get either of these, then you can make up artificial colostrum, which is a poor substitute without antibodies, but will do in a pinch: Mix 850 mL pints of warm milk, 1 beaten egg, 2 mL of sugar or corn syrup, 5 mL cod liver oil. Feed 80 - 140 mL warm four times a day for two days. Then, switch over gradually to one of the excellent lamb milk replacers containing 30 per cent fat, which can be fed cold. Give four feedings of 170 - 230 mL a day for several weeks, (usually about two months) until the lamb is eating hay and grain well.

A new technique is now used for feeding orphaned or extra lambs from birth onward. This involves formalin given at the rate of 1 mL of formalin per 4.5 litres (1 gallon) of milk replacer, mixed with water.

Formalin is the commercial name for the 37 per cent solution of formaldehyde. The use of this material takes much of the labor out of feeding lambs, since with this method, the milk can be fed at barn temperature and given free choice. Bacterial growth in the milk is kept down by the presence of formalin in this concentration and indications are that the milk will be free of bacteria for well over one week.

Nursing equipment needs to be washed only once a week when formalin is used. **CAUTION** - it must be remembered that formalin is a bactericide and a preservative and extreme care must be taken to prevent injury to the lamb by an overdose.

The following points are important in getting lambs on feed and carrying them on to ultimate finishing weights.

Keep Them Going

- Use a lamb milk replacer which contains approximately 30 per cent fat and 25 per cent protein.
- Reduce bacterial contamination by adding 1 mL of 37 per cent formalin per 4.5 L of milk.
- Feed milk at barn temperature.
- Vaccinate with enterotoxemia antitoxin immediately.

Weaning

- Wean at three to six weeks of age, 9 - 13 kg (20 - 30 lb) and/or when they are eating considerable solid feed.
- Keep water available in one container and dilute milk in another. Decrease the amount of diluted milk over a five to six day period and then stop all nipple feeding.
- Reduce the amount of alfalfa hay and self-feed a pelleted growing ration to approximately 27 kg (60 lb); then gradually switch to a fattening ration (70 per cent alfalfa plus 30 per cent grain pelleted).
- Vaccinate with enterotoxemia toxoid or bacterin.

The Castration of Lambs

Castration of sheep is generally carried out for one basic reason:

- It simplifies management of stock.

Any attempt to run large numbers of entire males on a property, along with females of the same species, is difficult. In the sheep industry, where it is essential to grow animals of the opposite sex together, castration provides the only practical and economical solution.

If necessary, lambs are generally castrated prior to four weeks of age, although many are left until six to eight weeks. It is important to keep in mind, however, that the older the lamb, the greater the development of the testicular blood supply and the greater the risk of hemorrhage after castration (if a knife is used). Tail docking is universally carried out at the same time.

It is important to minimize disturbance, setbacks and shock during this extremely critical period. When assessing lamb losses after castration, it is necessary not only to include deaths directly attributable to castration and tail docking, but to realistically assess numbers lost due to mismothering, secondary infections and other less obvious side effects.

Regardless of castrating technique, several points should be adhered to as closely as possible during castration. Use of old yards should be avoided if at all possible in order to minimize the risk of infection and tetanus. An economical and practical procedure is to use temporary yards in lambing paddocks. Ewes and lambs should be upset as little as possible, and following castrating lambs should be placed very carefully on their feet. As a further aid to the prevention of mismothering, the day's castrating should be finished at least two hours before sunset and further movement of the flock avoided. If possible, lambs should be castrated in calm, fine weather. Excessively warm days are as dangerous as cold, wet days, especially if a knife is used.

A further point of importance is the advisability of vaccinating lambs against enterotoxemia and tetanus. An obvious and convenient time to carry out vaccination is while lambs are being handled at castration and docking time.

For centuries, castration and tail docking of lambs have been achieved by using a cutting edge to incise the scrotum, usually combined with a hook or clamp to pull away the exposed testicles. Ram lambs are placed on their rumps on a makeshift bench or cradle, the fore and hind legs on either side held together by an assistant. The operator uses the cutting blade to completely remove the lower third of the scrotum; the exposed testicles are then pulled away with the hook or clamp of the marking instrument. In this way, the cord is ruptured and the stretching and breaking of the contained blood vessels does, in fact, enhance more rapid clotting. Immediately after castration, the tail is completely severed with the cutting edge of the marking instrument.

The use of a hot iron to sear the blood vessels is not particularly practical in the field, because of the excessive time required.

In comparatively recent times, wide use has been made of the ligature principle of bloodless castration. This has been no doubt due to the introduction of the efficient and readily applied "Elastrator" rubbing ring.

With the aid of a special applicator, a powerful elastic ring is applied to the base of the scrotum. Having made certain that **both** testicles lie within the scrotum below the ring, the instrument is removed. Pressure from the ring crushes off the blood supply to the scrotum and the testicles and the scrotum and its content soon wither and fall off. Similarly, another ring is applied to the tail and the portion deprived of blood may be removed with a knife or allowed to fall off naturally. Elastrator rings are most effective if applied shortly after birth.

Weaning

The lambs are usually weaned between three to five months of age. By five months, most of the ewes have gone dry and require a rest before next mating. The best pasture possible, together with adequate shelter, should be reserved for the weaners, as weaning is the time worm infestation is likely to play havoc with the young sheep. Well-fed sheep can better resist the effects of parasitic infestation.

It is not uncommon to leave a few grown sheep with the weaners to lead them to water and to the self-feeders. Cross-weaning is sometimes carried out. This means transferring the lambs from one flock of ewes to another from which the lambs are removed to the first flock.

Early weaning of lambs is most successful when the management system plans point toward it from the day the lamb is born. Encourage lambs to start on creep feed as soon as possible (6 to 8 days old). To feed and provide a simple lamb shelter which will entice the lambs away from their mothers to the creep, locate the creep area in a sunny area close to where the ewes bed.

The composition of the creep ration offered is probably the most critical factor in determining the age at which these lambs can be weaned. The ration must be highly palatable, meet the young lamb's nutrient requirements, and stimulate rumen development. The following rations, based on body weight of the lambs, have proven quite satisfactory:

Ingredient	**7-14 kg (15-30 lb)**	**14-20 kg (30-45 lb)**
	kg lb	**kg lb**
Whole oats, barley or wheat	11.3 (25.0)	22.7 (50.0)
Soybean meal, 44% c.p.	17.5 (38.5)	10.7 (23.5)
Alfalfa meal	11.3 (25.0)	11.3 (25.0)
Animal fat (tallow)	4.5 (10.0)	— —
Dicalcium phosphate	0.5 (1.0)	0.5 (1.0)
Salt, trace mineralized	0.2 (0.5)	0.2 (0.5)
Antibiotic	2.8g/50kg (2.5 g/100 lb)	1.1 g/50kg (1.0 g/100 lb)

It is extremely important that the ration be in the same form (pelleted or ground are recommended) in the creep as in the weaning ration. The following supplement is used by the Peace River association for lambs over 20.4 kg (45 lb):

Peace River Lamb Association Supplement Pellet Ration

	kg	lb
Barley	335.0	670
Sulfur	2.5	5
Beet Pulp	271	542
Urea	140	280
Limestone	100	200
Co-Iodized Salt	50	100
T.M. Salt	50	100
Tallow	40	80
Vitamin ADE	10	20
T.M. 50	1.5	3
	1,000 kg	2,000 lb

The pellets are mixed with whole barley in the ratio of 10 per cent pellets: 90 per cent whole barley. Producers are encouraged to self feed the ration, however, they should introduce it into diet gradually because of the urea in the feed.

Everything that will cause extra stress at the time of weaning should be eliminated if possible. On the day the lambs are to be weaned, the ewes should be quietly removed to quarters where they are out of sight and hearing of the lambs. It is desirable to temporarily leave several ewes with the lambs to lead them to feed.

Weaning the lamb is normally not a problem to the ewe other than discomfort, unless the lamb is allowed to get back in and suck after two or three days. The milk flow can be reduced by reducing the feed level to the ewe. This is probably best done several days before weaning the lamb, thus helping to encourage the lamb to go to dry feed.

In addition, a producer would be wise not to move the ewes any extensive distance during the first week or 10 days after weaning or create a situation where they are apt to bruise their tight udders.

Shearing and Wool Preparation

The wool clip is an important source of income in sheep production. If given proper care, the wool should help materially in paying expenses for the care and feed of the ewes, leaving the sale of lambs as net profit. A sheep producer can increase the value of the wool clip by selecting and keeping only ewes and rams which have high quality fleeces. The flock owner should select breeding ewes which do not contain grey or black fibres in their fleeces. Only ewes which are well covered with long, dense, fine fibred fleeces should be kept. Ewes which have coarse open fleeces or which do not produce a heavy fleece should be culled from the flock.

Shearing time in Alberta is late May or early June. The weather is usually warm enough then so that the shorn sheep will not become chilled. Shearing is more easily done during warm weather, since the oil or grease content of the fleece is higher and the fleece tends to lift from the sheep's skin, resulting in the clippers gliding more easily through the fleece.

Wool must be dry for shearing, and must be kept dry afterward. Damp wool in storage will soon become mildewed and will greatly decrease in market value. Many flock owners shut the sheep in the barn or shed the night before shearing. This prevents them from getting wet should it happen to rain. If penned closely, the sheep will tend to sweat and the wool tends to "rise", making it easier to remove the fleece. Also, the sheep's stomachs will not be full of feed and they may be sheared with less discomfort.

Shearing should be done on a clean floor. Floors where dirt and straw can be picked up in the fleece are to be avoided. A clean canvas can be spread on the ground if shearing is to be done outside.

Shearing can be done by using either handshears or a power shearing machine. Shearers prefer machines because of greater ease and speed. For small farm flocks of from 30 to 50 head, hand shears or electric sheep shears are recommended. However, for larger flocks, the gasoline or electric motor driven jointed shaft machine is preferable. These machines have more power and can do the job faster, since they have a wider shearing head. Shearing equipment should be kept in first class shape.

Sheep Shearing

"Tally-Hi" a method of shearing developed in Australia in 1963, makes shearing much easier and faster than other methods.

Strokes of the shearing handpiece progress in a smooth-flowing, easy manner from one shearing position to the next, contrasting sharply with the jerky movements of some other methods. This presumably leads to a saving

of up to 30 seconds on each sheep once the method is mastered.

The accompanying diagrams illustrate how "Tally-Hi" differs from other methods. Free-flowing vertical strokes replace short cross blows and emphasis is on filling the comb and tightening the sheep's skin to avoid skin cuts.

Sheep are more comfortable because of the "Tally-Hi" positioning - which reduces struggling and minimizes the effort required of the shearer.

Another advantage is that fewer sweepings are left on the shearing board, thus allowing a faster shed routine.

Figure 4. Support sheep firmly between your knees. Rest sheep's right foreleg on your left side to tighten skin on belly. Make first stroke of handpiece straight down left side to leave a clean, straight edge for "long blow". Second stroke runs parallel. Third stroke down right side, leaving a clean straight edge for "last side". Short, angled strokes clear lower belly. Crutch is cleared in normal way.

Figure 5. Hold sheep fully relaxed against your legs with sheep's left side uppermost and applying pressure in flank. Shear wool from hind leg as illustrated. Then drop wrist below point of entry of comb and shear three strokes from tail and up side - using your left hand to stretch skin. These run in same direction as strokes of the "long blow".

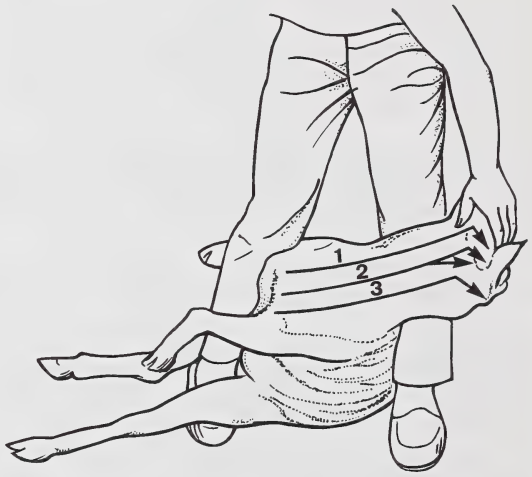


Figure 6. As illustrated, your right leg is between sheep's fore and hind legs. Hold back sheep's head and rest its neck slightly below your left knee. Keep your weight on your left leg and do not allow sheep to sit too straight. Shear top-knot as usual. Make first stroke slightly below jugular vein on wrinkly sheep and straight along neck. Second stroke is parallel, but carry it on to shear down side of face and ear. Third stroke follows on to clear wool from ear, horn and poll. Then clean front leg and shear around shoulder towards neck.

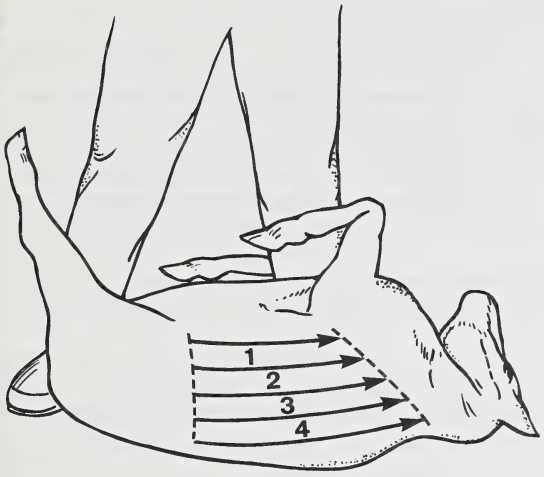


Figure 7. Shear "long blow" normally, until reaching backbone. However, do not pull foreleg back towards sheep's head. If loose skin has to be stretched, use your left hand. See how the three strokes taken from sheep's side while shearing first hind leg makes it unnecessary to reach back into wrinkly skin on hind leg and hip. Make sure bottom tooth comb is flat on skin.

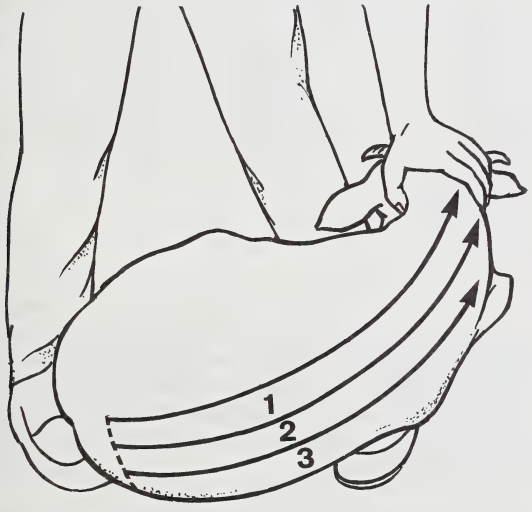


Figure 8. On reaching the backbone, make sure sheep's tail is behind your right foot. Your left leg is under sheep's shoulder, with your left foot across sheep to give leverage. Apply downward pressure to the sheep's head with your left hand to "roll" sheep up. Shear two strokes over backbone to save time on "last side". Avoid standing on or tearing fleece when swinging right leg out to shear "last side".

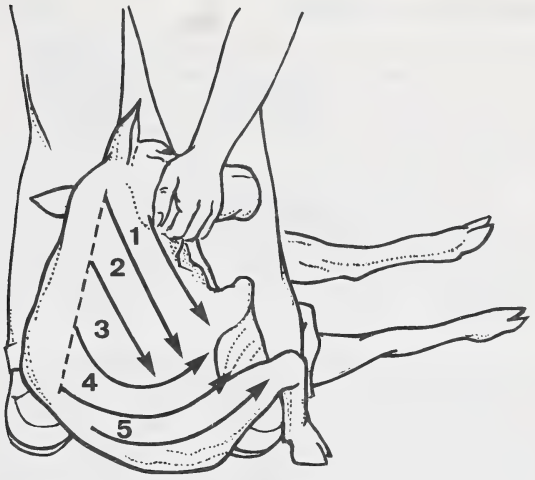


Figure 9. Clamp sheep between your legs. Hold sheep's head with knees. After cleaning wool from horn, ear and face, shear straight down to point of shoulder, using left hand to straighten wrinkles. Allow sheep's right foreleg to come forward after the third blow. Grasp foreleg and sheer shankings clear.

Figure 10. Letting the last foreleg go as soon as it is cleared, continue down flank. Second stroke is parallel from shoulder to flank, while third stroke continues on and outside the leg. Make remaining blows at same angle, starting with a full comb at back of wool. Finish off rump with sheep between your legs, and with left hand in flank to tighten skin.

Wool Preparation

A table 1.2 m (4 ft) wide, 2.4 m (8 ft) long and 0.9 m (3 ft) high, with a top made of slats or chicken wire is suitable for the preparation of fleece for market. The fleece should be spread out flesh side down so that dirt and tags can be removed.

The fleece is shaken to remove all the loose chaff and dirt, which will fall through to the floor. All tags and any grey or black fibres should then be removed from the fleece, bagged and marketed separately from the good wool.

Roll and tie each fleece separately with the flesh side out. Each side of the fleece is then rolled toward the centre to form a strip about 40 - 46 cm (16-18 in.) wide. This is then rolled into a neat bundle, starting from the rump end. By following this procedure, the best quality wool will form the outside of the bundle. Each fleece should then be tied with a specially prepared paper wool twine. Binder twine should never be used because it cannot be removed in the manufacturing process. It lowers the value of the fleece and means less money to the grower.

Small amounts of wool, such as are obtained from the average sized farm flock are shipped in large jute sacks which can be obtained from wool handling firms. Such sacks hold from 90 - 102 kg (200 to 225 lb) of wool. If wool is stored, it should be kept dry and clean.

Grading of Wool

Canadian wool in the fleece is classed or graded along three major lines as follows:

- general condition and cleanliness
- length of staple
- diameter of fibre.

General Condition and Cleanliness

The presence of grease or yolk, seeds, chaff, burrs or other foreign matter determines the condition, shrinkage or clean content of any fleece. The wool produced from the farm flocks of Alberta is classified Western Canada Domestic Type. It is sub-divided into the following classes:

- *Bright* - Wool that is well grown, of good color, and with very little shrink.
- *Semi-Bright* - Wool that is average in character, rather dingy in appearance and carrying slightly more organic matter and foreign material.
- *Dark* - Wool that is dark colored and quite heavy with sand or any other foreign material; also includes wools that are badly stained or fleeces that are brashy and wasty.

Length of Staple

Sound wool is classed according to length of staple.

- *Staple wool or combing wool* - if the fibre is two inches or more in length.
- *Clothing Wool* - If the length of the fibre is less than two inches.

Diameter of Fibre

The average diameter of the fibre in a fleece determines the quality division or grade. The following are the grades used in Canada with respect to diameter of fibre of "fineness". The corresponding American and English grades are also given.

	American	English
Canada Fine	Fine	64's-70's - and finer
Canada ½	½ Blood	58's - 60½'s - 62's
Canada ⅜	⅜ Blood	54's - 56's
Canada ¼	¼ Blood	46's - 48's - 50's
Canada Low ¼	Low ¼ Blood	42's - 44's
Canada Coarse	Braid	36's - 40's
Canada Grey & Black		
Canada Defective		

Canada defective wool comprises wool which shows faults or defects that impair its value for manufacturing purposes. The more common defective wools are: dead, chaffy and burry, cotts, tags, damaged and kempy. Generally speaking, the finer wools command a slightly higher price on the market.

NUTRITION

Introduction

Proper nutrition is one of the most important components of a successful sheep operation.

Feed analysis, proper ration formulation and adequate mineral/vitamin supplementation form sound bases for good nutrition. Adequate quality and quantity of feed, in conjunction with good housing, conscientious management and disease control, should achieve optimum production of a sheep flock.

Feeding sheep adequately during the winter confinement period is expensive. However, feed dollars invested wisely can return big dividends in terms of more live lambs produced per ewe, better milking ewes, faster gaining lambs and more money in the bank.

Nutrients

Important nutrients in sheep rations are:

- Water
- Energy
- Protein
- Minerals
- Vitamins

The levels at which each nutrient are required by sheep depend on whether the animals are being fed for maintenance, maintenance plus production or maintenance plus production plus reproduction. Most nutrients can be fed in excess of requirements, but if any nutrient is present in an inadequate amount, it will limit the performance of the animal. This 'principle of the first limiting nutrient' is illustrated in Figure 11. In this example, all but one of the nutrients are supplied in amounts adequate for a daily gain of 0.5 kilogram. Energy, however, is supplied at a level adequate for a daily gain of approximately 250 g. The daily gain which will be achieved by an animal on this ration is about 250 g. The performance, therefore, is determined by the 'first limiting nutrient'.

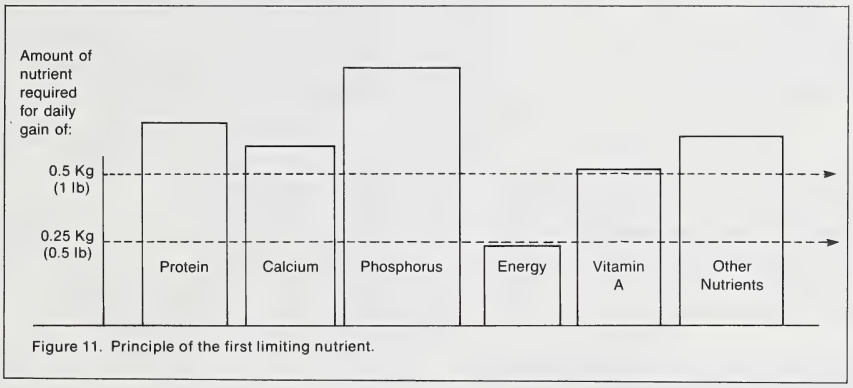


Figure 11. Principle of the first limiting nutrient.

Water

Water quality is important. Sheep are fussy drinkers. They don't consume stagnant or bad smelling water. If sheep are forced to drink such water, or subsist on snow only, production will suffer. Hence, a sheep operation should be planned around an adequate supply of clean fresh water.

Water consumption of sheep varies a great deal, since it depends on many factors. Some factors which influence the water intake of sheep are:

— ambient (environmental) temperatures (hot and cold weather)
— rainfall
— temperature of drinking water (lush or arid pasture)
— snow coverage and breed of sheep
— stage of production (dry period, pregnancy or lactation)
— wool cover
— water content of feed (hay vs. silage)
— composition of feed (grain vs. hay)
— management (confinement vs. pasture).

The following table lists the Agricultural Research Council's suggested water intakes for British conditions.

These are approximate figures only. Under Canadian summer range conditions, the combination of low relative humidity and high temperatures may cause sheep to drink more water than the quantities suggested in this table.

Table 3. Suggested Water Intakes (ARC 1965)

Class of Stock	Environmental Temperature (C)	Water intake kg water/kg feed DM	Water Intake Gallons/lb DM*
Sheep, growing and fattening	up to 15°	2.0	0.20
	15° to 20°	2.5	0.25
	greater than 20°	3.0	0.30
Pregnant ewes	up to 15°	4.0	0.30
	15° to 20°	5.0	0.50
	greater than 20°	6.0	0.60
Lactating ewes	up to 15°	3.0	0.30
	15° to 20°	3.8	0.38
	greater than 20°	4.5	0.45

** DM is dry matter*

Water should be:
- clean, fresh and free of ice
- contain less than 7000 ppm total solids
- contain not more than 100 ppm nitrates
- should be free of blue green algae
- should be free of fecal contamination.

Energy

Generally speaking, insufficient energy or carbohydrate intake is the most important cause of malnutrition of sheep in Western Canada. Energy deficiency or starvation can result, if unsupplemented high moisture silage, low quality forage or inadequate amounts of feed are fed during periods of high energy demand.

Specifically, silage contains too much water to exclusively meet energy requirements of nursing ewes or those in late pregnancy. Feeding poor quality, weedy, decomposed or moldy hay or straw, discourages sheep from eating, and energy deficiency may result.

Good quality pasture grass, hay silage, straw and cereal grains, are all good sources of energy for adult ruminating sheep.

Figure 12 illustrates clearly how total energy intake is distributed for the various body functions. It shows that not all energy supplied in the feed is utilized by the sheep. The energy contained in fecal material is lost to the animal. When discussing energy requirements and formulating rations, **digestible energy** figures are used by animal nutritionists in Alberta.

It can be seen from the diagram that only after the essential life functions of a sheep are taken care of, such as maintenance of the body, locomotion, stress and disease resistance, etc., that energy will be utilized for production. Thus, a ration containing enough energy to adequately maintain a dry ewe during the warm summer months could be totally insufficient to help ewes survive cold stressful winter conditions.

A shortage of energy eventually causes:
- slowing or stoppage of growth
- depletion of body fats
- loss of body weight
- premature birth of weak lambs
- high lamb death losses at birth or shortly after
- poor milk production by ewes
- poor wool growth and quality
- reduced ability to withstand stress and disease.

Excessive intake of energy is not desirable either. It may cause:
- reduced fertility
- greater susceptibility to vaginal prolapse during pregnancy
- dystocia (difficult birth)
- poor milk production
- digestive upsets
- poor ability to survive stressful disease.

The ideal levels of energy to be fed to sheep depend on many factors:
- age and sex of sheep
- type of production, e.g. pregnant and lactating ewes, or feedlot lambs
- temperature changes and seasonal weather
- heat loss due to shearing
- stressful management conditions, overcrowding,
- sanitation, disease.

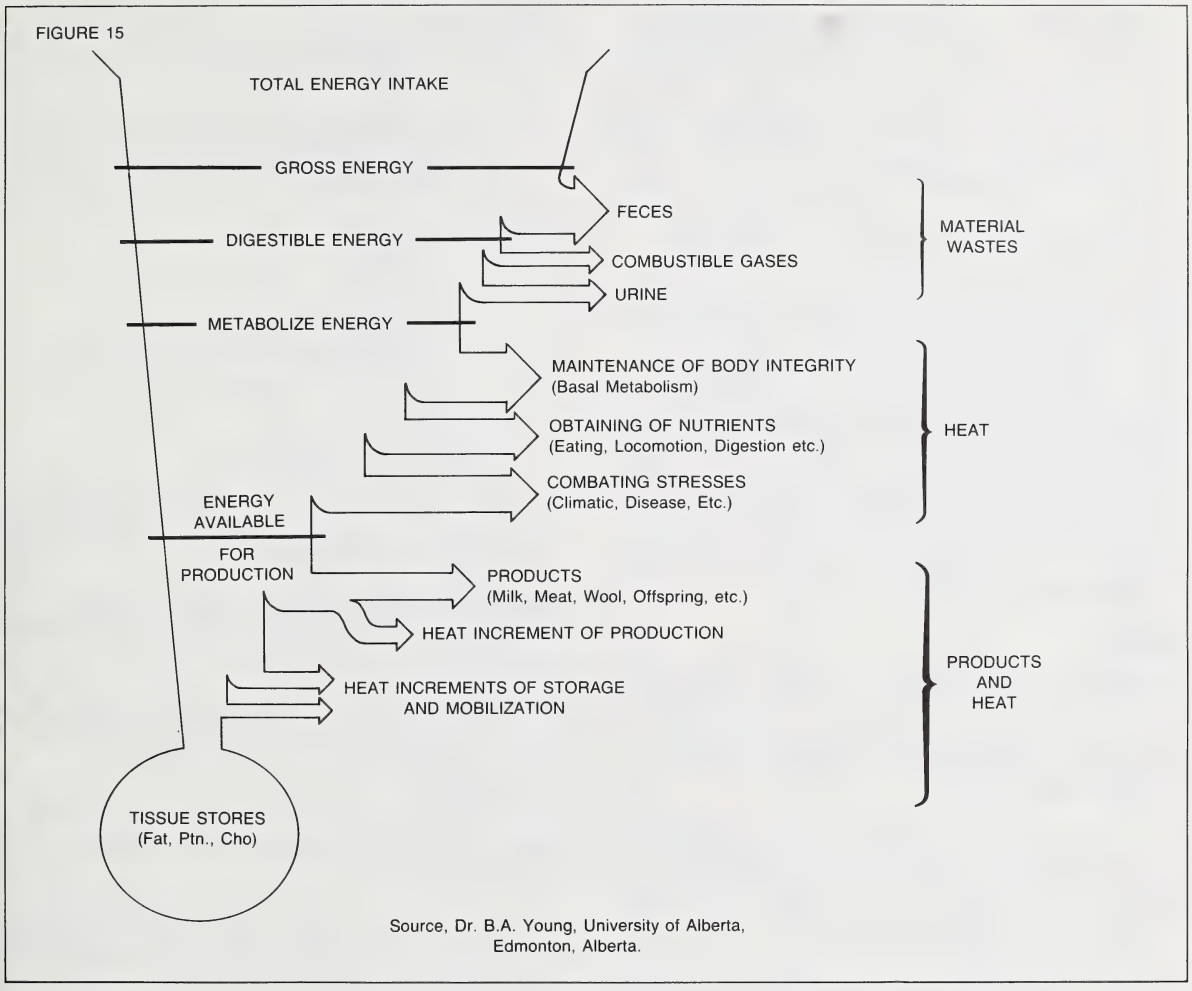


Figure 12. How total energy intake is distributed to the various body functions. (*Source: Dr. B.A. Young*)

Minimum digestive energy requirements for all classes of sheep on a daily basis can be found on Table 5, NRC Daily Nutrient Requirements of Sheep.

Protein

The quantity rather than the quality of proteins is important in sheep rations. Proteins fed to ruminating sheep are almost completely changed upon arrival in the rumen. Enormous numbers of microbes living in the rumen change the feed protein (nitrogen and carbon) into bacterial or protozoal protein. These highly proteinaceous bacteria eventually die, pass out of the rumen into the abomasum and intestine. Here they are digested by the sheep's digestive enzymes, absorbed and utilized. The quality of the proteins fed to sheep can vary, but the quality of the microbial cell protein is consistent. Hence, relatively low quality (low cost) proteins rather than high quality (expensive) protein can be used to supplement sheep rations.

Some sources of protein available to sheep producers are:

— soybean meal (44% - 48% protein). It is a highly palatable protein supplement for creep feed type rations for lambs which are to be weaned early.
— canola meal (38% - 40% protein) a relatively low cost Alberta product. It is also suitable for creep rations or

supplementation of cereal grain based feedlot rations.
— good quality legume or grass hays (12% - 16% protein).
— grains are energy feeds. They are relatively low in protein (8% - 12% protein).
— commercial supplements containing urea are commonly used as a source of protein for early weaned lambs weighing 23 kg (50 lb) or over.

Although protein quality is not critical for ruminating sheep, it is very important for nonruminating young lambs, namely those less than four weeks of age. Such lambs need ewes milk and 16% protein creep rations for best growth performance. Orphan lambs need the best quality milk replacer and creep feeds to bring them through the first four weeks of life. Lambs fed on poor quality milk replacers, or those eating grains and roughage too early (less than four weeks of age) without sufficient milk, generally die of unthriftiness and starvation. The preruminant digestive system is as yet unable to handle such feed stuffs. Lambs may be weaned as early as 30 - 40 days of age, depending on their body condition and rate of creep feed consumption.

Urea

Although some lambs are said to be able to handle urea fairly well at 28 days of age, urea should not generally be used as a feed additive until the lambs are able to grow efficiently on a finishing ration. They should be 23 kg (50 lb) of body weight or over.

The process of protein synthesis in the rumen enables us to supply urea rather than protein as a nitrogen source. Best utilization of urea will occur with high levels of grain feeding. The microbes need nitrogen and plenty of carbohydrates to manufacture protein.

There are limits on the amounts of urea which may be used:

— a maximum of 1% (1 kg/100 kg of feed) urea can safely be added to the grain mix.
— urea can be extremely toxic if not properly mixed in with the ration, or when it is introduced too quickly at high levels in rations.
— a two to three week adaptation period may be required before maximum growth rates are seen.

It is probably best to use commercially prepared urea containing pellets for supplementation of grain based on lamb finishing rations, to avoid possible toxicity problems.

Minerals

The minerals required by sheep are divided into two groups:

Major (Macro) minerals,
example - Calcium (Ca)
Phosphorus (P)
Magnesium (Mg)
Sodium Chloride (NaCl)
Potassium (K)
Sulfur (S)

Trace (Micro) minerals,
example - Iodine (I)
Iron (Fe)
Copper (Cu)
Molybdenum (Mo)
Cobalt (Co)
Manganese (Mn)
Zinc (Zc)
Selenium (Se)
Fluorine (F)

From a practical point of view, the sheep producer should be concerned with the following:

Calcium-Phosphorus Ratio (Ca:P ratio)
Most grasses and legume hays contain adequate levels of calcium. Grains have a low calcium content.

On the other hand relatively high phosphorus levels are found in grains. Forages are low in phosphorus. (See Table 4, Average Analysis of Alberta Feeds).

Calcium and phosphorus are required by sheep for the maintenance of bone structure and proper actions of muscles and nerves.

Signs of a deficiency of calcium and/or phosphorus are seen on farms where deficient rations are fed and where mineral supplementation is not practised.

The following signs and disease conditions could be evidence of Ca and P deficiency or Ca:P imbalance:
- abnormal bone development (rickets)
- knock knees
- slow growth, "runtiness", listlessness
- depraved appetite (chewing on rocks, wood and bones)
- "downer ewes".

The ratio of calcium to phosphorus is not very critical for adult sheep. Sheep can handle a Ca:P ration anywhere from 1:1 to 7:1 as long as the minimum requirements of available calcium and phosphorus are met.

From Table 6, it can be seen the calcium and phosphorus ratio of alfalfa hay is 1.65% Ca to 0.21% P or 7.8 to 1. Thus, there is about 7.8 times more calcium than phosphorus in alfalfa hay.

Also brome grass hay Ca:P = 0.43:0.15 which is roughly three times more calcium than phosphorus. Thus, Ca:P ration is 3:1.

Sheep on mainly roughage rations (high calcium - low phosphorus) need phosphorus supplementation. A 1:1 Ca/P commercial mineral mix could be used.

Sheep on grain rations with minimum roughage (low calcium - high phorphorus) need calcium. Thus, a 2:1 Ca/P mineral mix is used. If the ration contained adequate phosphorus but is very low in calcium, limestone could be used instead.

How do we check to see if there is enough calcium and phosphorus in a ration?

Table 4. Average Analyses of Alberta Feeds[1]

	No. of Samples	Bushel Weight (lb)	Moisture (%)	Protein (%)	Calcium (%)	Phosphorus (%)
GRAINS						
Barley	3665	47.1	12.0	12.1	0.05	0.39
Oats	2128	39.9	10.7	11.3	0.07	0.35
Spring Wheat	724	58.4	12.3	15.6	0.04	0.40
Mixed Cereal	950	44.1	11.5	12.0	0.06	0.38
Fababeans	153	60.3	7.9	30.0	0.13	0.48
Field Peas	81	61.6	11.7	22.8	0.08	0.42

	No. of Samples	Moisture (%)	Protein (%)	Fibre (ADF)[2] (%)	Calcium (%)	Phosphorus (%)
HAYS						
Legume (unsp.)[3]	142	11.4	14.0	39.9	1.29	0.20
Alfalfa	1221	11.0	16.9	37.5	1.65	0.21
Clover (unsp.)	79	11.3	13.0	45.4	1.18	0.19
Red Clover	75	12.3	13.2	46.6	1.22	0.19
Sweet-clover	47	11.0	13.0	41.6	1.16	0.18
Legume-Grass	1018	11.1	11.0	40.7	0.85	0.18
Alfalfa-Grass	2625	10.8	13.1	38.2	1.12	0.19
Grass (unsp.)	619	9.9	9.2	39.1	0.54	0.16
Brome Grass	225	9.8	8.8	38.4	0.43	0.15
Timothy	115	9.4	7.6	40.0	0.43	0.15
Native Grass	150	9.1	8.0	40.2	0.44	0.13
Slough Grass	139	9.9	8.6	38.0	0.42	0.15
Barley	345	12.6	10.0	34.3	0.35	0.25
Oats	1492	12.5	8.9	36.2	0.28	0.21
Spring Rye	64	10.1	8.3	39.3	0.22	0.18
Fall Rye	60	13.7	10.0	38.9	0.22	0.20
Spring Wheat	128	12.0	9.8	36.4	0.20	0.22
Mixed Cereal	502	13.0	9.3	35.1	0.32	0.23

Table 4. Average Analyses of Alberta Feeds[1] (Cont'd)

	No. of Samples	Moisture (%)	Protein (%)	Fibre (ADF)[2] (%)	Calcium (%)	Phosphorus (%)
SILAGES						
Barley	434	63.1	10.1	34.6	0.44	0.27
Oats	345	66.2	9.2	37.2	0.35	0.23
Corn	104	70.3	9.4	31.3	0.37	0.22
Mixed Cereal	1391	64.4	9.3	35.8	0.39	0.25
Legume (unsp.)	73	63.0	14.4	43.0	1.38	0.23
Alfalfa	84	60.8	17.2	40.6	1.78	0.24
Clover (unsp.)	44	70.1	14.3	46.8	1.34	0.22
Red Clover	45	70.3	14.6	44.4	1.47	0.20
Sweet-clover	103	68.8	14.4	45.2	1.26	0.21
Legume-Grass	187	66.5	12.8	44.1	1.12	0.21
Alfalfa-Grass	304	60.3	13.8	40.8	1.32	0.21
Grass (unsp.)	39	62.8	11.6	40.7	0.84	0.22
STRAWS						
Barley	273	9.0	4.6	46.3	0.31	0.32
Oats	468	10.1	4.3	45.9	0.24	0.10
Spring Wheat	70	8.9	4.0	49.6	0.21	0.08
Mixed Cereal	79	9.3	4.9	45.4	0.29	0.11

	Moisture (%)	Protein (%)	Protein (as fed) (%)	Calcium (%)	Phosphorus (%)
OTHER FEEDS					
Corn	12.0	10.0	9.0	0.03	0.32
Dehy.	8.0	18.9	17.0	1.43	0.26
Soybean Meal	10.0	52.4	47.0	0.33	0.73
Rapeseed Meal	10.0	40.0	36.0	0.73	1.14
Urea	—	281.0	281.0	—	—
Ground Limestone	—	—	—	38.0	—
Dicalcium Phosphate (Dical)	4.0	—	—	23.0	18.50
Rock Phosphate (Defluorinated)	—	—	—	33.0	18.00

NOTES:

1. All analyses, except bushel weight and moisture, are reported on a moisture-free (dry) basis. Analysis (as fed) = Analysis (dry) x $\frac{(100 - \% \text{ Moisture})}{100}$
2. A.D.F. - acid detergent fibre
3. Unsp. - unspecified

SOURCE: Agricultural Soil & Feed Testing Laboratory, 1965-1975.

Table 5. Daily Nutrient Requirements of Sheep (100% Dry Matter Basis)**

Body Weight (kg)	Body Weight (lb)	Gain or Loss (g)	Gain or Loss (lb)	Dry Matter[a] Per Animal (kg)	Dry Matter[a] Per Animal (lb)	Dry Matter[a] % Live Wt.	Energy TDN (kg)	Energy DE[b] (Mcal)	Energy ME (Mcal)	Nutrients per Animal: Total Protein (g)	DP[c] (g)	Grams DP per Mcal DE	Ca (g)	P (g)	Carotene (mg)	Vitamin A (IU)	Vitamin D (IU)
EWES[d]																	
Maintenance																	
50	110	10	.02	1.0	2.2	2.0	0.55	2.42	1.98	89	48	20	3.0	2.8	1.9	1275	278
60	132	10	.02	1.1	2.4	1.8	0.61	2.68	2.20	98	53	20	3.1	2.9	2.2	1530	333
70	154	10	.02	1.2	2.6	1.7	0.66	2.90	2.38	107	58	20	3.2	3.0	2.6	1785	388
80	176	10	.02	1.3	2.9	1.6	0.72	3.17	2.6	116	63	20	3.3	3.1	3.0	2040	444
Nonlactating and first 15 weeks of gestation																	
50	110	30	.07	1.1	2.4	2.2	0.60	2.64	2.16	99	54	20	3.0	2.8	1.9	1275	278
60	132	30	.07	1.3	2.9	2.1	0.72	3.17	2.60	117	64	20	3.1	2.9	2.2	1530	333
70	154	30	.07	1.4	3.1	2.0	0.77	3.39	2.78	126	69	20	3.2	3.0	2.6	1785	388
80	176	30	.07	1.5	3.3	1.9	0.82	3.61	2.96	135	74	20	3.3	3.1	3.0	2040	444
Last 6 weeks of gestation or last 8 weeks of lactation suckling singles[e]																	
50	110	175(+45)	.39	1.7	3.7	3.3	0.99	4.36	3.58	158	88	20	4.1	3.9	6.2	4250	278
60	132	180(+45)	.40	1.9	4.2	3.2	1.10	4.84	3.97	177	99	20	4.4	4.1	7.5	5100	333
70	154	185(+45)	.41	2.1	4.6	3.0	1.22	5.37	4.40	195	109	20	4.5	4.3	8.8	5950	388
80	176	190(+45)	.42	2.2	4.8	2.8	1.28	5.63	4.62	205	114	20	4.8	4.5	10.0	6800	444
First 8 weeks of lactation suckling singles or last 8 weeks of lactation suckling twins[f]																	
50	110	-25(+80)	-.06	2.1	4.6	4.2	1.36	5.98	4.90	218	130	22	10.9	7.8	6.2	4250	278
60	132	-25(+80)	-.06	2.3	5.1	3.9	1.50	6.60	5.41	239	143	22	11.5	8.2	7.5	5100	333
70	154	-25(-80)	-.06	2.5	5.5	3.6	1.63	7.17	5.88	260	155	22	12.0	8.6	8.8	5950	388
80	176	-25(-80)	-.06	2.6	5.7	3.2	1.69	7.44	6.10	270	161	22	12.6	9.0	10.0	6800	444
First 8 weeks of lactation suckling twins																	
50	110	-60	-.13	2.4	5.3	4.8	1.56	6.86	5.63	276	173	25	12.5	8.9	6.2	4250	278
60	132	-60	-.13	2.6	5.7	4.3	1.69	7.44	6.10	299	187	25	13.0	9.4	7.5	5100	333
70	154	-60	-.13	2.8	6.2	4.0	1.82	8.01	6.57	322	202	25	13.4	9.5	8.8	5950	388
80	176	-60	-.13	3.0	6.6	3.7	1.95	8.58	7.04	345	216	25	14.4	10.2	10.0	6800	444

Table 5. Daily Nutrient Requirements of Sheep (100% Dry Matter Basis) (cont'd)**

Body Weight (kg)	Body Weight (lb)	Gain or Loss (g)	Gain or Loss (lb)	Dry Matter[a] Per Animal (kg)	Dry Matter[a] Per Animal (lb)	% Live Wt.	Energy TDN (kg)	Energy DE[b] (Mcal)	Energy ME (Mcal)	Nutrients per Animal Total Protein (g)	DP[c] (g)	Grams DP per Mcal DE	Ca (g)	P (g)	Caro-tene (mg)	Vita-min A (IU)	Vita-min D (IU)
Replacement lambs and yearlings[g]																	
30	66	180	.40	1.3	2.9	4.3	0.81	3.56	2.92	130	75	21	5.9	3.3	1.9	1275	166
40	88	120	.26	1.4	3.1	3.5	0.82	3.61	2.96	133	74	20	6.1	3.4	2.5	1700	222
50	110	80	.18	1.5	3.3	3.0	0.83	3.65	2.99	133	73	20	6.3	3.5	3.1	2125	278
60	132	40	.09	1.5	3.3	2.5	0.82	3.61	2.96	133	72	20	6.5	3.6	3.8	2550	333
RAMS																	
Replacement Lambs and yearlings[g]																	
40	88	250	.55	1.8	4.0	4.5	1.17	5.15	4.22	184	108	21	6.3	3.5	2.5	1700	222
60	132	200	.44	2.3	5.1	3.8	1.38	6.07	4.98	219	122	20	7.2	4.0	3.8	2550	333
80	176	150	.33	2.8	6.2	3.5	1.54	6.78	5.56	249	134	20	7.9	4.4	5.0	3400	444
100	220	100	.22	2.8	6.2	2.8	1.54	6.78	5.56	249	134	20	8.3	4.6	6.2	4250	555
120	265	50	.11	2.6	5.7	2.2	1.43	6.29	5.16	231	125	20	8.5	4.7	7.5	5100	666
LAMBS																	
Finishing[h]																	
30	66	200	.44	1.3	2.9	4.3	0.83	3.65	2.99	143	87	24	4.8	3.0	1.1	765	166
35	77	220	.48	1.4	3.1	4.0	0.94	4.14	3.39	154	94	23	4.8	3.0	1.3	892	194
40	88	250	.55	1.6	3.5	4.0	1.12	4.93	4.04	176	107	22	5.0	3.1	1.5	1020	222
45	99	250	.55	1.7	3.7	3.8	1.19	5.24	4.30	187	114	22	5.0	3.1	1.7	1148	250
50	110	220	.48	1.8	4.0	3.6	1.26	5.54	4.54	198	121	22	5.0	3.1	1.9	1275	278
55	121	200	.44	1.9	4.2	3.5	1.33	5.85	4.80	209	127	22	5.0	3.1	2.1	1402	305
Early-weaned[i]																	
10	22	250	.55	0.6	1.3	6.0	0.44	1.94	1.59	96	69	36	2.4	1.6	1.2	850	67
20	44	275	.60	1.0	2.2	5.0	0.73	3.21	2.63	160	115	36	3.6	2.4	2.5	1700	133
30	66	300	.66	1.4	3.1	4.7	1.02	4.49	3.68	196	133	30	5.0	3.3	3.8	2550	200

[a] To convert dry matter to an as-fed basis, divide dry matter by percentage of dry matter.

[b] 1 kg TDN = 4.4 Mcal DE (digestible energy). DE may be converted to ME (metabolizable energy) by multiplying by 82%.

[c] DP = digestible protein.

[d] Values are for ewes in moderate condition, not excessively fat or thin. Fat ewes should be fed at the next lower weight, thin ewes at the next higher weight. Once maintenance is established, such weight would follow through all production phases.

[e] Values in parentheses are for ewes suckling singles last 8 weeks of lactation.

[f] Values in parentheses are for ewes suckling twins last 8 weeks of lactation.

[g] Requirements for replacement lambs (ewe and ram) start when the lambs are weaned.

[h] Maximum gains expected. If lambs are held for later market, they should be fed as replacement ewe lambs are fed. Lambs capable of gaining faster than indicated should be fed at a higher level. Lambs finish at the maximum rate if they are self-fed.

[i] A 40-kg early-weaned lamb should be fed the same as a finishing lamb of the same weight.

** NOTE: This affects only Dry Matter Intake.*

Table 6. Nutrient Content of Diets for Sheep (Nutrient Concentration in Diet Dry Matter)

Body Weight (kg)	Body Weight (lb)	Gain or Loss (g)	Gain or Loss (lb)	Dry Matter[a] Per Animal (kg)	Dry Matter[a] Per Animal (lb)	% Live Wt.	Energy TDN (%)	Energy DE[b] (Mcal/kg)	Energy ME (Mcal/kg)	Nutrients per Animal Total Protein (%)	DP[c] (%)	Ca (%)	P (%)	Carotene (mg/kg)	Vitamin A (IU/kg)	Vitamin D (IU/kg)
EWES[d]																
Maintenance																
50	110	10	.02	1.0	2.2	2.0	55	2.4	2.0	8.9	4.8	.30	.28	1.9	1275	278
60	132	10	.02	1.1	2.4	1.8	55	2.4	2.0	8.9	4.8	.280	.26	2.0	1391	303
70	154	10	.02	1.2	2.6	1.7	55	2.4	2.0	8.9	4.8	.27	.25	2.2	1488	323
80	176	10	.02	1.3	2.9	1.6	55	2.4	2.0	8.9	4.8	.25	.43	2.3	1569	342
Nonlactating and first 15 weeks of gestation																
50	110	30	.07	1.1	2.4	2.2	55	2.4	2.0	9.0	4.9	.27	.25	1.7	1159	253
60	132	30	.07	1.3	2.9	2.1	55	2.4	2.0	9.0	4.9	.24	.22	1.7	1177	256
70	154	30	.07	1.4	3.1	2.0	55	2.4	2.0	9.0	4.9	.23	.21	1.9	1275	277
80	176	30	.07	1.5	3.3	1.9	55	2.4	2.0	9.0	4.9	.22	.21	2.0	1360	296
Last 6 weeks of gestation or last 8 weeks of lactation suckling singles[e]																
50	110	175(+45)	.39	1.7	3.7	3.3	58	2.6	2.1	9.3	5.2	.24	.23	3.6	2500	164
60	132	180(+45)	.40	1.9	4.2	3.2	58	2.6	2.1	9.3	5.2	.23	.22	3.9	2684	175
70	154	185(+45)	.41	2.1	4.6	3.0	58	2.6	2.1	9.3	5.2	.21	.20	4.2	2833	185
80	176	190(+45)	.42	2.2	4.8	2.8	58	2.6	2.1	9.3	5.2	.21	.21	4.5	3091	202
First 8 weeks of lactation suckling singles or last 8 weeks of lactation suckling twins[f]																
50	110	-25(+80)	-.06	2.1	4.6	4.2	65	2.9	2.4	10.4	6.2	.52	.37	3.0	2024	132
60	132	-25(+80)	-.06	2.3	5.1	3.9	65	2.9	2.4	10.4	6.2	.50	.36	3.3	2217	145
70	154	-25(+80)	-.06	2.5	5.5	3.6	65	2.9	2.4	10.4	6.2	.48	.34	3.5	2380	155
80	176	-25(+80)	-.06	2.6	5.7	3.2	65	2.9	2.4	10.4	6.2	.48	.34	3.8	2615	171
First 8 weeks of lactation suckling twins																
50	110	-60	-.13	2.4	5.3	4.8	65	2.9	2.4	11.5	7.2	.52	.37	2.6	1771	116
60	132	-60	-.13	2.6	5.7	4.3	65	2.9	2.4	11.5	7.2	.50	.36	2.9	1962	128
70	154	-60	-.13	2.8	6.2	4.0	65	2.9	2.4	11.5	7.2	.48	.34	3.1	2125	139
80	176	-60	-.13	3.0	6.6	3.7	65	2.9	2.4	11.5	7.2	.48	.34	3.3	2267	148

Table 6. Nutrient Content of Diets for Sheep (Nutrient Concentration in Diet Dry Matter) (Cont'd)

Body Weight (kg)	Body Weight (lb)	Gain or Loss (g)	Gain or Loss (lb)	Dry Matter[a] Per Animal (kg)	Dry Matter[a] Per Animal (lb)	% Live Wt.	Energy TDN (%)	Energy DE[b] (Mcal/kg)	Energy ME (Mcal/kg)	Nutrients per Animal Total Protein (%)	DP[c] (%)	Ca (%)	P (%)	Caro-tene (mg/kg)	Vita-min A (IU/kg)	Vita-min D (IU/kg)
Replacement lambs and yearlings[g]																
30	66	180	.40	1.3	2.9	4.3	62	2.7	2.2	10.0	5.8	.45	.25	1.5	981	128
40	88	120	.26	1.4	3.1	3.5	60	2.6	2.1	9.5	5.3	.44	.24	1.8	1214	159
50	110	80	.18	1.5	3.3	3.0	55	2.4	2.0	8.9	4.8	.42	.23	2.1	1417	185
60	132	40	.09	1.5	3.3	2.5	55	2.4	2.0	8.9	4.8	.43	.24	2.5	1700	222
RAMS																
Replacement lambs and yearlings[g]																
40	88	250	.55	1.8	4.0	4.5	65	2.9	2.4	10.2	6.0	.35	.19	1.4	944	123
60	132	200	.44	2.3	5.1	3.8	60	2.6	2.1	9.5	5.3	.31	.17	1.7	1109	145
80	176	150	.33	2.8	6.2	3.5	55	2.4	2.0	8.9	4.8	.28	.16	1.8	1214	159
100	220	100	.22	2.8	6.2	2.8	55	2.4	2.0	8.9	4.8	.30	.17	2.2	1518	198
120	265	50	.11	2.6	5.7	2.2	55	2.4	2.0	8.9	4.8	.33	.18	2.9	1962	256
LAMBS																
Finishing[h]																
30	66	200	.44	1.3	2.9	4.3	64	2.8	2.3	11.0	6.7	.37	.23	0.8	588	128
35	77	220	.48	1.4	3.1	4.0	67	3.0	2.4	11.0	6.7	.34	.21	0.9	637	139
40	88	250	.55	1.6	3.5	4.0	70	3.1	2.5	11.0	6.7	.31	.19	0.9	638	139
45	99	250	.55	1.7	3.7	3.8	70	3.1	2.5	11.0	6.7	.29	.18	1.0	675	147
50	110	220	.48	1.8	4.0	3.6	70	3.1	2.5	11.0	6.7	.28	.17	1.1	708	154
55	121	200	.44	1.9	4.2	3.5	70	3.1	2.5	11.0	6.7	.26	.16	1.1	738	161
Early-Weaned																
10	22	250	.55	0.6	1.3	6.0	73	3.2	2.6	16.0	11.5	.40	.27	2.0	1417	112
20	44	275	.60	1.0	2.2	5.0	73	3.2	2.6	16.0	11.5	.36	.24	2.5	1700	133
30	66	300	.66	1.4	3.1	4.7	73	3.2	2.6	14.0	9.5	.36	.24	2.7	1821	143

[a] To convert dry matter to an as-fed basis, divide dry matter by percentage of dry matter.

[b] 1 kg TDN - 4.4 Mcal DE (digestible energy). DE may be converted to ME (Metabolize energy) by multiplying by 82%. Because of rounding errors, calculations between Table 7 and Table 8 may not give the same values.

[c] DP = digestible protein.

[d] Values are for ewes in moderate condition, not excessively fat or thin. Fat ewes should be fed at the next lower weight, thin ewes at the next higher weight. Once maintenance weight is established, such weight would follow through all production phases.

[e] Values in parentheses are for ewes suckling singles last 8 weeks of lactation.

[f] Values in parentheses for ewes suckling twins last 8 weeks of lactation.g Requirements for replacement lambs (ewe and ram) start when lambs are weaned.

[h] Maximum gains expected. If lambs are held for later market, they should be fed as replacement ewe lambs are fed. Lambs capable of gaining faster than indicated should be fed at a higher level. Lambs finish at the maximum rate if they are selffed.

[i] A 40-kg early-weaned lamb should be fed the same as a finishing lamb of the same weight.

Example:
Assume we have some 70 kg (150 lb) ewes in the corral. Their lambs were weaned a month ago. These ewes are on a daily maintenance ration of 1 kg brome grass hay and 0.5 kg of barley straw.

Table 6 shows that brome grass contains 0.43% Ca, 0.15% P which is 4.3 grams of calcium/kg straw and 1.5 grams of phosphorus/kg hay.

Barley straw contains 0.31% Ca and 0.10% P which is 3.1 grams of calcium/kg straw and 1.0 grams of phosphorus/kg straw.

Therefore, if a ewe eats 1 kg brome hay and 0.5 kg straw, she would take in

$$4.3\ g + \frac{3.1\ g}{2} = 5.85 \text{ grams of calcium/day.}$$

AND

$$1.5\ g + \frac{1.0\ g}{2} = 2.00 \text{ grams of phosphorus/day.}$$

Table 7, (Daily Nutrient Requirements of Sheep) shows us that such ewes need 3.2 grams of calcium and 3.0 grams of phosphorus. Thus, animals are getting enough calcium, but are short of phosphorus.

We need to buy a 1:1 Ca/P mineral mix. There are different feed companies making different mixes. We find a mineral mix with the following analysis for Ca:P. (See Table 8 Examples of Commercial Mineral Mixes.)

Ca actual 16.0% (16 g/100 g of mix)

P actual 16.0% (16 g/100 g of mix)

The ewe needs 1.0 grams of phosphorus extra (3.0 g - 2.0 g) per day.

Thus she needs 1/16 x 100 = 6.25 grams of mineral mix/day.

If we give these ewes 6.25 grams of mix/day, they will receive an extra 1 gram of calcium as well for a total daily calcium intake of 5.85 + 1.00 = 6.85 grams of calcium/day.

Thus their Ca/P ration becomes 6.85/3.00 = 2.28:1, which is adequate for ewes.

Table 7. Examples of Commercial Mineral Mixes

1. 12-12 Minerals for Cattle

Calcium Actual	12.0%	Fluorine Maximum	0.2%
Phosphorus	12.0%	Manganese	0.18%
Salt	15.0%	Cobalt	.003%
Iron	0.5%	Copper	.03%
Iodine	.004%	Zinc	.15%

2. 16-16 Minerals for Cattle

Calcium Actual	16.0%	Fluorine Maximum	0.2%
Phosphorus	16.0%	Manganese	0.18%
Iron	0.5%	Cobalt	.003%
Iodine	0.004%	Copper	.03%
Zinc	0.15%		

3. 16-8 Minerals for Cattle

Calcium	16.0%	Fluorine	0.2%
Phosphorus	8.0%	Manganese	0.18%
Salt*	25.0%	Copper	0.03%
Iron	0.5%	Zinc	0.15%
Iodine	0.004%	Cobalt	0.003%

NOTE: High salt in this mix

*NOTE: * Salt is very high*
Copper is dangerous for sheep!
Calcium is not present

Don't Use for Sheep!!!

NOTE: At the moment, there are as yet no mineral mixes specifically designed for sheep (namely copper free). One should try to purchase a cattle mineral mix containing copper at 0.03% or lower.

Feedlot lambs on full grain rations with minimum roughage will require a 2:1 Ca/P mineral mix, or limestone (33% calcium), since concentrate rations are usually high in phosphorus and low in calcium.

The method of calculating how much limestone or 2:1 mineral to add is similar to that used in the above example.

An example of a suitable 1:1 mineral mix is given in the appendix.

NOTE: Feedlot lambs are susceptible to urinary calculi (kidney stones) if calcium is too low, phosphorus too high, particularly when water intake is restricted.

Salt (NaCl)
Salt has many functions in the body. Deficiencies may occur:
— during very hot weather
— in rapidly growing feedlot lambs
— during lactation of ewes.

Lack of salt leads to:
— reduced appetite, slow growth
— loss of body weight
— reduced milk production
— abnormal appetite (eating bedding or dirt)

Some suggestions for the use of salt in sheep rations:
— a mineral mix containing 25% salt can be used, mixed in with a grain based ration according to calcium and phosphorus requirements.
— in addition, loose cobalt - iodized (blue) salt should be provided in boxes, protected from the weather.
— in feedlots where urinary calculi (water belly) in male lambs is a problem, a maximum of 3% salt may be added to the grain ration ie. 30 kg/tonne (60 lb/ton), provided plenty of salt free, good quality water is available at all times.

Magnesium (Mg)
Magnesium is necessary for enzyme systems and for the nervous system. Normally, feeds contain adequate levels of magnesium. Magnesium is closely associated with the metabolism of calcium and phosphorus.

Magnesium deficiency causing grass tetany may be a problem among lactating ewes grazing on lush grass pastures in the early spring. Pastures heavily fertilized with nitrogen and potash are more likely to trigger this condition. Potash interferes with magnesium uptake by the pasture grasses. A discussion on grass tetany may be found in the veterinary section of this manual.

Most feedstuffs contain adequate amounts of magnesium.

Cobalt
This trace mineral is essential, since without it, Vitamin B12 cannot be manufactured by rumen microbes. Cobalt forms part of the Vitamin B12 molecular structure.

A deficiency of cobalt may cause sheep to become thin, unthrifty and anemic. Adequate cobalt intake is achieved, if loose cobalt-iodized salt is fed free choice. Most mineral mixes contain cobalt (see mineral mixes Table 8).

Iodine
This trace mineral is required by the thyroid gland for regulation of food utilization (metabolism).

Iodine deficiency can be a cause of goitre (hyperthyroidism) which is commonly seen in newborn lambs born to deficient ewes. Goitre can be recognized in young lambs by:
— abnormal swelling under the throat due to an enlarged thyroid gland
— abnormal wool coat at birth
— still births and neonatal mortality.

Again, cobalt iodized salt and mineral mixes supply plenty of iodine.

Selenium (Se)
Selenium is important because of its role along with vitamin E in the prevention of nutritional muscular dystrophy (NMD) (white muscle disease, stiff lamb disease).

Forages grown in the grey wooded and black soil zones of Alberta tend to be lower in selenium than those grown on brown or dark brown soils. However, deficiencies can occur in nearly all areas of the province.

Minimum requirements of selenium in sheep feed is 100 ppb (parts per billion). This level fed to ewes will prevent NMD in baby lambs.

Selenium has recently been cleared for use in loose trace mineralized salt. Ewes raised in selenium deficient regions should be fed such salt on a year round basis. However, selenium is allowed to be mixed commercially into common cattle or sheep mineral mixes. Selenium is also available through veterinarians. There are injectable solutions as well as feed additives available on prescription.

Copper (Cu)
Copper is an integral component of several enzyme systems. Copper is widely distributed in natural feedstuffs. Under normal conditions, the copper supplied in the feed is adequate and sheep don't need copper supplementation. However, high levels of molybdenum (Mo) and sulfate (SO_4) can interfere with copper retention and cause copper deficiency.

Copper is stored in the liver of the sheep. If copper is fed continuously, it may become a cumulative poison. Studies have shown that there is a 3-way relationship among copper, molybdenum (Mo) and sulfate (SO_4). The higher the levels of molybdenum and sulfate are in the feed, the more copper a sheep can safely tolerate. The lower the levels of molybdenum and sulfate are, the more susceptible sheep are to copper poisoning.

At the moment, the Agricultural Soil and Feed Testing

Laboratory has not determined the molybdenum and sulfate status of Alberta feedstuffs. Therefore, it is difficult, if not impossible, to definitely state what the required and safe levels of copper are. It is recommended that copper intake of Alberta sheep be kept as low as possible by attempting to purchase low copper mineral mixes (0.03% or lower).

Copper deficiency is rare in Alberta. Signs are:
— poor wool quality
— enzootic ataxia or sway back in lambs
— softening of bones (osteoporosis)
— poor growth, anemia.

Copper poisoning is more common. The signs of acute toxicity are:
— gastroenteritis, abdominal pain, diarrhea (green to blue green feces)
— high death losses.

Chronic toxicity:
— lack of appetite, depressed demeanor
— yellow discoloration of eyes, gums, tongue (icterus jaundice)

A veterinarian should be consulted regarding treatment of copper poisoning.

Vitamins

The vitamins A, D, E and K are fat soluble. They can be stored in the liver and body fat during periods of abundant supply and rationed out from these organs when supplies become scant.

Water soluble vitamin B-complex and C cannot be stored for future use. B-Vitamins are manufactured by rumen bacteria in adequate amounts on a daily basis, provided the ration is adequate in energy, protein and minerals to enable these bacteria to function. Vitamin C is manufactured in the animal's tissue.

Vitamin A

Vitamin A is an essential nutrient for sheep, being important for sight, and for the maintenance of healthy tissues such as the lining of the digestive tract, and the reproductive tract, the lungs, the eyes and the skin. A deficiency of Vitamin A can cause signs such as night blindness, blind or dead offspring, poor growth, general unthriftiness, and increased susceptibility to disease.

Vitamin A can be provided to ruminants in a synthetic form or as carotene. Carotene is found in green forages and can be converted to Vitamin A by the animal. For ruminants, **1 mg** of carotene is equivalent to **400 I.U.** of Vitamin A. Greenness of the feed is not necessarily an indication of the level of carotene present. Since the availability and stability of carotene in feeds may vary, one should not rely on carotene to meet an animal's total Vitamin A requirement.

As a relatively inexpensive safeguard, sheep that are not on green pasture should be supplemented with a synthetic source of Vitamin A. If possible, a vitamin supplement containing Vitamins A, D and E should be used to guarantee a good supply of these other vitamins as well. Common methods of supplementation are:

By injection - Injectable forms of Vitamin A, given in adequate dosage, can be stored by sheep in their liver for periods of up to three months. An injection of Vitamin A is **not** a vaccination. It must be repeated when the stored Vitamin A is used up, usually after about three months.

By mixing it with grain - The animal's daily requirement can be mixed into its daily ration of grain, or the cumulative required amount can be mixed with grain to be fed weekly or bi-weekly. As Vitamin A may be destroyed by continued exposure to air, only those amounts of grain and vitamins that are used up in a short period should be mixed at one time.

By mixing it with the salt or mineral - Enough vitamin to meet the flock's requirements for a week can be mixed with their weekly supply of salt or mineral. No more than one week's supply should be mixed at a time as Vitamin A is readily destroyed by exposure to moisture, certain minerals and continued exposure to air.

Practical Feeding Levels for Vitamin A in International Units (I.U.) Per Head Per Day

Replacement Lambs	1,500-2,000
Feedlot Lambs	4,000
Pregnant Ewes	7,000
Pregnant Ewes (last 6 weeks of gestation)	9,000
Lactating Ewes	9,000

Read the label carefully on all vitamin supplements before using. Improper dosage with vitamins can be ineffectual or possibly toxic.

Vitamin D

Vitamin D is required in addition to calcium and phosphorus for the maintenance of a normal healthy skeletal (bone) system. Mature non-pregnant sheep exposed to sunlight do not need supplementary Vitamin D.

Pregnant ewes or feedlot lambs kept indoors on deficient rations need additional Vitamin D to prevent rickets. Vitamin D functions in metabolism by regulating calcium absorption from the intestine, deposition into and mobilization from bones. Adequate levels of this vitamin are provided when recommended dosages of Vitamins A, D and E are provided.

Vitamin E
Vitamin E occurs plentifully in green forages and in grain. It has a sparing effect on the requirement for selenium.

- It protects Vitamin A and D from oxidation.
- It helps preserve and maintain muscle function.

Adding Vitamin E in excess of recommended levels to the ration of sheep is not useful in preventing reproductive failure.

Vitamin K
Vitamin K is a vitamin of little practical importance in sheep nutrition. Deficiencies are very rare. A synthetic form of Vitamin K is available for the treatment of moldy sweet-clover poisoning.

Vitamin B Complex
Many of the B vitamins are of little practical importance in ration formulation for sheep. There are either adequate quantities in natural feedstuffs or enough of these vitamins are manufactured by the microflora of the gut to meet the animal's requirements. With ruminants, one needs to be concerned with providing the nutrients that the bacteria need for vitamin synthesis.

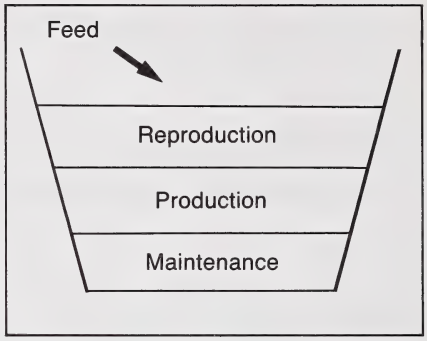
Some attention has to be paid to nonruminating young lambs to insure that adequate levels of the essential B vitamin are present in milk replacers or creep feeds.

Nutrient Requirements
Different classes of sheep have different nutrient requirements. The feeding program has to meet the requirements for:

1. Maintenance of nonpregnant, nonlactating ewes and nonbreeding rams.
2. Maintenance plus reproduction for pregnant ewes and breeding rams.
3. Maintenance plus growth or production for young lambs, feedlot lambs or lactating ewes.

The first requirement, that of maintenance, is defined as the amount of feed necessary to keep an animal at a particular weight without changing the body composition of the animal. Nutrients are required to maintain body functions such as breathing, heart beat, eating, drinking, movement and keeping warm. Nutrients are essential for body repair, as well.

The maintenance requirements of an animal must be met first, before any reproduction, growth or production can occur. If we picture an animal as a bucket into which we are pouring feed, the relationship between maintenance and production can be more easily seen.



It is obvious that the bottom of the bucket must be filled before the top can be reached.

Sheep have specific **maintenance** requirements for each of the essential nutrients. (See Table 7 & 8).

The requirements for **reproduction** are important for the breeding ewe flock. Ewes are pregnant for at least five months per year and longer when accelerated lambing is practiced. Reproduction requirements consist of the amount and quality of feed needed above that required for maintenance to produce and raise a healthy lamb. The costs of feeding a pregnant ewe flock during the winter months dictate careful evaluation and allocation of feedstuffs.

Meeting the requirements for **production**, (milk, wool, meat, growth), involves feeding large quantities of good quality feed. For instance, lactating ewes need about twice the energy and protein a dry ewe needs. Rapidly growing feedlot lambs require more energy and protein than more normally growing lambs used later as replacement ewes or rams.

The various factors which determine the level of nutrients required by sheep can be summarized as follows:
- breed, age and sex of sheep
- the nature and rate of production desired
- the concentration and overall balance of nutrients in the ration
- hormonal and physiological activities of the animals fed
- stresses from the environment.

In nutrition, we attempt to formulate balanced rations that supply all the required nutrients at adequate levels and in a proper balance, at a reasonable cost. In sheep operations, feed costs may make up to 65% or more of total operating costs, with winter feeding costs contributing a major portion.

When formulating rations, one ought to keep the following ideas in mind:

- **Allocate feed resources efficiently** - The best quality feed should be fed to those animals with the highest requirements (growing lambs and lactating ewes).
- **Watch feed intakes** - When a maintenance ration is being fed at recommended daily rates, sheep might not get enough of it to satisfy requirements because of poor quality, poor palatability or excessive moisture content of the feed. Competition among sheep for limited quantity of feed tends to reduce feed intake of some. On the other hand, ad lib feeding of a maintenance ration can result in feed intake far higher than necessary. Overfeeding is wasteful.
- Always have cobalt-iodized salt, a calcium-phosphorus mineral, a selenium fortified trace mineral mix, (if necessary), vitamin A, D & E and water provided.
- Reduce feed wastage and contamination through management. For example, line or bunk feeding is better than dumping feed on the ground.

Ration Formulation

Animal nutritionists attempt to formulate rations which:

- meet the animal's nutrient requirements
- are balanced properly
- are palatable
- promote or discourage feed intake, depending on the purpose of the ration
- are suitable for a given management situation (facilities, expertise, mechanization, etc.)
- are reasonably priced

In the process of ration formulation, the nutritionist needs information about the animal's requirements, the feeds that are available for use, and the nutrient composition of the feeds. The following outline will give some idea of the questions that need to be answered before formulation is attempted. The final ration will only be as good as the information which went into its making.

- What type, age, weight of sheep do we wish to feed? What level of production, rate of gain, do we desire? What areas of the province and time of the year will feeding take place?

The sheep producer provides the answers to these questions. Thus, different rations can be designed for different classes of sheep, different seasons and regions.

- Where can information regarding the nutrient requirement of sheep be found?

  NRC Nutrient Requirement of Sheep. See Table 5 & 6.
  Agriculture Canada Bulletins
  Alberta Agriculture Publications
  University Bulletins and Research Papers

- What feeds are available for use in the formulation? Are these home grown or can they be purchased? Which are the most economical feedstuffs for a specific ration?

The answers depend on the producer's opinion and knowledge of market prices.

- Where can the general information regarding the nutrient content of feedstuffs be found?

  In Table 9, Approximate Energy Value of Alberta Feeds.
  In Table 6, Average Analysis of Alberta Feeds
  In Nutrient Requirements of Sheep*

- How may a producer obtain this information for his own feed?

  Through feed analysis carried out by government and private feed testing laboratories.
  Alberta Agriculture provides a feed analysis service.
  Sampling of Feed - follow the sampling procedure outlined in the pamphlet ***Guide to Feed Sampling***, available from a local district agriculturist. Address to which feed samples may be mailed:

  Soil and Feed Testing Laboratory
  O.S. Longman Building
  6909 - 116 Street
  EDMONTON, Alberta
  T6H 4P2

** Nutrient Requirements of Sheep, National Academy of Sciences, National Research Council, 5th Revised Edition, Table 16, Page 50.*

Table 8. Approximate Energy Values for Feeds Commonly Used in Sheed Rations

	Digestable Energy* Mcal/lb	
HAY & GREENFEEDS	**Mcal/kg**	**Mcal/lb**
Alfalfa - early bloom	2.31	1.05
Alfalfa - mid bloom	2.20	1.00
Red Clover	2.24	1.02
Sweetclover	2.05	.93
Oats	2.20	1.00
Barley	2.20	1.00
Brome Grass	2.24	1.02
Timothy	2.33	1.06
Native Grass	2.02	.92
SILAGES		
Oats - dry basis	2.77	1.26
Oats - 65% moisture	0.97	.44
Barley - dry basis	2.77	1.26
Barley - 65% moisture	0.97	0.44
Corn - dry basis	3.04	1.38
Corn - 70% moisture	0.90	0.41
Alfalfa - dry basis	2.38	1.08
Alfalfa - 65% moisture	0.84	0.38
STRAWS		
Oats	1.76	0.80
Barley	1.76	0.80
Wheat	1.54	0.70
GRAINS		
Oats	2.95	1.34
Barley	3.37	1.53
Wheat	3.45	1.57
Corn	3.63	1.65
SUPPLEMENT		
Rapeseed Meals	2.86	1.30
Soybean Meal	3.15	1.43
Dehy. Alfalfa	2.31	1.05
32% Commercial Supplement	2.57	1.17
Urea	0	0

** Energy values reported are on an as-fed basis unless otherwise noted.*

- How does a producer interpret the results obtained?

  Advice on ration formulation can be provided upon request to sheep producers who:

  - supply for feed analysis representative samples of all grains and roughages that are to be used in the sheep ration.

  - supply all information about submitted samples as requested on the feed and ration information sheets.

A meaningful ration can only be formulated if the kind of feedstuff, its quality, and the analysis results of each are known.

On the basis of test results and information given by the sheep producer, animal nutritionists can tailor rations according to the needs of an individual flock, upon request.

If the information provided with the test samples is incomplete, only the feed analysis figures are returned to the producer. Specific information regarding ration formulation cannot be given.

Producers may prefer to formulate their own sheep rations. Some examples are shown at the end of this section. First, some general information on how to feed sheep.

Feeding Ewes

As we stated before, the ewe's nutritional needs vary according to their body condition and the stage of their breeding cycle.

Pre-breeding feeding methods - Flushing, or getting the ewes on an increasing plane of nutrition to make them gain weight just prior to breeding, is a technique used widely by sheep producers. It tends to increase ovulation rate and betters the chances of obtaining multiple births.

The effect of flushing appears to be greater on thin ewes than on ewes in a fatter than normal condition. The flushing effect can be obtained by moving the ewe flock to a better pasture than the one they are on, or by feeding a high quality hay supplement with grain.

Post-breeding feeding - After breeding, the ewe flock is best maintained on a good pasture initially. In A confinement feeding system, feeding should be just sufficient to allow the ewes to maintain their body weight. Hay and/or silage fed to appetite would be sufficient. Poor quality roughage during this period would require some supplementation with grain to prevent starvation. Allow three weeks after breeding before drastic reductions in energy intake are made. Sudden reduction in feed after breeding may cause failure of implantation of fetuses in the womb.

Before lambing feeding - During the final six to eight weeks of pregnancy, the growth of fetuses is very rapid. This is a critical period in the ewe's reproductive cycle. The plane of nutrition should be increased gradually until lambing. Good quality hay or silage should be available and grain rations should be increased gradually from 0.23 kg (0.5 lb) grain/day at six weeks before lambing to 0.68 kg (1.5 lb) at lambing time.

Inadequate energy intake during this period may result in conditions such as pregnancy toxemia, birth of weak or dead lambs, loss of the mothering instinct and lower than adequate milk production.

Lactating ewes - Nursing ewes have to be fed at a high level of nutrition to maintain a good milk supply. Ewes nursing twins or triplets could be separated from those supporting one lamb and fed separately according to milk production. Ewes nursing twins may produce 20% - 40% more milk than those with singles.

Good quality hay should be available free choice. In addition, grain should be fed at 0.7 - 0.9 kg (1.5 - 2.0 lb) for single lamb ewes and 0.9 - 1.4 kg (2.0 - 3.0 lb) for ewes supporting twins or triplets.

Post weaning feeding of ewes - After weaning, the nutritional requirements of the ewe are no longer as critical. Only a maintenance ration is required for the period between weaning and flushing.

Pasture grazing, or if in confinement, a mixture of hay and straw is sufficient.

It must be emphasized again that, in addition to the above feeding recommendations for ewes, the following have to be fed as well:

- Cobalt-iodized salt - free choice
- Calcium and Phosphorus mineral mix - free choice
- Selenium supplementation, if necessary in a trace mineralized salt mixed into grain supplement
- Vitamin A, D and E as recommended.

Feeding the Ram

The immature growing ram should be on hay or pasture. Some supplementary grain feeding might be necessary at times, if roughage or pasture is of poor quality. About 2 -4 weeks prior to the breeding season, the ram should be introduced to grain. The grain intake could be as high as 0.5 - 0.7 kg (1 - 1.5 lb)/day.

However, if the rams are in excellent body condition at the start of the breeding season and they are in good flushing pasture with the ewes, grain feeding should not be necessary.

Feeding Lambs on Milk Replacers

Lambs less than four weeks of age are essentially non-ruminants. They require:

— high levels of milk fat
— high quality protein at high levels
— very low fibre
— most of B complex vitamins.

Lambs which may be saved by proper use of a top grade milk replacer are the following:

— orphan - mismothered, death of ewe, bad uddered ewe
— lambs suffering weakness due to inadequate milk supply of ewe
— the weaker lamb from a set of twins or triplets. There is experimental evidence to suggest that higher survival rates and better performance are obtained if the weaker lambs were left with the ewe and the stronger lambs were weaned and placed on a milk replacer.

Recommended Practices for Raising Lambs on Milk Replacer

1. Make sure all lambs receive at least 170 mL (6 oz) of fresh or frozen colostrum as soon as possible after birth.
2. Give lambs a Vitamin E-Selenium injection at four days of age in known selenium deficient areas. Vaccinate against enterotoxemia at seven to ten days and again after six weeks, since these lambs do not receive passive immunity from their dams.
3. Remove the lambs from the ewes (preferably within 24 hours after birth) and put them in a pen where they cannot see or hear the ewes.
4. After starving the lambs 4 to 6 hours, introduce them to a teat bar and make sure they begin feeding.
5. Place lambs in a warm enclosed area with others on milk replacers, to avoid competition.
6. Do not place very young lambs in pens with older lambs.
7. Hang a light over the milk replacer pail or dispenser. Lambs are attracted by light and will adapt more quickly.
8. Mix the milk replacer to 20% dry matter. (Four parts water to one part milk replacer). Feed it cold i.e., 4.5°C (40°F) and free choice.
9. The milk replacer should contain 24 - 26% crude protein and at least 25 - 30% fat. It should not settle out when left standing.
10. Do not use milk replacers containing more than 25% lactose (milk, sugar). High lactose levels can cause diarrhea and abomasal bloat.

11. If milk replacer containing insoluble ingredients is being fed to reduce costs, an automatic mixer should be incorporated in the tank.
12. Clean the feeding equipment twice weekly (or after each feeding, if the replacer is being fed warm). To prevent souring, 0.10% Formalin may be added. (1 mL formalin per 4.4 L of milk).
13. After 7 - 10 days provide creep feed ad lib, along with fresh water. The creep feed should contain 16-18% protein and be high in energy. It also must be palatable and easily accessible. Mixtures of soybean meal and barley are less expensive than many calf or lamb starters, and have been used with good results.
14. High quality alfalfa hay may be offered free choice. Lambs should not eat much of it before they have developed a rumen, about 4 weeks of age.
15. Antibiotics may be added to the milk replacer or creep feed if indicated by disease problems. Recommended level (M.I.B.)* for creep feed is 110 g/tonne of oxytetracycline HCl.

Creep Feeding Lambs

Traditionally, lambs born in late spring out on the range in southern Alberta, stay with the ewes all summer and are weaned in the fall, at which time they enter a feedlot to be finished.

However, early weaning has become an acceptable practice in recent years in other parts of the province.

Early weaning is the term used to define weaning of lambs at 30 - 60 days of age. The best early weaning age is said to be 40 - 45 days or about 20 kg (45 lb) of body weight. Weaning earlier may result in set backs in growth performance.

For early weaning to be successful, creep feeding is essential. Nursing lambs fed a creep feed will help them develop a fully functioning rumen within about 35 - 40 days.

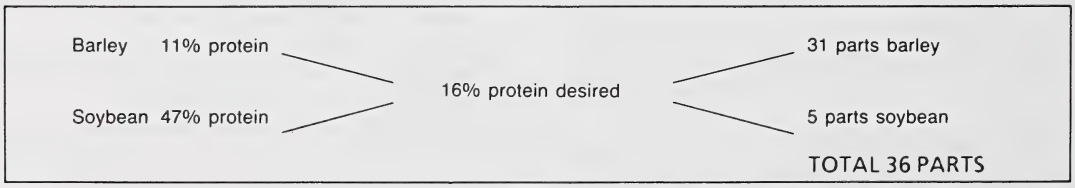
Good creep rations can be formulated from home grown barley and purchased soybean meal.

At Fairview Agricultural College, the following creep ration is being used successfully:

— Barley-soybean meal mix to get a final protein level of 16%
— Cobalt-iodized salt (1%)
— Limestone (1%)
— Dry vitamin A, D and E to provide 2500 units Vitamin A/lb. feed
— Oxytetracycline 27.5 g/tonne.

The proportion of barley vs. soybean can be found by the Pearson square, after feed analysis of barley and soybean meal.

This is done as follows (subtract diagonally)



Thus, per 100 kg 16% protein mix, one could use:
31/36 x 100 kg = 86 kg barley
5/100 kg x = 14 kg soybean meal

Advantages of early weaning

- Healthy creep fed 4-5 week old lambs have developed a mature rumen and no longer depend on the ewe for adequate growth.
- Early born and early weaned lambs can be placed in a feedlot and finished rapidly, in order to take full advantage of probably high market prices.
- Ewes can be taken off grain earlier and placed on a low cost maintenance ration, average quality hay or relatively poor quality pasture.

Disadvantages of Early Weaning

- Lambs not consuming adequate amounts of creep feed grow very poorly if weaned early.
- More intensive husbandry and better expertise is required to make a success of early weaning.
- Capital and other costs may be higher for early weaning, viz. facilities, equipment, labor.

** Medicating Ingredients Brochure*

Feeding Weaned Lambs

The first two weeks after early weaning can be a difficult stressful period for lambs. The earlier the weaning, the greater the potential for problems. The greater the stress, the more susceptible the lambs are to nutritional disease (indigestive upsets, diarrhea) and infectious diseases (coccidiosis, pneumonia).

Some management procedures for recently weaned lambs can be found in the management section of this manual.

Several factors must be considered before a sheep producer can design a ration for early weaned lambs.

- Purpose of lamb feeding. Is replacement breeding stock to be produced, or are the lambs expected to reach market weight as rapidly as possible?
- Sources and costs of ration components.
- Facilities and equipment for feeding.

Generally speaking, lambs raised as potential breeding stock can be put in a good pasture or fed hay and perhaps some grain to meet nutritional requirements. Such lambs should stay in good body condition, but should not be allowed to become too fat. Excessive fatness interferes with efficient breeding.

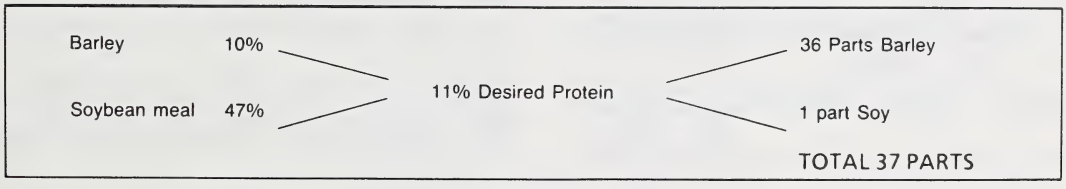
Feedlot lambs need to be fed highly concentrated grain based rations to allow them to grow as rapidly as possible. Best rates of gain for market lambs can be had by feeding a ration consisting of a grain/protein supplement mix. Although a 10% roughage content of the ration for finishing lambs is usually recommended, straight concentrate rations have been used with good success at the Fairview Agricultural College.

Whole barley is used there as the basis of the finishing ration. A certain quantity of a 50% pelleted protein supplement is added. The amount added depends of the protein content of the barley. The pellet contains protein, urea, vitamins, minerals and an antibiotic. Pelleting helps to prevent the urea from settling out. A 50% protein lamb feedlot pellet is now commercially available in Alberta to be used with whole barley.

Using such highly concentrated finishing rations requires expert management. Grain overload, indigestion and founder are conditions which commonly occur as a result of management errors.

However, smaller producers wishing to finish their own lambs can use a barley/soybean meal mixture using rolled barley and soybean meal to a final protein level of 11%. It is not advisable to use urea in home mixed rations because of probable settling out of urea and consequent urea toxicity.

To get the correct mix the Pearsons square can be used again:



Thus for 100 kg of mix one could use:
36/37 x 100 = 97 kg of barley
1/37 x 100 = 3 kg of soybean meal

Then add:
454 g (1 lb) of ground limestone
454 g (1 lb) of cobalt iodized salt

Dry vitamin A, D & E as recommended (5500 I.U. in vitamin A/kg of feed).

It must be remembered that unsupplemented grain based rations are high in phosphorus and low in calcium. Hence, the addition of limestone.

Low salt intake, high phosphorus, low calcium and restricted water intake can also be contributing causes of **urinary calculi**.

Ration Formulation Techniques

As was mentioned before, specific rations can be formulated for each of the various classes of sheep mentioned.

The calculation of **least cost rations** can be very complex, and is best left to animal nutritionists and regional livestock supervisors who have access to computer facilities.

However, sheep producers themselves should have knowledge of the rudiments of ration formulation and ought to be able to make up adequate rations using home grown roughage and grains.

This will now be illustrated by means of a few examples.

Example 1
We have ewes due to lamb in 30 days. They weigh about 70 kg (150 lb) each. These ewes are kept in the corral and have no access to pasture.

Home grown feeds available are slough grass hay and barley.

Representative samples of slough hay and barley were collected by the district agriculturist and sent to the Soil & Feed Testing Laboratory in Edmonton. The results on the as fed basis were:

	Moisture	Protein	Ca	P
Barley	12%	10.6%	.04%	.34%
Slough Hay	9.9%	7.7%	.42%	.13%

How much of each do we feed these ewes to meet their requirements?

Table 9. Average & Maximum Daily Feed Intake for Cattle & Sheep

Body Weight		Average as fed		Maximum as fed	
kg	lb	kg	lb	kg	lb
18.1	40	0.9	2.0	1.0	2.2
27.2	60	1.3	2.8	1.4	3.0
36.3	80	1.6	3.4	1.7	3.7
45.4	100	1.8	4.1	2.0	4.4
68.0	150	2.5	5.5	2.7	6.0
90.7	200	3.1	6.9	3.4	7.5
13.6	300	4.2	9.2	4.5	10.0
181.4	400	5.2	11.5	5.7	12.5
226.8	500	6.2	13.6	6.7	14.8
272.2	600	7.1	15.6	7.7	16.9
317.5	700	7.9	17.5	8.6	19.0
362.9	800	8.8	19.3	9.5	21.0
408.2	900	9.6	21.2	10.4	23.0
453.6	1,000	10.3	22.8	11.2	24.8
499.0	1,100	11.1	24.5	12.1	26.6
544.3	1,200	11.9	26.2	12.9	28.5

Solution:
As a general principle a ewe can eat an equivalent 3.5% of her body weight in ration dry matter, but will only eat about 2% as hay. (See Table 10).

Thus, a 45.5 kg (150 lb) ewe eats 1.36 kg (3 lb) of hay per day on an as fed basis.

Table 8 (Energy Value Table) shows that slough grass (native grass) contains 2.02 Mcal of Digestive Energy (DE) per kilogram.

Thus, hay supplies 1.36 kg (3 lb) x 2.02 Mcal. = 2.75 Mcal DE per day.

Table 5 (Daily Nutrient Requirements) shows that a 70 kg (150 lb) ewe in late gestation or nursing twins requires 5.37 Mcal of digestible energy per day.

Thus, 5.37 - 2.75 = 2.62 Mcal has to be supplied by barley.

Table 8 (Energy Value Table) shows that barley grain contains 3.37 Mcal DE/kg.

Thus, $\frac{2.62 \text{ Mcal}}{3.37 \text{ Mcal}} \times 1 \text{ kg} = 0.78 \text{ kg}$ of barley is required.

Thus, we feed these ewes: 1.36 kg of slough hay
0.78 kg of barley.

How about protein content of this ration?

The laboratory report shows that:
Barley contains 10.6% protein and hays 7.7%.
Thus, 1.36 kg of hay contains 1.36 x 7.7/100 = 0.10 kg of protein
0.78 kg of barley contains 0.78 x 10.6/100 = 0.08 kg of protein
Thus, a ewe will consume 0.18 kg of protein or180 g of protein per day.

Table 7 shows that ewes in late gestation weighing 70 kg require 195 g of protein per day. Thus, they need 15 g protein more.

We can provide this by feeding more barley, namely
15 g/10.5% x 100 = 0.14 kg barley OR we can add canola meal
Canola Meal = 36% protein (See Table 6) namely
15/36% x 100 = 41.7 g of canola meal/day/ewe.

How about calcium and phosphorus?

Again, the laboratory report shows that:
our hay contains 0.42% calcium 0.13% phosphorus
and our barley contains 0.04% calcium 0.34% phosphorus

Thus:

1.36 kg hay x 0.42% = 5.7 g Ca and 1.36 kg x 0.13% = 1.8 g P
0.78 kg barley x 0.04% = 0.31 g Ca and 0.78 x 0.34% = 2.7 g P

Total: The ewes each day consume 6 g Ca and 4.5 g P

Table 5 (Daily Nutrient Requirements) states that these ewes need 4.5 g Ca and 4.3 g P. Thus, this ration should be quite adequate for calcium and phosphorus. Nevertheless, a 1:1 mineral mix should be provided as a safeguard.

Example 2

The ewes have lambed successfully and we now have every ewe suckling 2 lambs on the average. Again, we wish to use slough hay, (our field is just a slough) and barley.

How much of each do we feed now, since they are supporting twins:

Calculations:

The ewes eat 1.36 kg of hay (2% of body weight). Energy requirements are calculated as under example 1. We require 8.01 Mcal DE per day (Table 7 - Daily Nutrient Requirements).

1.36 kg of hay supplies 1.36 x 2.02 = 2.75 Mcal DE.

Thus, we need 1.56 kg of barley $\frac{8.01 - 2.75}{3.37}$

How about protein?

Protein provided by 1.36 kg of hay and 1.56 kg barley is 1.36 x 7.7/100 + 1.56 x 10.6/100 = 0.27 kg protein or 270 g of protein

Table 7 (Daily Nutrient Requirements) suggests that lactating ewes in this group need 322 g of protein per day. Thus, there is a deficit of 322 - 270 = 52 g protein.

Canola meal containing 36% protein is used.
We need 52/36 x 100 ≈ 144 g of canola meal

Our final ration per ewe per day will be:

1.36 kg hay
1.56 kg barley
and
0.15 kg canola meal

How about calcium and phosphorus?

Calculations are similar to those in example 1.

Briefly:

1.36 kg hay	= 5.72 g Ca	and	1.77 g P
1.56 kg barley	= 0.62 g Ca	and	5.30 P
0.15 kg canola meal	= 1.32 g Ca	and	2.07 g P
TOTAL	7.66 g		9.14 g

Thus, total daily intake is 7.66 g Ca and 9.14 g of P.

Table 5, (Daily Nutrient Requirements) suggests that lactating ewes should get 13.4 g of Ca and 9.5 g of P.

Thus, this ration is deficient by:
9.5 - 9.15 = .35 g phosphorus and 13.4 - 7.66 = 5.7 g calcium

If we choose a 16-8 mineral (see Table 8) we need a daily intake of 5.7/17 x 100 = 35 g of mix/day, to meet the calcium requirements of 5.7 g/day.

35 g of 16-8 mix will provide a ewe with 35 g x 8= 2.8 g of phosphorus/day.

PREDATOR DAMAGE CONTROL

Alberta Agriculture established a coyote control program over 30 years ago aimed at reducing loss and damage to the livestock and poultry industries in Alberta.

Every municipality (M.D., I.D., and County) has been accepted and approved for the provincial and coyote control program. Also every municipality has a pest control officer, appointed, trained and equipped with the materials, devices and methods recognized as acceptable and effective for coyote damage control.

Municipal agricultural field personnel investigate, assess and establish control measures upon receipt of a complaint. However, heavy workloads and extra difficult predation cases cannot be handled by fieldmen, so regional Alberta Agriculture predator specialists are requested by field staff to look after these situations. Owing to the vast areas serviced by predator specialists, their services may only be requested by agricultural field staff to handle special cases.

In addition to the tools of both agricultural field staff and predator specialists, Alberta Agriculture and the Fish and Wildlife Division work cooperatively where either department will respond to the request of another to provide either immediate assistance or combined extra assistance where required.

Alberta Agriculture provides compensation to poultry and livestock producers where direct or indirect predation damage occurs and is confirmed by an investigating officer as being caused by a predator (including dogs).

Compensation for such confirmed damage and loss must meet with established eligibility requirements before compensation is paid out. The Livestock Disaster Indemnity Program (LDIP) is considered a stop-gap measure designed to replace livestock and poultry damaged or lost through predation and is regarded as an extra tool to reduce predation damage.

Following is a brief procedure of Alberta Agriculture's policy of coyote damage control.

Responsibility:
The onus of responsibility to control predation damage is on the producer. It is also his/her responsibility to secure outside assistance, materials and devices where necessary.

- The first level of assistance the producer should secure is that of the local agricultural fieldman who may provide the necessary action over the telephone or through investigating the situation. The agriculture fieldman may set out or issue materials and devices or recommend alterations or improvements in management (such as curfewing sheep or improving fences, etc. to aid in reducing damage).

- The local Fish and Wildlife office may also provide assistance in abating predation activity. In the absence of the agricultural fieldman, the complainant should contact the local Fish and Wildlife officer to provide technical control assistance.

- Listed below are recognized officials who may be contacted regarding investigations, assessments and verification of evidence for compensation under the Livestock Disaster Indemnity Program. These officers include:

  - district agriculturists
  - Fish and Wildlife officers
  - agricultural fieldmen
  - veterinarians
  - R. C. M. P.
  - predator specialists

- Predator Specialists are specialists in the field of predator damage control. Their functions are diverse and variable. They provide on-the-spot instruction to producers during training sessions sponsored by Alberta Agriculture and local municipalities. They also provide on-the-scene training for producers suffering damage from predation. Their assistance shall only be solicited by the agricultural field staff.

Upon request by the municipal field staff, predator specialists shall undertake control work after payment of a nominal retainer fee ($5 - $15) for each case investigated. Work conducted by predator specialists should significantly reduce damage. The specialist will provide assistance until he/she is satisfied the case is solved.

BASIC TECHNIQUES OF PREDATOR DAMAGE CONTROL

Livestock Management Practices

The four main problems of livestock production that cause severe predator problems are:

- poor feed
- poorly constructed fences
- poor or mismanaged pastures, and
- poor disposal of dead livestock.

When young lambs are turned out in the pasture with ewes, the ewes are often in a weak and undernourished state, leaving both the lambs and the ewes vulnerable to predation. The ewes are weakened by the rigors of lambing, consuming poor feed and from feeding several lambs.

Some sheep producers do not feed their sheep properly. They often give other livestock the best quality of feed while the sheep get second or lower grades. To ensure that the sheep survive when put out on pasture, this method of raising sheep must change. These producers should also consider the inhumaneness of treating sheep in this manner. Under The Cruelty to Animals Act, this practice may be punishable by law.

Fencing can be very important in preventing predation from occurring simply by preventing predators from gaining access to livestock. One of the first questions asked to learn the type of predator involved in an incident is how it gained access to the area. How did the animal arrive; where did it enter? A good page wire fence, properly constructed with barb wire above the page wire, would keep out most predatory animals with the exception of birds. This type of fence will assist by:

- keeping the predators out
- helping identify any predators that do penetrate it (by leaving hair on the fence and digging under it)
- making trapping or snaring relatively easy at the access point.

Pasture management may eliminate or reduce predatory problems by keeping the sheep from areas where predation may most likely occur. This may encompass areas such as heavy brush, areas near creek beds, bottoms of coulees and patches of brush, etc. Perhaps the curfewing of livestock may eliminate predatory problems. This is done by turning lambs out in the morning and bringing them home in the evening for protection when predatory animals are out foraging.

It is extremely important that livestock are large enough to defend themselves, to escape, or to endure some predatory stress before being turned onto the pasture. Very young animals are lost because of this one factor.

It has been found that the amount of time spent with livestock has a direct correlation with the amount of predation that those livestock sustain. The more time a farmer spends inspecting his livestock, the less problem he tends to have. Livestock producers seeking outside employment tend to neglect livestock, and do so at great risk of predation. Whether it is coincidental or whether the predator seems to sense the absence of man, it is certainly known that those who do spend time with their livestock suffer far fewer losses than those who do not.

Improper disposal of dead animals is a contributing factor to increased predation. Livestock as carrion provide predators with a guaranteed year-round food supply. When this carrion is too badly decomposed or gone, predators simply turn to live animals. All dead livestock should be disposed of so that very limited food is available from early fall to late spring. Dispose of carrion in the following way:

- have carcasses removed to rendering plants
- bury or burn carcasses
- render carcasses inedible as carrion with applications of discarded fuel and machine oil.

This type of pasture management cannot be overemphasized because of the serious problems its neglect causes in predator damage control as well as disease control. Deteriorating carcasses are a menace to livestock production as they are a harbor for diseases and parasites as well as attractants for predators and other pest animals.

Under The Livestock Disease Act, it is **unlawful** to dispose of dead livestock without the above mentioned treatment and management.

Repellents

The inclination to attack and kill domestic animals may possibly be removed by the use of repellents or mechanical repellent devices. Repellent devices function on the principle that the strong odor of the device overcomes the desire of the animal to attack livestock. As it relates the strong odor with the food supply, the would-be killer simply loses interest in pursuing such food. Subsequent experiences will totally convert a would-be killer to a 'safe' predator.

The neck collar repellent device, in principle, functions during the phase between attack and kill, thus either repelling the predator with an aversive agent, or destroying the predator outright with a toxic material placed in the neck collar.

Other types of repellents are scarecrows and chemicals. Commercially produced insecticides, i.e. nicotine sulfate (Blackleaf 40), placed on pasture fence posts seem to reduce coyote attacks on sheep and lambs. Whether this insecticide really acts as a repellent or whether it is a coincidence that predators have not returned once this material was utilized is not known. Mothballs are not considered an effective predator repellent.

More useful repellent devices have been tried and most of them are fairly successful. One of these is a simple scarecrow placed in the field where livestock are suffering predation. Scarecrows are best utilized along with other techniques e.g. moving scarecrows frequently throughout the pasture. Scarecrows should never be left for more than three or four days in one spot. By rotating scarecrows, predators take a longer time to adjust to their presence.

Den Hunting

One of the most effective nonlethal techniques of predator control is the removal of the source of the problem. At the time that young lambs are turned out with their mothers in April and early May, coyote bitches are whelping and nursing litters of pups. Breeding time for coyotes in Alberta varies from the first part of February to the middle of March. Pups are born approximately 63 days later. It is at this time and for the next eight to twelve weeks that female coyotes have a great demand for food and water. It is felt that a female coyote without pups would **not** normally be involved in livestock predation activities as would a female coyote with a litter of pups.

The results of den hunting are satisfactory, the only basic requirement, other than a few tools, is a little hard work. Successful den removal requires time and work in searching, exploring and physically removing coyote pups. However, successful removal of six to eight potential killers at one time is worth six to eight times the effort of destroying just one of these predators. The following is a concise outline describing the various steps to successful den removal. The menace of coyotes should never be underestimated and a small error on the den hunter's part could mean the difference between trouble-free livestock production and the survival of an entire coyote family with continued livestock loss.

The average coyote den is perhaps 2.5 - 3.0 m (8-10 feet) in length. In the northern part of the province or in forest areas, dens prepared by coyotes are usually shallow, with the nesting part of the den being less than a metre from the surface of the ground. The soil is usually moist, making it very easy to dig out the pups from the den. In forested areas, coyotes utilize abandoned homes of other animals such as bear and wolf. Coyotes also prefer the soft soil and isolation that abandoned beaver homes and dams provide.

Where predation has occurred, the coyote den is generally within one kilometre of the killing site, and within 180 to 360 m of a water source. This is very important because water in the south is scarce whereas water in the north is not. The coyote den generally consists of one entrance, a runway and the nest.

Equipment necessary for den hunting:
- two people each with a good, sharp spade
- a good flashlight (sealed beam type)
- shotgun (with #5 or #6 shot)
- a heavy, sharp-pointed probing bar about 2 m (8 ft) in length
- a barbed wire probe
- a gassing hose.

Three steps to successful den hunting:
- locating dens
- determining current coyote occupancy
- removal and follow-up.

Locating dens should be done from mid-April to mid-June; not earlier as bitches will not be whelping yet. After June or July, pups and adults may have abandoned their den. The best time of day is early in the morning after the bitch has returned from her short hunt, about 2-4 hours after sunrise. Generally speaking, den locating should be conducted near predation (1-8 km but generally within 3-4 km). Dens should be close to water, not further than 1 km; usually on southern exposures of hills. In flat prairie areas, coyotes may utilize old irrigation canals, eroded hillsides, or old holes dug out near patches of buck-brush and native prairie grasses. In the south (Calgary-South) available water supplies are **vital** especially during early spring.

Coyotes may assist den hunters in locating dens. Farmers may have noted coyotes moving in a particular direction, or heading into particular brush cover at different times of the day. This may indicate they were generally heading towards their den. If the den hunter approaches a den too closely, the female coyote may be flushed out and in doing so, will head directly away from the den. A helpful assistant in den hunting is a frisky yappy dog or hound that will invariably bring the bitch out of the den. If the dog approaches too closely (within half a kilometre of a den) the bitch may chase the dog away.

Closer to the den, hunters may see many trails and fresh tracks indicating the close proximity of the den. They may also see bones, feathers, wool, droppings, flattened grass, etc.

When the pups are old enough to leave the den, they spend most of their time playing in the grass; a sure conclusion of an active coyote den is the small patches of flattened grass (usually a diameter of 2-3 m) next to the den.

NOTE: Once active coyote dens have been located, they should not be left unattended. Placing a jacket or spade over the den may prevent coyotes from escaping if the hunters must leave for some reason.

Determining the current coyote occupation - upon approaching the den, even if it is not seen, the hunter may suspect the presence of coyotes occupying the den by the number of fresh and recent food remains, trampled grass, and fresh coyote spoor and droppings. If the den is located in dense bush with heavy undercover, this evidence may not be obvious, except near the immediate den entrance.

When the den has been discovered, the spade and flashlight will assist in determining occupancy. Digging away the top or uphill portion of the entrance, and making sure none of the soil falls into the den, the hunter may extend himself a few feet inside the den. Using the flashlight and crawling into the den entrance, the hunter may look as far as the light will cast. This may require clipping off a few curves inside the runway with the spade to eliminate shadows and give further projection of light. Inside the active den there should be droppings, feathers, etc. and, of course, the nest of pups (and occasionally an adult or two). Sometimes the very young pups may be heard squealing and crying in the nest, however, older pups three weeks and older will not make any noise at all. In such situations, a hound is very useful in indicating presence of coyote pups.

Extraction and removal - immediately after the coyotes have been found in the den, care should be taken to fill in all holes **near** the main entrance, irrespective of their size and depth. This may prevent adults or wandering pups from escaping by these possible exits.

There are many ways of removing pups (and adults) from dens:

— digging - where possible, removing soil from the den runway and gathering the pups.

— if pups cannot be reached by digging, a simple extracting device, the probing wire, may be used. This wire consists of a 6-9 m (20 to 30 ft) length of barbed wire, doubled back and wound around itself for rigidity, and then attached to a sturdy wooden handle 30 cm (12 in.) in length. The wire is operated like a plumber's key by inserting it in the den runway and constantly rotating it (to assist its movement down the runway) until it reaches the end of the den or strikes an occupant. The wire should be withdrawn the same way with constant rotation.

— gassing with carbon monoxide or sulfur dioxide gas cartridges will destroy pups in the den if no other means of extraction is feasible. The carefully placed rubber gassing hose (with all extra den holes plugged and a good sealer on the hose in the entrance) will destroy coyotes. The vehicle to which the gassing hose is attached should be allowed to run for at least one hour. Be cautious of carbon monoxide fumes if you enter the den.

After removal and follow-up work are completed, all holes and diggings should be filled in with soil to preserve the terrain and prevent accidental mishaps with livestock, vehicles and people.

Shooting

Almost every farm has a firearm on the premises. Farmers, however, usually do not consider themselves good marksmen, and therefore miss out on a very useful, economical and effective control technique. A properly sighted firearm can be a convenient and easy-to-use device in controlling predation.

Various techniques make shooting predators easier. Preparedness is probably the most important and one that most livestock producers seem to overlook. A prepared gun is one that has been properly sighted in the distance of 90 m (100 yards) in bush country or 180 m (200 yards) for prairie and can consistently hit a target 7.5 cm (3 in.) in diameter at that distance. If the firearm is carried in a vehicle or on a tractor, it may eliminate any animal that is a current or potential killer. Firearms can be either sighted in upon consulting a local sporting goods firearm manager, or consulting a friend who has experience in sighting in such rifles. It is not a very difficult technique and certainly a profitable one. Practising aiming several items daily will soon make one proficient with a firearm.

Hunting using a vehicle has proven very effective in eliminating coyotes. The vehicle is used to get close enough to the coyote to shoot it. Once the rifle has been properly sighted, the trick is to get a well-aimed shot at the coyote. Two occupants can get most of the coyotes encountered while driving along the road or through fields by simply:

— not allowing the coyote to see an occupant slip out of the vehicle,

— letting the coyote think the vehicle did not stop. Predators will watch a vehicle pass and as soon as a vehicle stops, they focus right in to see what action is taking place at the vehicle. Some don't even wait to look at the stopped vehicle - they move out as soon as they see the vehicle stop. By slowing down and allowing the hunter to slip out the far side while the vehicle is still moving, the coyote will not see the hunter as he is always watching the vehicle. This is

when the hunter can shoot the animal. It is simply a matter of good marksmanship. If the hunter is alone in the vehicle, the only other chance of getting a shot at the coyote is to continue driving down the road, park some distance away where the coyote cannot see the vehicle or the hunter, and return by foot under shelter of a ditch or brush. Do not overlook the use of a sling to steady your aim. A small tripod rest may also be very useful. The prone or sitting positions are much steadier for aiming than is standing.

A call may also be used in this situation where the caller will go into the brush some 90-180 m (100-200 yards) from where the coyote is located. In a situation like this, it is best to wait five to ten minutes before commencing to call. This will allow the coyote time to calm down or to let it believe that the vehicle has gone and there is no danger. Proper instruction should be obtained before using a call.

Dogs

A very selective technique for controlling predatory animals is the use of hounds and dogs. Although not commonly used, dogs can be very effective in immediate problem-solving.

The cost of maintaining dogs does not warrant their widespread use. Only a few producers who have large flocks and large losses do have hounds for this purpose. Hounds pursue by sight and are thus useful only in open country.

Dogs can be used in a variety of ways:

- Directly hunting, pursuing and capturing coyotes. The dogs required are of two types:
  - a large, killer type hound, usually of a height from 80 - 86 cm (32-34 in.) at the shoulder and usually 36-45 kg (80-100 lb) generally greyhound or wolfhound breeds.
  - a catcher or trip dog. This dog is usually of greyhound size that throws or trips a coyote so the hunter may humanely destroy it, or have the hounds destroy the coyote.
- Dogs can be used for tracking coyotes. This requires that the producer turn out a tracking dog to the area where a fresh kill has been discovered. The dog will trail the predator until it may be apprehended. The tracking dog does not hunt or destroy the animal, it simply leads the hunter to it. This technique has worked many times. This type of hound is usually a Black and Tan, Bluetick, Red Bone or crosses of these breeds.
- Other breeds of dog can be used in den hunting as previously discussed. Some breeds also serve as sheep-dogs and guard dogs. Collies and German Shepherds are large enough to handle coyotes and warn the producer by barking when predators sneak in.

Traps and Snares

Many producers avoid using a method of controlling predators that has proved to be very successful, selective and rewarding.

Trapping is considered by most farmers to be a special art or skill. This is false. With some practice, proper trapping fundamentals and correct equipment, almost anyone can trap a predatory animal whether it be a wild dog, coyote, fox or wolf.

Scents and baits are required to successfully prevent a coyote from identifying the trapper and to stimulate him to investigate the area. If baits and scents are placed near the trap, his curiosity will get him trapped while inspecting these foreign and interesting odors. These sets are basic and used for preventive or current predator problems. Winter trapping also yields income from fur pelts.

Almost everyone knows where predators are located in a general area. Upon inspecting these areas, more knowledge may be gained; locating the number and species of predators as well as general travelling habits. Coyotes are usually seen around the edges of small sloughs or next to bush or in cultivated areas next to bush. Closer inspection of these areas will show tracks. In the winter, many tracks will be seen throughout the travelling areas of predators, thus making location easier.

Simple trap sets may be placed where a coyote has been known to travel - near a fence line, a haystack, along edges of harvested fields, or near rock piles, where these predators leave their scent and mark out their territories.

In trapping, follow-up work is very important. After traps have been set, inspection must be made early every morning to see if a predator has been trapped and, if so, to destroy and remove the animal quickly and humanely.

A coyote that has been trapped by one or two toes may soon free himself. A crippled coyote is a more serious nuisance than a healthy one. It is important that such animals be destroyed as quickly as possible.

After traps have been used for a period of time (i.e. three to four months) they should be descented by placing them in a manure pile. In wooded areas, place them in a spruce bough fire allowing the entire trap to become totally blackened with the resins and the smoke from the

fire. In areas of the province where spruce is not found, other local green brush may be used such as sagebrush, buckbrush, etc.

The conibear trap, a very humane trap in the hands of an experienced trapper, may take coyotes or fox. But, because of the size of the conibear trap and the metal exposure, coyotes tend to avoid entering such devices. Conibear traps may be used on smaller predatory animals such as weasels and mink and large rodents that are causing problems to livestock. In some cases, wild dogs that are creating predatory problems may be taken with conibear traps. It is felt the conibear trap really has very little use in the control of coyotes or wolves.

The use of a legal foot snare is a socially acceptable device in that it causes no pain or disturbance to the animal. The legal foot snare is used in bear control programs in the province but it is unlawful for anyone to use this snare other than authorized government personnel.

Humane foot snares have been designed for coyotes, but to date have not proven successful.

Neck snaring also involves the same fundamentals of location as trapping. The basic difference is that snaring does not involve any attractant. More important, there should be nothing to cause predatory animals to investigate a set where a snare has been located. Snaring does require definite pathways or specific areas where predators are passing. The snare is designed to lock up and tighten very quickly around the throat of the predator. Most predators usually die within a few minutes. Thus, snaring is a humane way to destroy a predator.

Locating travel routes of predators is not difficult in cultivated areas where predation occurs. For instance, it is easy to find where predators have passed under a fence as they leave hair on the wire. In page wire, they might make a hole in the fence or burrow under the wire. These are ideal snaring locations where the anchoring of the snare can be provided by the actual page wire or fence wire itself. Because of danger to other species, snares may be used only under authority of a Damage Permit which may be obtained through Fish and Wildlife officers. Snares must be removed when their period of use is past.

Cyanide Guns

Humane coyote getters and M-44s are set in very similar fashions. They are to be used in the same situations as the principles of both devices are almost identical. The M-44 principle is noiseless, where the coyote getter makes a loud report. The M-44 is a spring loaded device, whereas the cyanide gun expels the cyanide powder by means of a shot from a pistol cartridge. Owing to the silence and the short distance the cyanide powder is driven, the M-44 has gained acceptance as a safer, more effective device than the coyote getter.

When the coyote getter is placed and handled correctly, it can be very effective. To help understand the different ways to use this equipment, the following sets will give some basic idea of how coyote getters and M-44s may be used.

Trail Sets: The trail set is most commonly used. It is easy, quick to set and very convenient to check and maintain. Coyote getters may be placed along trails or along fence lines where coyotes have been known to travel. When making the set, be sure to eliminate human scent as much as possible. Place the coyote scent directly on the cartridge and put some on a post next to the getter. If there are livestock in the field, place three 15-20 cm (6-8 in.) rocks around the getter. This will prevent livestock from stepping on the getter and from actually pulling it.

In placing getters, it is important that they be placed at least 30 cm (1 ft) from the fence. This will allow the coyote passing under the fence enough distance to properly approach the getter and successfully fire the mechanism.

Kill Site Sets: If a carcass has been found killed by predators the previous night, a cyanide gun may be set either right into the carcass or close to it. In placing getters near the carcass, they will attract predators. To discourage birds from scavenging and possibly setting off the cyanide guns, the bait may be buried. The getter may also be covered with a light layer of chicken or sheep manure.

These are a few of many techniques possible with coyote getters. As with other methods, part of the success lies with the versatility and adaptability of the user. Sets should be **modified** and **changed** frequently to avoid bait shyness in coyotes.

It is important to ensure that these devices are set to select for coyotes and not present a hazard to nontarget species. All getters should be marked by some identification in the field. Along fences and heavy brush, cloth flagging should be used to identify getters. Flagging

may also assist in attracting predators long distances if scent is applied directly on it. In open areas, a small stake or well known landmark and the distance from it may also be used to identify the cyanide gun. Warning posters should be used for all poison sets. The coyote getter set and location data booklet should also be used to record coyote getter sets. These are available, along with warning posters, cyanide guns, shells and scent, from municipal pest control officers.

Strychnine Sets

Strychnine cubes - the fundamentals involved in the use of strychnine poison are very important. In order to prevent any secondary poisoning or any nontarget species poisoning, the proper placement of strychnine cubes into bait is very important. To prevent nontarget species from eating near where the cube is inserted, and to render the carcass as natural looking as possible, care must be exercised. A knife wound or large opening may make the coyote suspicious, creating bait shyness. A large knife wound or large opening may also encourage feeding by small rodents and scavenger birds. Therefore, insert strychnine under a large leg or on the underside of a smaller carcass using small slits to insert. Strychnine cubes used in freshly killed carcasses are very effective in destroying the predators involved. Predatory animals tend to return to carcasses to feed a second and third time.

Prepared baits - The 54 per cent strychnine cubes available from municipal pest control officers may be placed in other food sources of predators such as chicken heads and parts, rabbits, ground squirrels, hamburger, raw eggs, dog food, table scraps, etc. **ONE** cube is designed to kill one coyote.

A chicken head with a hole punched in it with a screw driver and a cube placed firmly in the middle and closed, or the cube placed in the mouth of the chicken provides a very effective bait for coyotes.

The same procedure may be used for a variety of other baits such as rabbits, ground squirrels, fish heads, etc. Imagination and creative thinking are an important part of predator control. If one thinks like a predator and conducts control work in this fashion, positive results should be obtained. It is not always the hard and fast rules of behavior that capture an animal; it's when he is really not "thinking" and when he is off-guard that he is most readily taken. Such baits as discarded scraps from the table also work. Coyotes have been taken with cold porridge treated with strychnine cubes - porridge certainly is not one of the basic foods of a coyote!

Strychnine cubes should be stored in the safety Palm 'n Turn vials with the clearly displayed poison label and its antidote on the container. Poison warning posters should also accompany the supply of strychnine cubes and these should be stored with the cubes in a proper locked facility.

The prepared beef tallow strychnine baits available from municipal pest control officers may be used in the immediate area of a kill or may be set in the same fashion as other prepared baits. With predation-killed carcasses, the tallow baits should be expelled from their paper containers 9-15 m (30 to 50 ft) from the carcass, generally in the direction the coyotes were known to come from. When the predator returns to feed (or kill again), he may pick up these baits along the way. Six prepared baits should be sufficient for each carcass. Scents such as blood or intestinal fluids or coyote scent may be placed on these baits to make them more attractive.

In the warm months, these baits may be buried with chicken manure or placed in a shady area and covered with dry leaves or grass.

One excellent winter set with beef tallow baits is to pour a little blood on each of a dozen baits and allow them to freeze. With snowshoes, a horse, or a vehicle, go into the fields or brush where predators are known to travel and locate their tracks. Drop a bait on the coyote trail and step on it to drive it down into the snow. One or two baits should be used every half kilometre.

With snowmobiles, simply make a trail around the entire edge of the field and place a pellet in front of the machine when a predator trail is encountered. The baits are driven into the snow without the operator getting off the machine. Baits should be placed no closer than 440 m (400 yd) apart. There are exceptions where unusually high activity may require more baits to be placed at shorter intervals.

FLOCK HEALTH

Introduction

The cost of disease can be expressed in terms of death losses, loss of production because of sick or injured sheep, drug expenses, and loss of income from condemnations. Since many farms and ranches are affected by disease in one way or another at certain times of the year, the total annual cost of disease to the sheep industry is significant.

Disease may be due to infectious organisms, parasites, stress conditions, poor nutrition and general management shortcomings. Death losses, feverish illness, slow deterioration of body condition, poor reproductive and growth performance, or simply the inability of the owner to realize a profit at the end of the year when a profit could reasonably have been expected, these all can be caused by disease.

An illness can be treated as it comes along, or it may be prevented by various means. Treatment of disease is sometimes essential and quite rewarding. However, most sheep ailments are difficult if not impossible to treat successfully. Treating disease is time consuming, costly and often frustrating because many sheep fail to respond favorably to treatment.

Prevention is the key to success as far as disease management is concerned. A normally functioning healthy sheep can usually be kept healthy and productive with well balanced rations in a reasonably comfortable stress-free environment by a knowledgeable conscientious producer, thoroughly familiar with the principles of disease prevention.

However, unexpected events can throw even the best-managed operation into a state of calamity. There can be sudden changes in temperature, weather or managerial accidents. Such factors can cause stress. Severely stressed sheep may become susceptible to illness by virtue of the fact their resistance decreases. Their defence mechanism breaks down, causing a myriad of disease-causing agents to successfully invade the body. Close attention to the details of sheep management will enable one to deal decisively with disease as soon as it is detected. An accurate diagnosis is essential for proper treatment, and should be obtained as quickly as possible after a problem is discovered.

Practising veterinarians with an interest in sheep are uniquely qualified in helping sheep producers with their sheep disease management problems.

Veterinary pathologists (veterinarians specialized in post-mortem examinations on animals) are available for consultation at any one of the four provincial veterinary laboratories in Alberta.

Field veterinarians employed by Alberta Agriculture are available to assist local practising veterinarians with field investigations into the causes of livestock disease.

Provincial Government Programs

Only programs involving the veterinary aspects of the sheep industry are outlined here.

Diagnostic Laboratories

There are four diagnostic veterinary laboratories operated by the Alberta government. Listed as follows they are:

Provincial Veterinary Laboratory
O.S. Longman Building
6909-116 Street
Edmonton, Alberta
Phone: 436-8904

Regional Veterinary Laboratory
Fairview, Alberta
(Located next to the Fairview
Agriculture College)
Phone: 835-2238

Regional Veterinary Laboratory
Airdrie, Alberta
(Located in the Provincial
Building just south of the
overpass at Airdrie)
Phone: 948-5101

Regional Veterinary Laboratory
3115-5th Avenue, North
Lethbridge, Alberta
Phone: 329-5190

The function of the diagnostic laboratory is to assist field veterinarians in the diagnosis of diseases. In addition, the laboratory could be used for disease monitoring. For instance, the occasional culled animal could be submitted to attempt to keep an eye on slowly progressing diseases such as Johne's disease, maedi, caseous lymphadenitis or intestinal worm infestations. Constant monitoring for disease tends to keep the flock healthier.

The laboratories will accept any animal specimen or portion of an animal. The ideal specimen is a whole,

freshly dead animal or fetus, or one sick or moribund (almost dead). Sheep producers may submit samples to the laboratories themselves. It is much preferred if specimens are submitted through the private practitioner who has an understanding of the pattern of disease and management on the farm. More meaningful results are obtained this way. There is no charge for the diagnostic services provided by the laboratory.

The Animal Health Division is also responsible for the toxicology laboratory which is equipped to examine certain specimens for the presence of poisonous substances. Water samples can be tested as to suitability for livestock consumption.

Field Services

Communicable Diseases

By authority of The Livestock Diseases Act of Alberta, certain disease control programs are operated by the Animal Health Division. Regulations are in effect to control and prevent the spread of foot rot in sheep. Other disease control programs may be instituted as circumstances warrant.

Livestock Inspection

The Animal Health Division takes responsibility for the inspection of all livestock passing through auction markets in the province. The inspection is actually conducted by veterinary practitioners hired and paid for by the department. The purpose of the inspection is to try to prevent the spread of diseases through auction markets. All animals are visually examined for evidence of contagious diseases which could endanger the herd of the purchaser. Rejected animals may be sold for immediate slaughter or returned to the farm of origin. About one and one-half million animals per year are inspected in auction markets.

Inspection is also conducted at provincial grazing reserves and other community pastures as cattle and sheep are entered. The inspection here is to prevent the entry of contagious diseases that might endanger the health of other animals on the pastures.

Livestock Medicine

Over 400 livestock medicine outlets are licensed by the division. These are generally situated in general stores, feed mills, etc., but do not include pharmacies or veterinary clinics. The premises are inspected to make sure that drugs are handled properly so that the livestock producer can be certain that any purchases he makes from such an outlet will be drugs of good quality and full potency.

Disease Investigation

Veterinarians with the provincial government frequently get called to assist with disease investigations usually at the request of private practitioners. These veterinarians are not expected to treat sick animals on an individual basis; they only investigate problems on a flock or herd basis.

Meat Inspection

A program of meat inspection at smaller abattoirs not currently inspected by the federal authorities is in effect. Meat from these abattoirs is stamped "Alberta Approved". Inspection is done by trained lay inspectors with a veterinarian as backup authority.

On the following pages an attempt will be made to outline as completely and concisely as possible certain steps and procedures sheep producers can employ to reduce the cost of disease in their flocks.

Facilities for Sheep

Facilities are important from a disease prevention point of view.

Good Housing Facilties

- Space requirements
- ewes need 1.0-1.4 m^2 (10-14 ft^2)
- ewes and lambs need 1.2-1.6 m^2 (12-16 ft^2)
- mothering pens need 1.7 m^2 (17 ft^2)
- fattening lambs need 0.8-1.4 m^2 (8-10 ft^2)
- exercise, at least four times housing area
- protection from wind, rain, and snow
- good roof and walls preferably insulated for intensive confinement rearing or lambing in winter
- good ventilation, to prevent build-up of foul air, heat and moisture
- draft free conditions for young lambs
- adequate facilities for person looking after sheep, especially during lambing
- have refrigerator handy for drug storage.

Corrals or Yards

- adequate number of holding pens for quarantine
- good runs, chutes, handling equipment for treatment or vaccination
- design equipment to allow for minimum of stress on sheep during handling operations
- provide good drainage from buildings and corrals, to prevent build-up of disease, which thrive in poorly drained soil
- provide easy access to tractor for manure removal.

Clean Water Supply

- locate waterers in such a way that no manure

contamination of water occurs (parasites, coccidiosis)
- have concrete pad or really good drainage around watering troughs to prevent foot infections and coccidiosis
- pay attention to water quality (nitrates, copper sulfates, total solids, freezing in winter, spoiling in summer)
- provide for in-line water medication especially for feedlot lambs (shipping fever treatment, coccidiosis treatments).

Feeding Facilities
- prevent fecal contamination of feed
- allow for easy cleaning of bunks
- fence line feeders, feed racks, self feeders tend to prevent disease as well as reduce feed costs
- allow adequate feeder space, to avoid starvation due to "pecking order"
- feed troughs - 38 cm (15 in.) per ewe
  - 30 cm (12 in.) per lamb
  self feeder - 8 cm (3 lineal in.) per lamb
  hay bunks - 15 cm (6 in.) per ewe and lamb.

Feed Quality and Nutrition
- supplement of available home grown feeds with extra energy, protein, minerals, vitamins, as determined by feed analysis
- good nutrition
  - prevents starvation
  - prevents nutritional deficiency diseases, e.g., pregnancy disease, abortions, milk fever, white muscle disease, and vitamin deficiencies
  - promotes healthy lambing and lactation
  - produces thrifty, healthy, creep fed lambs
  - provides for sound reproduction, fertility.

Manure Removal
- prevents build-up of disease
- have storage area away from buildings and corrals to prevent run-off into water and feed supplies.

Disposal of Dead Animals and Aborted Fetuses
- have a pit for burning
- bury and cover with lime
- prevent dogs from eating and dragging dead sheep and aborted fetuses all over the farm (can spread black leg, enzootic abortion, vibrionic abortion)
- prevent run-off from dead animal area.

Purchasing Breeding Stock

How to Buy Healthy Breeding Stock

Buy from a reputable breeder only for good quality and genetically proven stock.
- visit farm of such breeder, get an idea of possible disease levels, general management, history of foot problems, etc.
- watch carefully for crippled sheep
- examine mouth (sore mouth)
  tongue (actino bacillosis)
  jaw (lumpy jaw)
  lymph nodes (caseous lymphadenitis)
  teeth (age and soundness)
  udder (mastitis, lumps)
  testicles (size, hardness) brucellosis!
- look and listen carefully while watching the flock
  excessive coughing, (lung worms, shipping fever, chronic pneumonia, maedi)
  hard breathing after exercise (same as above)
- general body condition, any flesh under wool? Count ribs? (parasites, malnutrion)
- wool quality (keds, lice, skin infection, malnutrition)
- blood tests, (brucellosis, blue tongue) (for export to U.S. and Mexico)
- liens, financial encumbrances against sheep? (stomach ulcer in buyer)

Transportation
- reduce stress
- avoid overcrowding and trampling
- clean and disinfect vehicles
- feed and water
- avoid extremes in temperature.

Arrival on Buyer's Premises
- inspect and trim all feet if necessary
- run all sheep through a foot bath as outlined under "foot rot"
- vaccinate if desired (see vaccines)
- drench or inject sheep for worms (see deworming section)
- dip or dust for lice or keds
- isolate new sheep and watch carefully for four weeks for development or signs of disease.

Principles of Disease

Causes of Disease

Disease is any adverse deviation from the normal state of health. Usually one or more factors are found to have contributed to disease, hence there normally is at least one way in which disease can be treated and prevented.

Although bacteria and viruses often play a part in causing disease, the environment may be the major cause. The latter will strongly influence the severity of a certain disease condition. Other factors which play a very important role in causing sheep diseases are nutritional deficiencies such as sheer starvation (lack of energy or protein) and shortages of certain vitamins and minerals. Poisonous substances or plants, injuries, dog attacks and metabolic disturbances are other contributing factors.

Under normal farm conditions, a newborn lamb's body may be attacked by a wide variety and very large numbers of viruses, bacteria, fungi and parasites. NEVERTHELESS, the animal may remain healthy, thrifty and do quite well. It is only when the cards are stacked in favor of these invaders that newborn lambs become ill with diseases such as pneumonia, acute scours, navel infections, etc. Some of the cards in this game are poor body condition, poor nutritional status, lack of milk, cold drafty unsanitary lambing facilities, unfavorable weather conditions, and a build-up of certain disease causing microorganisms.

Infectious Disease Agents

Agents	**Examples**
Viruses:	foot and mouth disease, soremouth, blue tongue, rabies, scrapie
Bacteria:	enterotoxemia, pneumonia, foot root, arthritis, navel infections, some abortion diseases
Protozoa:	coccidiosis, sarcosporidiosis
Fungi:	some skin infections, mycotic pneumonia, rumen infections
Parasites:	insects such as keds, mites, lice, flies, bots worms, a variety of types and species

Noninfectious Disease Agents

Poisons:	poisonous plants, lead, arsenic, insecticides, etc.
Photo-sensitivity:	certain plants and the action of sunlight
Metabolic disorders:	milk fever ketosis
Inherited defects:	hydrocephalus, cleft palate

Before treating a disease, a correct diagnosis has to be established.

Diagnosis of Sheep Diseases
- owner can recognize from having seen it previously
- neighbor might recognize it
- local veterinarian, on the basis of examination, history, previous or present management, nutrition, environment, considers differential diagnosis and arrives at tentative diagnosis by deductive reasoning on the basis of his knowledge and experience
- a regional veterinary laboratory will confirm or deny the tentative diagnosis or come up with an entirely different one.

However, laboratory work can only be as good as the history or background information supplied by the owner or veterinarian who submits the specimens to be examined.

Treatment of Sick Sheep
Remove sick animals from apparently healthy ones and keep on the lookout for other sheep becoming ill as well. The incubation period of disease varies. Consider the economics of treating disease in sheep.
- value of animal vs. cost of treatment
- age and sex of the animal
- treatment vs. slaughter vs. destruction
- which drug is best for which disease, lowest cost for optimum results,

Drugs Available for Use in Sheep
(store in refrigerator)

- **Penicillin** - dihydro streptomycin
  to sheep not intended for slaughter during the next 30 days

- **Pencillin G.**
  to sheep not intended for slaughter during the next 5 days and often used for the following conditions:
  - retained afterbirths, difficult births, injured birth canal
  - uterus infections
  - certain hoof infections, but **NOT** for foot rot
  - early navel ill and arthritis
  - infected injuries (bite wounds)
  - after castration or docking
  - certain cases of mastitis (depends on drug sensitivity)

- **Oxytetracycline** injectable
  - intravenously preferred
  - use for pneumonia
    shipping fever
    mastitis
    septicemia
    navel ill

- **Chloramphenicol** injectable
  - colibacillosis (baby lamb diarrhea)
  - mastitis
  - certain other infections as designated by veterinary practitioner

- **Lamb scours medicine**
  - a variety of preparations are available
  - may consist of or contain drugs such as nitrofurazone, sulfa drugs, neomycin, tetracyclines and others

- **Calcium gluconate**
  - milk fever in ewes

- **Propylene glycol**
  - pregnancy toxemia
- **Dexamethazone**
  - to induce lambing (consult with a veterinarian before using this drug)
- **Mastitis tubes**
  - a variety is available. Discuss use and application with a veterinarian
  - ewes with mastitis
  - sheep with early eye infections (pink eye)
- **Rumen stimulant**, injectable or boluses
  - grain overload, frothy bloat, indigestion
- **Vibrio vaccine**
  - given three weeks prior to breeding to prevent vibriosis (abortions) to susceptible replacement stock
- **Foot Rot vaccine**
  - ewes and lambs when going into pasture, as often as required, at ten week intervals
- **Clostridial bacterin or toxoid**
  - to help prevent enterotoxemia (pulpy kidney), blackleg, tetanus
- **Selenium/Vitamin E** injectable solution
  - for white muscle disease, prevention or treatment
- **Pituitrin** (oxytocin)
  - contracts uterus after prolanged lambing, help invert
  - prolapsed uterus after replacement.
- **Vitamin B Complex**
  - occasionally sheep in poor condition need a booster
- **Levamisol** (e.g. Tramisol)
  - injectable dewormer
- **Vitamins A,D,E**
  - inject ewes twice per year (October and January)
- **Eye ointments**
  - discuss their use for eye infections with a veterinarian

On the shelf in a clean cupboard:

- **Formalin 37% Sol.**
  - to be diluted to 5% solution to be used in foot bath twice per year when feet are trimmed
- **Copper sulfate**
  - may use instead of formalin for foot bath, stains wool
- **Iodine tincture 2.5%**
  - navel dip after birth
- **Uterine boluses**
  - retained afterbirth, uterus infections
- **Disinfectant solutions**
  - disinfect hands, boots, equipment
- **Carmative boluses or powder**
  - digestive upsets, rumen overload
- **Mineral oil**
  - impaction of stomach or constipation
- **Bloat medicine** and trochar and canula
  - alfalfa bloat
- **Antiseptic lubricant** for lambing
- **Thiabendazole**
  - drench deworming
- **Suitable insecticides**
  - keds, lice
- **Elastrator or knife**
  - castrations

How to Use Drugs in Sheep

Read the label. It will tell:
- name of drug
- dosage of drug
- how and when to administer
- how to store (in fridge or not)
- expiry date
- withdrawal period.

How to Give Drugs to Sheep

Orally (by mouth)

By Drenching - It is important that sheep be drenched gently and with a great deal of patience. Without proper equipment and precautions, sheep may be lost due to injury, crowding in the drenching chute, or inhalation of the drench.

A drenching chute should be 50 cm (20 in.) wide and 9-12 m (3-4 ft) long and the sides should be solid.

- The operator stands behind the shoulder of the sheep being drenched. The free hand is placed under the jaw. The nozzle of the gun is inserted into the side of the mouth over the tongue towards the throat.
- The head would be held in its natural position, and the

dose given gently. Avoid pulling the head over backwards or sideways when drenching. Sheep that are down should be made to stand before drenching.

- Avoid drenching ewes in later pregnancy. Most deworming drugs can be safely used on pregnant animals, but the stress of handling such ewes could possibly result in pregnancy toxemia and perhaps abortion.

- Avoid using sharp worn out nozzles which could cause damage to the back of the throat.

As a bolus

- insert the bolus gun as given under "drenching"

- be sure proper size boluses are used in sheep (big cattle pills could become stuck halfway down and cause a choke, and bloat).

By stomach tube

- only pan about halfway down the esophagus

- give colostrum or electrolyte fluids to young lambs too weak to suckle

- use thin (5 mm o.d.) tubing, or a metal lamb esophageal feeder

- have the lamb stand up or sit up, with the head held in normal position before the tube is passed

- be sure the tube is not in wind pipe before pouring fluids in the tube.

By mixing into creep feed or milk replacers

- antibiotics with milk replacers or lamb starting rations.

By dissolving in water

- sulfa drugs or tetracycline drugs, mass treatment for pneumonia in feedlot lambs.

Under the skin (subcutaneously S C)

- lift up skin under front legs (no wool) and insert needle underneath the skin

- use clean needles 1.27 cm (0.5 in.) 16G

- some vaccines will cause a lump at injection site (no problem)

- use this site for vaccinations (except soremouth)

- calcium injections for milk fevèr

- other drugs as indicated on label on bottle.

Into the muscle (Intramuscularly - IM)

- Avoid the high priced rear leg muscles, many hind-quarters are condemned because of injection injury

- avoid nerve damage (short needles only 2.54 cm (1 in.) in rear legs

- inject drugs into neck preferably, but avoid the neck bones or shoulder blades

- avoid drugs that are extremely irritating to muscles

- pull plunger of syringe back after inserting needle to make sure that the needle did not penetrate a blood vessel. Injecting penicillin directly into the blood stream can cause sudden death

- use clean needles and sterile drugs only

- avoid routine intramuscular injections for newborn lambs (under four days of age). If ewes were managed properly during pregnancy, their lambs should not need injections of selenium or Vitamin ADE, antibiotics shortly after birth.

Into a vein (intravenously I V)

- jugular vein in the neck

- use piece of rope or fingers to raise vein

- very good for pneumonia treatment, milk fever or pregnancy toxemia

- give slowly to avoid shock

- sterile drugs only, given with sterile needles.

Into the uterus

- clip wool and tags away from rear end of ewe (crotching)

- wash, disinfect and lubricate hands and arms very THOROUGHLY

- insert boluses as deep into uterus as possible by hand OR

- infuse fluid antibiotic drugs with a syringe, a pipette or a piece of tubing

- be very gentle to avoid pain, shock or injury to the ewe.

Into the udder

- mastitis can be treated with specific antibiotics dispensed in special syringes or tubes. Cattle preparations can be used. Change the needle to a smaller one. Cattle needles will injure the ewe's teat sphincter
- wash gland and teat
- disinfect end of teat with alcohol
- insert tip of tube or syringe into teat opening and deliver dose
- massage udder after injection
- a hot swollen udder can be massaged for fifteen minutes using an udder balm ointment.

Into abdomen (Intraperitoneally I.P.)

- not very useful for sheep
- too dangerous. Can cause adhesions, infections, intestinal obstructions
- difficult to do very clean job.

Prevention of Disease

Sheep Vaccination

Vaccines were produced to develop immunity to specific diseases.

Read the label of a purchased vaccine carefully before using to see how much to inject, where to inject, how to inject, how to reconstitute, refrigeration, expiry date, what species and age of animal to use it on, possible side effects and contra indications.

A veterinarian should be consulted for details if the information on the label is not clear.

One should allow one or two weeks for full immunity to develop.

Some vaccines available to sheep:

Clostridial (bacterin or toxoid)

ewes
- those not vaccinated previously should be injected at eight weeks and four weeks before lambing
- a single yearly booster vaccination given at four weeks before lambing is required afterwards
- the immunity formed in such ewes is passed on to their lambs via colostrum and milk which is expected to protect the lambs until they are four to six weeks old.

to lambs reared in confinement
- those on lush pasture or good creep feed with the ewes should be vaccinated at six weeks of age
- a second injection should be given about four weeks later if the lambs are to go on to a high performance finishing ration.

to lambs grown on range pasture
- vaccinate at six weeks of age (when maternal immunity runs out)
- vaccinate again two weeks before they are to be weaned and placed on high grain finishing ration.

ewe lambs selected as future breeding stock should be vaccinated twice at six weeks of age and at two weeks before weaning in the fall

- vaccinating lambs less than six weeks old for black leg or pulpy kidney (enterotoxemia) while they are suckling their dams is not recommended. The passive immunity received in the milk interferes with the formation of the lamb's own active immunity.

Vibrio bacterins

- ewes should be vaccinated three to four weeks before they are turned in with the ram
- replacement ewe lambs and purchased ewes should be vaccinated upon entry into the flock and could be given a booster injection three to four weeks before breeding.

NOTE: Sheep vibrio bacterin is not the same as that used for cattle.

Footrot vaccine

- eight weeks before entry into community pasture
- repeat at entry
- repeat ten weeks after entry
- repeat at the end of pasture season
- should be given to all sheep going into pasture.

Soremouth vaccine

- commercially available in Canada
- live virus vaccine prepared from dried scabs
- could be dangerous if not applied properly

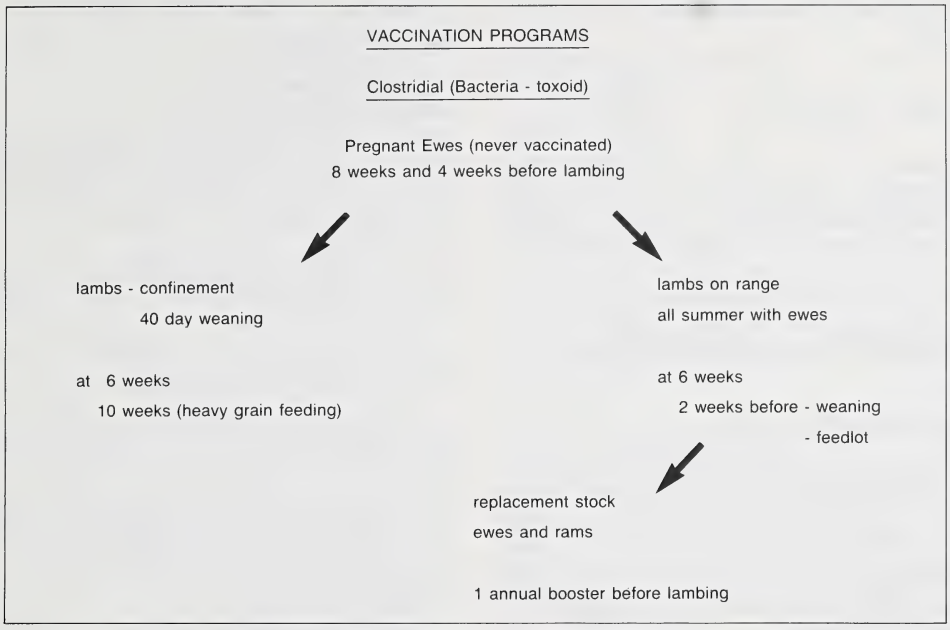


Figure 13. Vaccination program of pregnant ewes.

- apply to a light skin scratch under thigh region of rear leg of a sheep.

Some useful insecticides for sheep

Insecticides should be applied to healthy sheep only.

Only information on suitable chemicals and insects for which they are recommended is given here. Withdrawal periods (i.e., time interval between latest treatment and day of slaughter for human consumption), or age limits are given when necessary.

The product label should be read carefully for mixing instructions, restrictions, and contra-indications before an attempt is made to use it on sheep.

Make sure the product is legally approved for use in sheep.

To avoid grief, keep all chemicals out of reach of children and all domesticated animals.

Treat for keds and lice at shearing time or when fleece is short.

Consult with veterinarian when in doubt.

Carbaryl
- lice and ticks
- withdrawal seven days
- dust or suspension
- repeat in fourteen days

Coumaphos
- sheep ked, lice and ticks
- withdrawal seven days
- allow ten days before stress is imposed on sheep
- not on lambs less than 90 days of age
- do not drench with phenothiazine at the same time

Lindane
- lice and keds
- repeat in two to three weeks if necessary
- age not less than 30 days
- not for milking sheep (or goats)
- not for adult sheep nursing lambs
- withdrawal 30 days

Ronnel (Korlan 24E)
- lice and keds
- withdrawal seven days
- spray bombs and ointments available for maggot infested wounds

Rotenone
- keds and lice
- treat twice two weeks apart
- very safe for sheep

Drugs Not Recommended for Sheep

Ruelene
- damages the fleece of sheep

Fenthion (Spotton)
- withdrawal 45 days
- avoid stress for ten days
- do not use when organophosphate worm drenches are used
- not approved (Can. FDA) for use on sheep

Some Useful Deworming Drugs for Sheep

Carbon tetrachloride
- liver fluke disease
- very, very dangerous
- consult a veterinarian before deciding to use it
- given orally in mineral oil

Tetramisol (Tramisol)
- effective against lung worms and intestinal worms
- injectable solution available

Thiabendazole
- very safe and effective dewormer
- no good for tape worms, whip worms, flukes
- given as a drench

Dichlorophene (Teniatol, Teniathane)
- against tapeworm in sheep
- coccidiostat as well
- given orally

Phenothiazine
- fairly effective for most intestinal worm parasites
- light sensitivity can be a problem
- must not be used at same time as coumaphos (Co-oral)
- will stain wool if spilled during drenching

Sheep Diseases

A somewhat detailed discussion of the more commonly seen sheep ailments will be presented along the following rough outline:

- Diseases affecting sheep at any age at anytime
- Those affecting sheep at certain ages and under certain circumstances
  - Newborn and suckling lambs
  - Weaned and growing and feedlot lambs
  - Ewe diseases
  - Ram diseases
  - Miscellaneous conditions

Diseases Affecting Sheep of All Ages

External Parasites

Sheep Keds

The female ked lays no eggs, but produces live larvae at the rate of one larva a week for an average of 15 weeks. The larvae pupate and develop into the adult state in three to five weeks.

The keds spend their entire life on a sheep and are known to quickly migrate onto young lambs after ewes have been shorn. They can be a real problem during the winter under conditions of overcrowding. Keds cannot live separated from their host for more than four days.

Heavy infestations can cause restlessness, unthriftiness. The quality and value of fleece decreases because of residual debris and skin damage. Sheep should be dipped, sprayed or dusted shortly after shearing, at which time the treatment is most effective. Label directions for the insecticide used should be followed regarding repeat treatments.

Lice

Both biting (*Damalinia*) and sucking (*Linognathus*) species of lice infest sheep. In Canada, however, only biting lice are of importance. Sucking lice feed on blood, biting lice sometimes feed on wool fibres, but more often on skin scurf and materials contaminating the wool. The irritation associated with an infestation of lice can be so severe that it seriously interferes with feeding and resting. As a result, animals may be unthrifty and young sheep may be stunted in growth. Infested animals constantly rub against objects and scratch and bite themselves, so that their wool becomes dirty, ragged and torn.

Once present in a flock, lice spread rapidly. Although most infestations occur through direct contact, clean sheep sometimes become infested in a building previously occupied by lousy animals. As lice can live for only a few days off their hosts, they can be controlled best by treating infested animals. It is always advisable to take the added precautions of cleaning out bedding and spraying pens when animals are treated.

The same preparations and methods of treatment recommended for controlling sheep keds are usually equally effective against lice.

Sheep Nasal Fly

The sheep nasal fly (*Oestrus* species), often called the sheep nose bot fly, is really a true warble fly, and is related to the warble fly of cattle and the bot fly of horses. It is prevalent in all parts of Canada and is active during

the summer months. It does not lay eggs, as do other warble or bot flies, but deposits its larvae or maggots directly on or near the nostrils of sheep. Once deposited, the maggots make their way into the nasal passages and communicating sinuses, irritating the lining membranes. An intense, persistent, purulent discharge is present in the nostrils, sometimes in such quantities that it interferes with breathing and causes snuffles. The flies drive sheep frantic. To keep a fly from attacking, an animal will hold it's nose in the dust or against other sheep. This interferes with feeding and resting, and prevents the animal from thriving.

Deaths attributed to the sheep nasal fly have usually been found to be caused by diseases that are more difficult to recognize. Nevertheless, in heavy infestations, peculiar nervous symptoms are sometimes seen and heavy losses may occur.

Various methods of controlling the sheep nasal fly have been tried, but none of them is entirely satisfactory. Darkened sheds or pastures with dense clumps of brush offer some shelter in which sheep can escape from the adult fly. Infestations are less severe when such shelters are provided.

Blow Flies

Several species of flies (*Lucilia* or *Calliphora*) are sometimes troublesome in Alberta. These are quite commonly seen during the summer. The flies attach and lay eggs in open sores, on moist wool, around the rear end of sheep, spoiled with uterine discharge, blood, urine or feces. Eggs quickly hatch and resultant maggots feed on putrid wool material. The wool will come off. If there are wounds in the area the maggots quickly invade such wounds. Being "eaten alive" by burrowing larvae, and absorbing toxins produced by maggots causes the sheep to die in a few days.

Affected sheep are normally off by themselves, down with their head stretched out. They lose condition rapidly. Close examination will reveal wet, malodorous wool and maggots.

Treatment
- effective if carried out early
- shear the flock
- remove as many maggots as possible by using gasoline, benzene or chloroform
- use a 5 per cent Korlan ointment on affected region

Prevention
- don't lamb during the summer
- shear sheep before fly season
- sheep scouring from a lush pasture should be inspected often
- avoid docking and castration and shearing wounds during the fly season

Tick Paralysis

In Western Canada, sheep at times become infested with the Rocky Mountain spotted fever tick (*Dermacentor* species). This tick is capable of causing a disease known as tick paralysis, recognized by progressive, often fatal paralysis of the limbs. The tick is prevalent in the interior of British Columbia and in southern Alberta, and has been found in southern Saskatchewan, overlapping the western extension of the area where the wood tick is found.

Since many species of tick spend their early life on rodents and other small animals, their control is rather difficult. Sheep should be isolated from known tick-infested areas as much as possible, and periodically inspected for the presence of these parasites. Sprays and dusts of some of the newer insecticides have been found to protect sheep for the entire tick season.

Mange (Scabies)

Mange (*Psoroptes* species) can be a very serious disease of sheep, however in Canada it has not been a problem for many years.

Signs of mange in sheep include intense itchiness (as indicated by scratching, biting and rubbing), broken wool fibres, formation of scabs and thickening of the skin. The severity and locations of lesions on the host depend to some extent on the species of mite involved.

Since sheep mange, or scab, as it is commonly called, is a "named" (reportable) disease in Canada, all suspected cases should be reported to the nearest office of the Health of Animals Branch, Canada Agriculture, which will supervise the treatment and eradication of this disease.

Internal Parasites

Intestinal Round Worms

In areas where worm control programs are not in effect, intestinal parasitism is still a major cause of disease and deaths in this country.

Generally speaking, most worm life cycles are somewhat similar. The male and female adult worm live and produce eggs in the stomach or intestines. The fertile eggs hatch outside the body after having been passed out with the stool. After a number of changes or molts, a free-living mobile infective larva is formed which attaches itself to vegetation, which is eaten by a sheep. After entering the stomach or intestines, there is normally a final

transformation which eventually leads to adulthood and egg production.

There are some exceptions. The hookworm larva enters the sheep by penetrating the skin. The whip worm has no free-living form but is infectious upon hatching.

Names of common sheep intestinal worms and their habitats:

Stomach (abomasum)
- *Hemonchus* - barber pole worm
- *Ostertagia* - brown stomach worm
- *Trichostrongylus* - hair worm

Small Intestine
- *Trichostrongylus* - intestinal hair worm
- *Bunostomum* - hook worm
- *Nematodirus* - coiled neck worm

Large Intestine
- *Chabertia* - large mouth capsule worm
- *Esophagostomum* - pimply gut worm

Cecum
- *Trichuris* - whip worm

Parasites usually cause disease in sheep when conditions are good for the parasites and poor for the sheep. Examples of such conditions are:

Good for parasites-mild winter
- moist warm spring and summer
- overgrazed or permanent pastures
- irrigated or wet pastures
- ability to produce enormous number of eggs
- sheep producers who assume their sheep are free of worms.

Bad for sheep (in addition to above)
- age - very young lambs, or old sheep
- poor nutrition, thus low resistance
- poor immune status against worms
- type and numbers of worms
- stressful conditions, weather changes, transport
- overcrowding, late pregnancy, lambing stress .

Signs

The severity of worm infestation depends almost wholly on the balance of power between sheep and parasites as shown in factors above. If the odds swing in favor of the worms, the following signs of disease may be seen.

Hemonchus and Osteragia (stomach)

These worms are attached to the lining of the stomach. They suck blood and cause inflammation and ulceration. Hence the sheep become anemic, look very pale and may develop a swelling under the jaw (bottle jaw). There may be constipation as well. Sudden deaths do occur.

Trichostrongylus, Bunostomum, Nematodirus, Chabertia, Esophagostomum

These worms generally cause damage to the lining of the gut, resulting in enteritis, diarrhea, loss of appetite, loss of body condition, severe emaciation and death eventually. There may be sudden deaths in fat ewes with large numbers of these worms present.

Diagnosis
- stool examination at a veterinary clinic or laboratory
- history and signs of disease
- post-mortem exam of recently dead sheep.

Treatment
- injectable dewormer reduces labor requirements
- alternate use of thiabendazole as drench is suggested
- keep sheep's head horizontal when drenching. It's very easy to drown a sheep or cause acute or chronic aspiration pneumonia
- be gentle, avoid handling ewes in late pregnancy. Abortions and pregnancy toxemia may be seen after deworming heavily pregnant ewes
- prevent overcrowding in the chute
- avoid injuring the animal's mouth or throat with sharp or damaged drenching guns
- make sure to correctly read the product label for dosage, and check gun for correct delivery of drug.

Prevention of worm infestation in sheep

Pasture Management
- avoid marshy boggy pasture
- prevent overstocking of pasture
- keep grass reasonably well grazed. Infective larvae are killed by direct sunlight
- letting a sheep pasture be grazed by cattle breaks the infective cycle. (Sheep worms don't bother cattle and horses)

Sheep Management
- use strategic drenching schedule for worm control. Deworm at the time major infections are likely to occur.

Most suitable occasions are:

Early lambing (January through February)
- drench ewes shortly after lambing. A spring rise in egg counts occurs six to eight weeks after lambing, just in time to infect the young lambs. Hence, drenching ewes shortly after lambing is completed will help to prevent the spring rise.

- deworm ewes again before they go to pasture (in May) to prevent pasture contamination
-deworm lambs at weaning time (40 to 50 days of age) or before they enter feedlot or pasture

Late Lambing (April through May)
- deworm ewes in mid-winter (January, February) before the spring thaw, to prevent heavy contamination of lots or corrals
- deworm ewes again shortly after lambing (May) to prevent occurrence of spring rise of worm egg production and infections of lambs.
- depending on time of lambing a drenching may have to be used before pasture entry
- mid-summer (July, August) deworming useful particularly under conditions of high rainfall and humidity
- late fall weaned lambs (September to October) before they go into feedlot
- deworm ewes at weaning time (September to October)
- deworm all newly purchased stock when they arrive on farm at beginning of quarantine period.

All classes of sheep
- avoid malnutrition of sheep (makes them more susceptible to worms)
- use proper feeding equipment feeding
- avoid overcrowding
- submit to a laboratory a number of randomly selected fecal samples in fall and spring to monitor levels of fecal worm eggs. This allows one to evaluate effectiveness of deworming program.

Miscellaneous Internal Worms
Lung Worms (Dictyocaulus)
These worms can be an annoying problem in areas where wet pastures and cool climate provide favorable conditions for the worm's life cycle. The adult worms live and mate in the passages of lungs, eggs are coughed up, swallowed, hatch into larvae and are passed out with the manure. The infective larva crawl up a blade of grass and wait for a new sheep host.

Signs - shown with heavy infestation usually are:
- rapid breathing, coughing, weakness and other signs of pneumonia

Treatment
- can be effective if levamisole (tramisol) is used

Tapeworms (Moniezia or Thysanosoma)
This group of worms appears to be common in intestines of essentially normal sheep in Canada. Unless the numbers of worms are so great that they interfere with normal movement of the bowel, they are said to be harmless.

The tape worm is made up of segments filled with eggs which are passed out with the droppings. The eggs are eaten by common pasture mites within which infective tapeworm larvae are developed. The mites are eaten by the sheep and a new crop of tapeworms is established.

Fortunately, sheep develop immunity against this worm and tapeworms are rarely seen in animals over one year of age.

Treatment is usually not necessary.

Liver Flukes
These parasites are hardly ever found in Alberta sheep. The life cycle is very complex. Water at a certain temperature, the appropriate species of snail to act as in-between hosts, exact moisture conditions and vegetation are essential requirements.

Evidently the climate in Alberta, especially in the drier southern regions, is not favorable to survival of the liver fluke.

Foot Diseases of Sheep
Foot Rot
Foot rot is a very serious infectious disease of sheep, caused by a specific bacterium *Fusiformis nodosis.*

Conditions favorable to development of foot rot in the presence of this bacterium are:

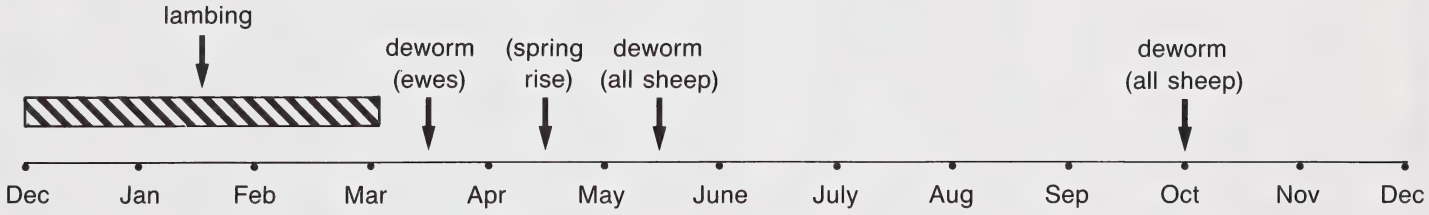
- wet pastures and corrals, periods of high rainfall
- feet become soft, skin becomes irritated, is easily injured by sharp grass, sticks and stones
- overgrown hooves lead to misshapen feet. Pockets and cracks develop and conditions are ideal for the foot rot bacterium

It must again be emphasized that foot rot can only start if this specific bacterium, *Fusiformis nodosis* invades the feet. Without this germ there can be no foot rot, no matter how wet the pasture or how deformed the feet. The foot rot germ is carried into a clean farm pasture or community pasture by a carrier sheep. When the grass is long and wet, and the weather is hot and humid, foot rot can spread so quickly from sheep to sheep that an entire healthy flock can virtually be wrecked in two weeks.

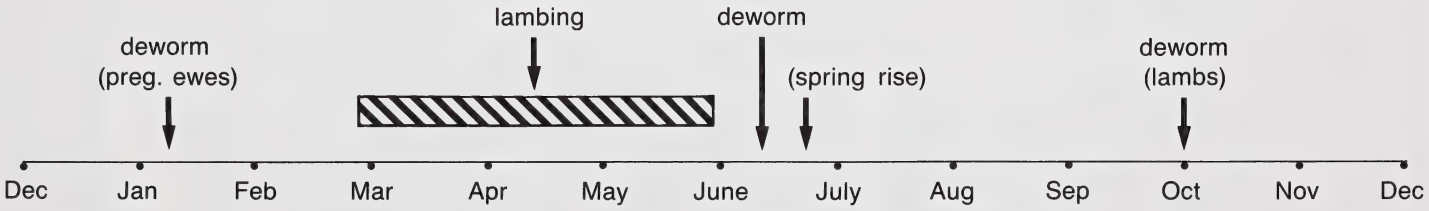
Signs
- it starts as a scald with moist reddened skin between the claws. The heels can be peeled from the inside of the hooves

STRATEGIC DRENCHING METHODS FOR WORM CONTROL IN SHEEP

EARLY lambing (Dec. - Feb.)



LATE lambing (Mar. - May)



- as the infection progresses, it spreads around the junction of skin and horn, goes on to separate the entire hoof from the foot
- there is a sharp disagreeable odor
- there is no pus formation
- a dirty grey moist zone of slimy dead tissue beneath the loose horn is seen
- maggot infestation is a common complication during the fly season
- acute lameness, sheep walk on their knees if front feet are infected
- sheep lose body condition because of pain and some interference with feed intake
- no abscesses form, and the area above the hoof is seldom involved
- sheep may look as though they are normal but they could be carriers
- sheep with overgrown, underrolled hooves are likely carriers as well.

Diagnosis
- closely examine every lamb and sheep in the flock immediately
- remember other causes of lameness, e.g., foot injury, sprain, scald, abscess
- call a veterinarian. This has to be reported. It is an Alberta Government notifiable disease. See Alberta Regulation 383/72 Livestock Disease Act.
- a veterinary laboratory can isolate and identify the causative bacterium.

Treatment
- very expensive, labor intensive, considering cost of equipment, materials, manpower, time and hard work
- footbath is essential
- examine and trim feet of **EVERY SHEEP**
- leave in footbath at least five minutes
- repeat footbath twice per week, the first week, and then once per week until pasture dries out
- identify all sheep affected with foot rot and isolate as a diseased flock

Divide into three groups (see Figure 15)

The Clean Flock
- is turned out into clean ground after the footbath, is kept under close supervision and returned for a check trimming and a footbath in six weeks. (This check trimming is important in picking out carrier sheep which may have been missed six weeks ago).

Note: A clean pasture is one that has had no sheep walking in it for at least two weeks.

The Diseased Flock
- sheep are visually checked and given a footbath twice per week for at least four weeks (ten minutes in footbath)
- sheep are closely examined every two weeks to check progress of all foot rot affected feet (viz. turn every sheep upside down and inspect feet one by one)
- sheep which seem to have responded to treatment after two-week and four-week inspections are isolated in a "recovered group"
- sheep which after four weeks of twice weekly footbathing still show no signs of improvement should be sent to slaughter
- sheep which are improving should be given a further series of twice weekly treatments after retrimming. Costs and benefits derived should be considered. It could be more economical to send such sheep to slaughter as well.

The Recovered Flock
- should be kept isolated from the clean flock
- should be kept under close supervision for evidence of lameness and recurring infection
- all individual feet in the group should be reinspected after 30 days and given footbath
- re-inspect and footbathed after a further 30 days
- if both 30 day inspections were passed, the flock would be turned out with the clean flock
- sheep returning home from a foot rot infected community pasture, or newly purchased sheep, whether healthy or not, should be turned upside down and checked and trimmed carefully to find diseased or carrier sheep
- should be given a footbath (four minutes at least)
- kept in isolation from the home flock for at least 30 days, and observed daily for evidence of lameness
- re-inspected, footbathed and turned out with the healthy home flock.

Various Remedies Used for Foot Rot

For flock treatments
- Copper sulfate, 14.5 kg (32 lb) in 90 L (20 gal) water for footbath. (Add vinegar if water is very hard)

Disadvantage - stains the wool green
- very corrosive to nails or metal in footbath structure

OR

- Formaldehyde 10 per cent as a foot bath treatment
- formula - 9 L (2 gal) formalin in 82 L (18 gal) water

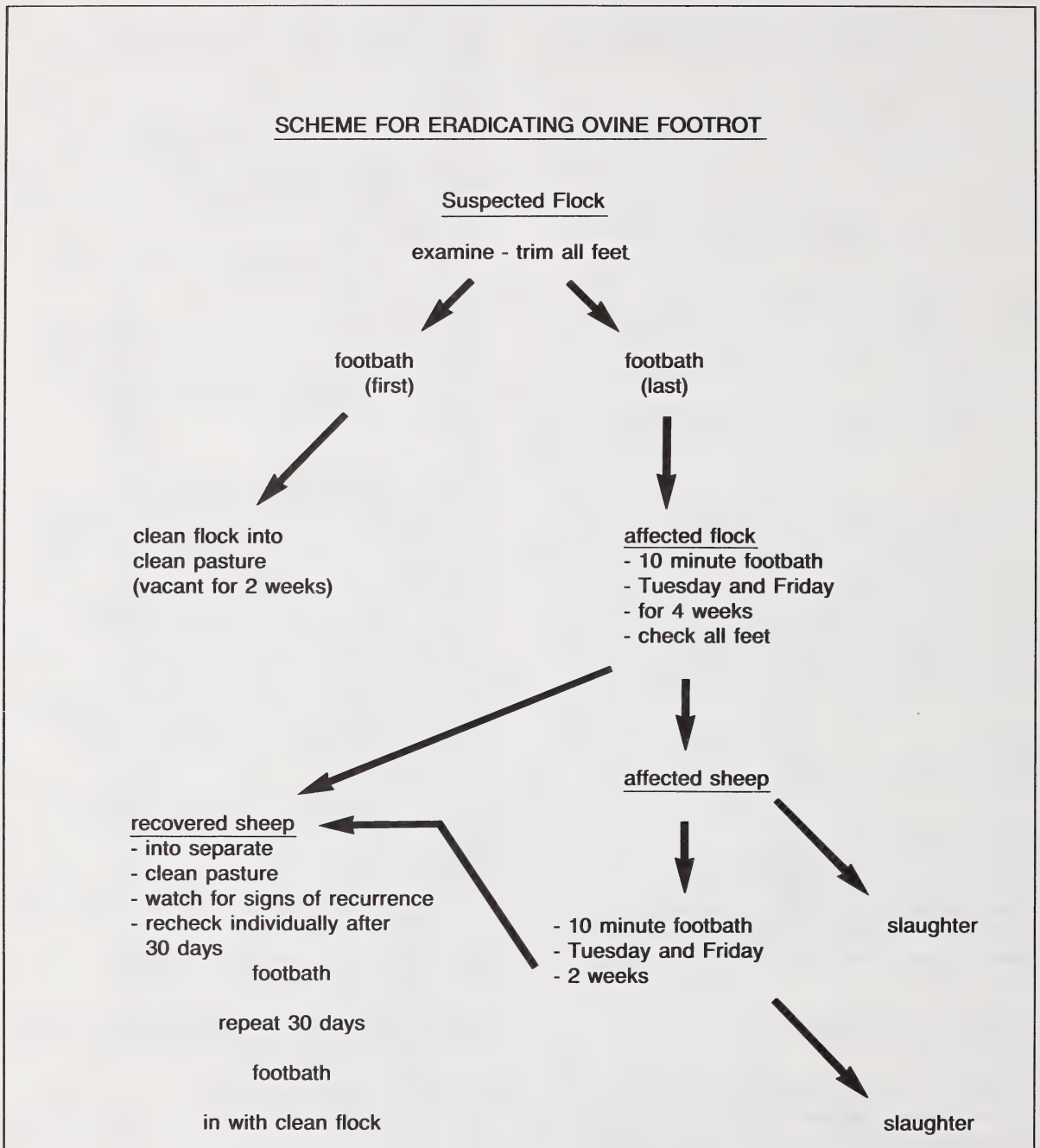

SCHEME FOR ERADICATING OVINE FOOTROT
Suspected Flock
examine - trim all feet
footbath (first)
footbath (last)
clean flock into clean pasture (vacant for 2 weeks)
affected flock
- 10 minute footbath
- Tuesday and Friday
- for 4 weeks
- check all feet
affected sheep
recovered sheep
- into separate
- clean pasture
- watch for signs of recurrence
- recheck individually after 30 days
footbath
repeat 30 days
footbath
in with clean flock
- 10 minute footbath
- Tuesday and Friday
- 2 weeks
slaughter
slaughter

Figure 15.

Individual treatment
- 10 per cent Formaldehyde solution

OR - 1 part of glycerin and one part undiluted formalin

OR - prepare saturated copper sulfate in pine tar

OR - tincture of iodine 5 per cent

Use a paint brush and apply to areas of the feet exposed by trimming.

Other Foot Conditions of Sheep

Foot Scald

- inflammation of skin between the toes
- there may be separation of part of heel and hoof from the foot, but separation is clean and healthy
- there is no greyish rotting and no offensive odor
- seen in wet pastures, prolonged wet feet
- put sheep on clean dry ground and they recover quickly
- Give foot bath.

Foot Abscess

- caused by soil bacteria (*Fusiobacterium necrophorum*)
- entry is through broken toes, scald injury, cracked walls, injury on junky yards, wooden sticks
- may separate hoof from sole
- often causes swelling and rupture of skin above the hoof
- trimming shows yellowish purulent material when abscess is opened
- sheep may become quite ill and die of blood poisoning in severe cases
- some infections are so deep (viz. in joints and connective tissues) that simple treatment is not effective and a chronic arthritis develops
- simple abscesses may be drained, flushed out with 2 per cent tincture of iodine and an injection of penicillin given into the muscle
- sheep with badly swollen foot infections do not respond well to any kind of treatment. Large doses of Pen/Strep may be injected once a day for five days. (10 to 15 mL).

There are several other conditions of the foot that should be differentiated before foot rot treatment is undertaken. These are:

- foot soreness, long travel on hard ground
- proud flesh between toes
- sore mouth may form scabs on coronet and cause lameness
- blue tongue (not in Alberta so far)
- foot injuries.

When in doubt about the cause of lameness in the flock, call a local veterinarian for an exact diagnosis and recommendations for treatment.

Bloat

- unusual distension of abdomen, particularly left flank area, due to excessive amount of gas trapped in the stomach.
- Incidence - can occur in sheep of all ages:
  - Young lambs - excessive intake of warm milk replacer
    - young leafy alfalfa hay
  - Weaned lambs - frothy bloat with grain feeding and finely chopped roughage
  - Ewes and lambs in pasture
    - succulent green, wet pasture after rain or dew
    - alfalfa, clovers and peas common
    - may occur on other forages
  - Other sheep - potato, turnip, beet tops, can cause choke, and bloat
    - trapped upside down in a little ditch or furrow, die of bloat.

Cause
- forage or grain in rumen (stomach) produces gas
- gas is mixed with this ingesta
- foam is formed and gas is trapped
- sheep cannot eructate (belch) this trapped gas
- esophageal obstruction with potato or beet prevents the blowing off of excess gas.

Treatment
- remove cause from sheep (obstruction)
- remove sheep from cause
- pass stomach tube to relieve pressure
- pour antibloat medicine or oil through stomach tube to break down foam
- DO NOT DRENCH at this time
- use trochar and cannula in an emergency ONLY, on left flank. May use a 5.1 cm (2 in.) 12G needle also 5.2 cm (2 in.) down from vertebra, in the space between the last rib and hip bone
- may inject bloat medicine through cannula or needle.

Prevention
- fill sheep with dry hay before they enter a new lush green pasture
- let pasture dry before sheep are turned in for the first time
- once sheep are in the pasture, leave them in, coyotes permitting
- be very careful with alfalfa, wait until alfalfa in field is frozen and dried up a bit
- beware of young leafy alfalfa hay during winter, try it on a few lambs first before the whole feedlot comes down with bloat
- if frothy grain bloat in feedlot is a problem, provide more uncut or long chopped roughage.

Plants Poisonous to Sheep

Plant poisoning is not likely to occur on carefully cultivated grounds or well managed range or pasture. It happens more often when animals graze on wild land, on western ranges, in wild meadows along streams, and in sloughs and woods. Most poisonous plants are unpalatable and livestock rarely eat them when wholesome forage is abundant. They are most dangerous to livestock in the spring, when sheep and other herbivores, after having been on winter rations, have an increased appetite for green growing plants. Poisonous species often put up tempting green shoots before grass becomes green. Animals may eat these and be poisoned. Overgrazing constitutes another special hazard. It encourages the increase of weeds and poisonous plants, which hungry animals are compelled to eat because grass is scarce. The effects of drought are similar to those of overgrazing.

Signs

- most plant poisonings are characterized by signs such as:

A
- acute death without signs
- labored or very rapid breathing
- frothing at the mouth and excessive salivation, weakness, inability to stand
- convulsions or erratic behavior, greenish saliva (vomiting)
- coma.

B
- other poisonous plants cause animal to become sensitive to light. Toxic substances may end up in the blood stream of sheep that eat such plants. The action of sunlight upon this circulating material will cause burning, swelling, inflammation and eventually sloughing of the skin over non-pigmented areas of the body. Body parts most commonly affected are tips of ears, top of head, back regions in shorn sheep and those with loose open wool. Regions around anus and vagina, feet and teats may be affected as well.
- Suffolks are less prone to this than Cheviots, Dorsets, and Finn sheep.

Examples of such light sensitivity plants are St. John's wort, trefoil clover.

Treatment

- most poisoned sheep, when found, are too sick and too far gone towards death for any treatment to be useful
- sheep affected with signs of light sensitivity should be
  - removed from vegetation
  - kept in sheds or have shade available
  - burned areas of skin treated with oil, or antibiotic ointments
  - kill plants causing the problem.

Prevention

- much more effective than treatment
  - make sure there is enough grass on the pasture besides poisonous plants. Sheep will avoid these plants if there is plenty of grass
  - have sheep fill up on hay before they are driven through an area where such plants are abundant. Hungry sheep will eat anything when on the run.
  - have plenty of drinking water, calcium, phosphorous and mineral mix available at all times to prevent depraved appetites.

Chemicals Poisonous to Sheep

Chronic Copper Poisoning

Cause

- excessive intake of copper over a period of time. e.g., copper sulfate licked from dried footbaths
- water troughs treated with copper sulfate to prevent algae
- free access to cattle minerals containing copper sulfate
- deworming using copper containing drugs
- cattle supplements used in lamb feedlot ration may contain excessive copper levels for sheep
- copper containing pesticides used in orchards
- the amount of copper stored in the liver gradually increases until the maximum holding capacity is reached, namely to a range of between 1000-3000 parts per million (1.0 - 3.0 gm. of Cu/kg liver)
- it may take 30 to 100 days to reach this level
- as a result of stress, the liver suddenly releases its stored copper, the copper in the blood rises, red blood cells break down, resulting in anemia and jaundice.

Signs

- sudden onset of signs after stressful events, such as a long drive or transport, shearing or deworming operation
- rapid breathing
- yellow skin and membranes of mouth, eyes
- dark brown urine
- most affected sheep die

Prevention

- avoid excessive intake of copper
- don't supply copper containing mineral mix free choice
- watch level of copper in supplements, e.g., beef or dairy supplements
- try to buy copper-free sheep minerals.

Urea Poisoning

Cause

- excessive intake of a molasses and protein supplement containing a high level of urea
- improper mixing of urea supplement into a grain ration
- putting lambs on urea containing rations too early and

too quickly
- accidents, spillage, negligence, etc.

Signs
- abdominal pain, muscle tremors, staggering
- convulsions, depression, coma
- weakness, bloat

Treatment
- vinegar, 568 mL (1 pint) per 34 kg (75 lb) body weight
- mineral oil
- purgative drugs.

Prevention
- more economical.

Miscellaneous Chemical Poisonings
Other poisonings of sheep which may occur from time to time are:
Nitrate poisoning - heavily fertilized immature cereal crops
Lead poisoning - paint, batteries, smelters, etc.
Oxalate - fresh sugar beet leaves
- oxalate containing plants
Insecticides - variety

Diseases Affecting Young Lambs
If a number of lambs start to look rough, dirty, thin and unthrifty, are not as active as they should be, one should look for obvious causes which almost always are found in the lambing shed.

- poor drainage and sanitation of the lambing area or mothering up pens which lead to accumulation or build up of disease causing organisms
- too hot in the mothering up pen and lambs catch a cold and pneumonia in hardening pens or when they are turned out
- overcrowding can have a serious effect on lambs
- remove sick animals from the flock, treat and isolate them immediately in a sick pen area to prevent infecting the rest of the flock.

Weak Lamb Syndrome
Causes
- prolonged lambing, anoxia and exhaustion
- chilling and lack of blood sugar
- ruptured liver, broken ribs or hips
- heart defects, cleft palate
- starvation, failure to nurse, blocked teat, mastitis, poor mother, competition
- uncrotched udder
- other lambs stealing milk
- scours, pneumonia, white muscle disease
- poor quality milk replacer in the case of orphans
- nutritional deficiency, vitamin A, energy in ewe.

Signs
- lamb looks gaunt, rough, thin, seems constipated, looks potbellied, passes on manure, just a watery brownish or blackish diarrhea
- it is often found down in a corner by itself, cold and listless, or may be seen nibbling hay or bedding.

Diagnosis
- check udder, teats, ewe's behavior
- check other causes
- cut open a dead lamb and see if there is milk in the stomach.

Treatment
- depends on the cause
- bring a chilled lamb back to life by warm water bath or a heated box, feed warm colostrum by stomach tube if necessary.
- check page 17 under management for good nursing tips
- treat disease as given under appropriate headings.

Prevention
- tender loving care and good sensible management.

White Muscle Disease (WMD)
Cause
- Nutritional muscular dystrophy (WMD) is a degenerative muscle disease of young lambs. It is seen most often in selenium deficient areas of Alberta. The soil in the general area west of a rough line between Edmonton and Fort Macleod tends to be lower in selenium (Se). Hence forage grown there is low in selenium.

Selenium deficiency interferes with transport, storage and usage of Vitamin E in the body.

Signs
- when ewes have been on a Se deficient ration, WMD may be present in ambs at birth
- affected lambs are unable to suckle
- are more susceptible to starvation, pneumonia and diarrhea
- there may be a stiff gait, and difficulty getting up. Lambs may stand with their front legs spread out, unable to lift up their heads
- depending on what other muscles are involved, there could be rapid breathing or sudden death, often seen after increased physical activity.

Treatment
- injectable selenium - tocopherol (Vitamin E)

preparations are available.
- read label or consult the dispensing veterinarian for specific product information.

Prevention1)
1) - Selenium/Vitamin E mineral-vitamin premixes are available on prescription from a veterinarian. (Commercial trace mineral mixes with Se are also available).
   - this can be added to a salt-mineral mix on a year round basis.
2) - if (1) had not been provided, one could inject the ewe with an solution for one to four weeks before lambing and inject lambs about four days after birth.
3) - if both (1) and (2) were not provided, one might have to inject newborn lambs with a Se/Vit E solution shortly after birth to prevent WMD.

NOTE: (1) is the best course to follow.

Injecting lambs at birth e.g., 0.5 mL given into muscle of rear leg together with a shot of vitamin ADE and antibiotics can be quite damaging to weak lambs. Pain and stress resulting from these injections can make the lambs even more susceptible to disease.

Navel Infection

Cause
- infection of the navel cord at birth and extension into belly

Signs
depression, high fever, weakness, lack of appetite, death can occur quickly, if not treated promptly.
- commonly gives rise to arthritis in one or more joints. Joints are hot, swollen and painful, and are difficult to treat properly.

Treatment
- antibiotics given daily for several days

Prevention
- sanitation at lambing
- treat all navels with 2.5 per cent tincture of iodine

Colibacillosis (Scours)

Causes
- bacterial, perhaps viral
- overcrowding; cold damp snowy weather and unsanitary overcrowded lambing facilities near the end of the season; poor nutrition and heating
- indigestible milk replacers
- lambs from ewe lambs probably more susceptible
- lack of colostrum intake (passive immunity).

Signs
affected first two weeks of life
- lambs born near the end of lambing season have higher incidence
- bright yellow or whitish green diarrhea
- lack of appetite, wet rear end, sunken eyes, gaunt appearance
- usually die of dehydration if not treated immediately
- blindness, brain infections or arthritis are common after effects.

Diagnosis
- type of diarrhea
- predisposing factors, circumstances
- laboratory work on stools of untreated lambs, culture and sensitivity.

Treatment
- treat immediately
- prevent lamb from sucking ewe by feeding it the following mixture four times per day, (bottle), but leave the lamb with the ewe
- suitable mixture to treat dehydration - 4.4 L of water, add 15 mL of baking soda, 7.5 mL of salt and give 125 - 185 mL four times per day. (The lamb will not nurse his mother as much, reducing milk intake but antibiotics work better).
- give antibiotic mixture by mouth after lamb is re-hydrated
- many available antibiotic drugs are useful for scours
- injectable chloramphenicol given twice per day usually quite effective in addition to the above suggestions.

Prevention
- good nutrition of ewes (selenium, vitamin E, vitamin ADE, energy intake)
- good management, sanitation, dry bedding
- isolation of affected lambs and ewes
- make sure lambs get colostrum within two hours after birth
- avoid overcrowding in lambing sheds
- use good quality milk replacers (medicated).

Pulpy Kidney Disease

A rapidly fatal disease of fast growing baby lambs, few days to 12 weeks of age.

Causes
- a toxin produced by *Clostridium perfringens* type D
- a change of feed from relatively poor to an improved diet
- plenty of ewe's milk, good quality creep feed, lush pasture, a high protein, grain based ration
- irregular feeding owing to competition and inadequate feeder space
- the bacteria grow in rich food material in the intestine,

produce a toxin which is absorbed into the bloodstream and kills the lambs
- lack of passive immunity in ewes milk.

Signs
- sudden death
- severe abdominal pains, kicking, head tossing, fever and perhaps diarrhea
- convulsions usually followed by coma and death
- affects the best lambs in the flock, particularly single lambs.

Diagnosis
- signs and circumstances are important for diagnosis
- post mortem kidneys look mushy
- glucose positive urine
- sac around heart distended with fluid or gelatinous fluid.

Treatment
- usually too late
- apparently some lambs recover if they can be made to scour (flush) out toxins
- remove lambs from lush pasture and reduce creep feed intake.

Prevention
- vaccinate ewes four to six weeks before lambing to give young lambs passive immunity for about six weeks. Vaccinate ewes lambing for the first two times namely at eight weeks and at four weeks respectively. Give booster injections once a year thereafter. Correct dosage varies with the product and the label should be read to be exact. Vaccinate lambs at six to eight weeks of age as well, especially those going on full concentrate feed.

Tetanus

An acute infectious brain and nerve disease of young lambs resulting from docking or castration on infected premises.

Cause
- *Clostridium tetani*, a spore bearing anaerobic bacterium, commonly found in the soil
- unsanitary surgical practices
- elastrator bands are common causes, contaminated knife
- deep puncture wounds, rusty nails
- toxin produced in damaged tissue is absorbed and gives rise to the signs of disease seen.

Signs
- early stiffness, stilted gait, saw horse type of stance
- lamb will stiffen completely, cannot open it's mouth
- intermittent tonic convulsions, especially in presence of sudden noises
- difficult breathing, paralysed diaphragm
- death in three to four days.

Treatment
- clean up necrotic tissues, wash and drain
- usually useless, too late.

Prevention
- castrate young lambs, dock in sanitary manner in clean pastures or in clean yards
- vaccinate ewes as under "Pulpy Kidney Disease" to give lambs immunity
- don't use elastrator bands on farms where tetanus has been diagnosed.

Arthritis

An infection of one or more joints of the legs of lambs from one week to several weeks of age.

Cause
- a variety of both pus and non-pus forming bacteria which may enter the body of the newborn lamb through the navel cord, the docking or castration wound.

Signs
- stiffness, pain when getting up or walking
- there may or may not be enlargement of joints depending on the type of causative organism
- affected lambs become rough, gaunt, unthrifty and develop into runts.

Treatment
- acute cases can be treated with penicillin-dihydro streptomycin, injected every day for five days
- if there is no response, have the veterinarian do a culture and sensitivity test on the joint fluid, and treat with the most effective antibiotic based on the results of this test
- treatment useless if infection is discovered too late or was ignored for too long.

Prevention
- dip navels in 2.5 per cent tincture of iodine at birth
- put lambs in clean grass pasture after docking or castration
- inject long-acting pen-strep at time of castration or docking.
- sanitary lambing facilities and clean surgery most important.

Pneumonia

Newborn lambs can get pneumonia shortly after birth when their ability to withstand disease is broken down by stress factors in combination with the right viruses and bacteria.

Cause
- P13 virus, PPLO and Pasteurella bacteria
- stress factors such as sudden changes in temperature, drafty, poorly ventilated overcrowded conditions
- sudden chill, starvation, exhaustion, allow the bacteria and viruses to invade the lungs.

Signs
- lambs become feverish 40 to 41°C (104 to 106°F)
- they stop suckling and go off feed
- become listless, weak and gaunt looking
- there is faster shallow breathing at first, followed later by fast labored breathing, discharge from the nose
- lambs can die very suddenly overnight
- under the right conditions a lot of lambs can be lost in a short time.

Diagnosis
- make sure of diagnosis before treatment is started
- take dead lambs to a veterinary clinic or laboratory immediately to differentiate from other causes of lamb death.

Treatment
- daily injection of oxytetracycline or some other antibiotic, as recommended by veterinarian

Prevention
- keep lambing area clean, dry and well ventilated, good facilities are essential
- don't keep lambs inside too long after birth, don't keep them too warm
- avoid stress and overcrowding.

Entropion
- inward turning of eye lid, causes eye damage

Causes
- probably hereditary defect in most severe cases
- sometimes merely due to dried up birth fluids in wool, causing eyelid to invert
- eyelashes rub against eyeball causing whitish discoloration of cornea (keratitis) and later, ulcerations of eye and blindness.

Signs
- excessive tear production and matting of wool on face
- cloudy or ulcerated eye
- closing of eyelids, evidence of pain
- blindness could result if nothing is done to correct this defect.

Treatment
- fold out lower eyelid and apply wound clip, stitch to keep eyelid rolled out
- eye ointment or pink eye powder only work if the underlying cause has been corrected
- some eyelids are folded in because of sticky dried up birth fluids.

Prevention
- breeding records may implicate a ram or ewe as being the genetic carrier
- cull only on the basis of firm evidence.

Diseases of Weaned and Feedlot Lambs

Grain Overload *(Lactic acidosis)*

A deadly mismanagement disease affecting lambs introduced to full grain rations too quickly. Commonly seen in feedlots.

Cause
- suddent intake by sheep not accustomed to such substances, such as grain, fruit cabbage, sugar beets, potatoes, grain or other early fermentable feed.

Signs
- dullness, stiffness, lack of appetite, staggering, blindness, droopy ears, dehydration and diarrhea common, inability to get up, coma, death, in acute cases
- loss of wool usually occurs after recovery
- laminitis, lameness because of sore feet, sheep may walk on their knees or prefer to stay down.

Treatment
- slaughter - treatment is laborious, expensive and frustrating
- mineral oil to help the ingesta to move on through
- anti-acids to neutralize lactic acid
- pyrahistine has been used to prevent or reduce founder
- purgatives or injectible rumen stimulants to empty rumen
- keep lambs moving, walk them around for several hours, and keep water holes closed during this time.
- remove from grain to prevent further engorgement of healthy lambs
- feed hay only for a few days and gradually re-introduce the grain.

Prevention
- avoid sudden changes in feed
- introduce lambs to grain ration gradually
- once lambs are accustomed to grain, keep the self-feeder full
- avoid competition, give plenty of trough space.

Shipping Fever

An infectious disease of lambs following weaning, transport, auction sales and other stress factors.

Cause
- variety of viruses and bacteria which are normally present in the lung system of sheep take advantage of lowered resistance of lambs to cause pneumonia.

Signs
- high fever, droopy ears, off feed, reluctant to walk, rapid shallow breathing, progressing to labored frothy mouth type of respiration
- sudden deaths are common, when septicemia (blood poisoning) occurs.

Treatment
- separate healthy from sick lambs
- treat sick lambs with antibiotics, preferably tetracyclines (injectable drugs are best)
- put sulfamethazine or a double sulfa drug in the water, in line medication or water trough for all lambs to drink
- dosage varies with products and a veterinarian should be consulted for efficient use of drugs
- lambs which don't eat or drink should be given adequate amounts of water and electrolytes by drenching or stomach pump to prevent dehydration and starvation.

NOTE: Looking after such animals by nursing them along is just as, if not more important, than merely injecting them with some antibiotics.

Prevention
- avoid excessive stress at weaning
- delay deworming, castration, vaccination until about ten days after arrival at the feedlot.
- introduce lambs to feed gradually and have good facilities
- provide good housing, dry bedding and avoid overcrowding
- try not to mix lambs of various sources too quickly after arrival
- using medicated feeds during the first stress period helps under certain circumstances
- watch copper levels if medicated calf starters are going to be used.

After effects
- If pneumonia is not treated promptly and effectively, some affected lambs look as though they have recovered but actually turn out to be chronic cases, suffering from pleuritis, adhesions, abscesses. They seem to to be coughing all the time, especially after moderate exercise. Antibiotics don't work on these lambs and it is impossible to make money on such them.

Coccidiosis

An infection of the intestine characterized by thin, watery diarrhea, often streaked with blood.

Cause
- most sheep carry a population of coccidia in their intestines all the time, and are never bothered by coccidiosis
- sudden change from grazing on a range to beet tops, grain or good quality hay and concentrates puts stress on the intestine and coccidia can multiply rapidly and cause disease.

Signs
- coccidiosis tends to appear two to three weeks after lambs arrive in the feedlot
- stool is watery, often bloody, wool around the rear end can be stained with blood
- lambs go off feed, dehydrate, become weak, go down and die
- sometimes there is a spontaneous quick recovery.

Diagnosis
- a veterinarian should be consulted
- microscopic exam of feces reveals coccidial organisms (oocysts)
- there are other diseases causing this type of diarrhea and severe death losses in a feedlot. Thus correct diagnosis is very essential.

Treatment
- this disease does not respond to home remedies
- a veterinarian should review the situation and prescribe specific treatment, usually given in drinking water
- drugs such as sulfa methazine, nitrofurazone, amprolium and rumensin can be used to treat, control or prevent coccidiosis
- water and electrolytes should be used in conjunction with drugs to treat dehydrated lambs
- good sanitation, a well drained corral and lots of bedding are essential.

Prevention
- good feeding management (see causes)
- properly placed and well designed water troughs and feed bunks prevent fecal contamination of feed and water
- locate feedlot on high, well drained ground. Coccidial oocysts do not survive well in dry soil.

Enterotoxemia

This clostridial disease affects feedlot lambs, is caused by a toxin, and is the same as pulpy kidney disease in nursing lambs.

Prevention
- vaccinate lambs at six to eight weeks of age or two weeks before they go into a full fed concentrated grain based ration. A booster injection may be given three weeks later.

- dosage recommendations given on the product label should be followed.

Paratyphoid (Salmonellosis)
This disease is relatively rare, but it can cause heavy death losses in a feedlot. If transmitted to the ewe flock via feed, water, footwear or carrier, replacement lambs and ewes in late pregnancy are likely to abort.

It is easily confused with coddidiosis and a veterinarian should be called at the first signs of watery diarrhea in the feedlot. Only prompt action can prevent large death losses.

Prevention
- good feeding system
- clean, dry, sanitary facilities
- avoid stress on lambs on full feed
- keep pregnant ewes away from feedlot

Sore Mouth (Orf, contagious ectyma)
A virus disease of lambs primarily, but can affect all classes and ages of sheep to a lesser degree.

Cause
- a skin infecting virus which is spread by direct contact and equipment. Abrasions or slight injuries to lips and gums facilitate entry of virus.

Signs
- show eight to ten days after infection
- small red spots, go to little pustules which break and result in scabs over a period of three to four days
- nose, eyelids, feet and udder may show scabby areas
- young lambs have difficulty suckling, ewes get sore teats
- feedlot lambs might have difficulty eating and could be lame if foot scabs are present.

Treatment
- feedlot lambs cure themselves after looking scabby for two to three weeks
- give soft, highly nutritious feed for a time until the disease clears away
- glycerine, 5 per cent iodine, antibiotic ointments have been used. Viral diseases usually don't respond to antibiotic treatments.

Prevention
- in flocks where sore mouth is a real problem vaccination of young lambs should be carried out.
- vaccine is available commercially in Canada.
- dried scabs can be collected and submitted to a laboratory to be made into a vaccine.
- young lambs could be vaccinated at time of docking and castration, if vaccination was deemed to be necessary.
- sore mouth is contagious to humans and one should wear gloves when vaccinating with the live virus.
- a small pin scratch is made on the inside of the thigh of sheep and the vaccine is brushed into the scratch.

Polio Encephalomalacia
A non-infectious brain disease of feedlot lambs, causing some death losses and considerable expense for treatment.

Cause
- not known with certainty but thought to be a deficiency of thiamine available to the lambs
- certain microflora in the rumen of the feedlot lamb produce thiaminase which destroys the essential thiamine supplied in the feed.
- lack of thiamine gives rise to a chain of events in the body which results in damage to the brain
- high mineral content of deep well water has been suggested as a contributing factor.

Signs
- lambs found dead or comatose
- usually there is blindness, staggering, head pressing, convulsive fits progressing to loss of consciousness and death
- a blind sheep holds its head up and appears to be staring at a point above the horizon.

Diagnosis
- a microscopic examination of brain in the laboratory.

Treatment
- injections of thiamine at two day intervals
- add brewers yeast to the grain rations
- isolate affected sheep.

Prevention
- avoid moldy feed
- have water analysis done, check for hardness and mineral content
- adequate water at all times to prevent salt poisoning.

Listeriosis
Also called circling disease of feedlot lambs.

Cause
- bacterium *Listeria monocytogenes*
- grows in the brain of lambs and forms many tiny abscesses in certain parts of the brain
- disease can be contracted from other sick sheep, contaminated water and feed, through abrasions in mouth and lips.

Signs
- depression, lack of appetite, fever
- paralysis on one side of face viz. droopy ear, lowered eyelids and droopy lip
- constant walking in a circle.

Diagnosis
- laboratory can culture bacteria from brain
- microscopic examination of the brain.

Treatment
- antibiotics injections can be tried, but affected sheep hardly ever respond to treatment.

Prevention
- don't leave dead sheep in the corral to contaminate bedding, feed and water supplies
- burn or bury affected cadavers
- keep pregnant ewes away from the sick lamb area.

NOTE: Listeriosis is an abortion disease of ewes as well.

Arthritis

An infectious and contagious joint disease of feedlot lambs, affecting one or more joints.

Cause
- a chlamydial agent transmitted via urine, feces, tears, navel discharge.

Signs
- start about four to eight weeks after entry into feedlot and lambs are on full feed
- stiffness, pain, fever, humped back
- eye infections present concurrently
- joints are painful, but not enlarged
- lambs don't move well, don't eat well and lose body condition.

Diagnosis
- typical post mortem finding in the joints
- on basis of signs.

Treatment
- tetracycline drugs injected individually for three days at standard dosage level
- chlortetracycline in feed in problem flock is said to be effective for flock treatment.

Prevention
- isolate affected lambs immediately because the infectious disease agent is transmitted through body excretions of the sick lambs
- no general preventative measures or management can be recommended.

NOTE: This disease is very common in western United States lamb feedlots. It appears to be rare in Alberta. It could become more common in the future.

Urinary Calculi (Water belly)

Obstruction of the penis in rams and wethers caused by kidney stones. Male feedlot lambs seem to be the most susceptible.

Cause
- certain salts precipitate out of the solution in the urine and form crystals and calculi
- many factors may contribute to the causation of urinary calculi

Contributing Factors
- heavily fed concentrate rations, phosphorus, calcium imbalance
- feeding of silica-containing prairie grass
- grazing on plants with high oxalate contents e.g., sugar beet tops and leaves
- deprivation of water makes urine more concentrated
- shortage of vitamin A has been implicated but is not a major causative factor.

Signs
- early restlessness, abdominal discomfort, repeated straining with grunting, kicking at belly, twitching of tail
- later, swelling under abdomen, or water filled appearance of abdomen, signs of toxicity (urine poisoning) and death.

Diagnosis
- post mortem examination. Look at and feel tip of the penis (appendage)
- insert finger into rectum and feel bladder or pulsating penis

Treatment
- surgical, consider costs vs. benefits
- snip off the appendage with knife if the calculus is in it.

Prevention
- have total feed analyzed for Ca and P. Let Ca level be higher than P.
- eliminate contributing factors
- in problem areas add ammonium chloride to the feed 0.5 per cent of ration 5 kg/tonne (10 lb/ton of complete feed)
- gradually add salt to the rations to a maximum of 3 per cent 30 kg/tonne (60 lb/ton of feed)
- provide plenty of warmed (well above freezing) water to feedlot lambs to promote water intake.

Rectal Prolapse

A condition most commonly seen in lambs on a high concentrate feedlot ration or lush pastures.

Causes
- injury may result from too close docking and infection
- excessive straining due to coccidiosis, intestinal worms, constipation, urinary calculi
- excessive coughing caused by dusty feed, poor housing conditions (bronchitis etc.) and possibly lung worms
- may be a heriditary predisposition to weakness of anus muscles.

Signs
- glistening red ball-shaped structure protrudes from the anus. This is rectal intestine which has everted itself.

Treatment
- early, when first seen, replace prolapse and fix with a purse string suture (poor results)
- amputate rectum surgically (poor results)
- slaughter lamb, especially if close to market weight.

Prevention
- good sanitation, housing facilities
- prevention program for worms, pneumonia and coccidiosis
- if rectal prolapses are a real problem and all other possible predisposing factors have been eliminated, the genetic aspects should be investigated.

Diseases of Ewes

Pregnancy Toxemia

A metabolic disease affecting pregnant ewes carrying a set of twins or triplets. Fat and skinny ewes can be bothered by this.

Cause
- insufficient energy intake during the last month of pregnancy
- improper sugar metabolism, which leads to low blood sugar, high ketone level in blood, fatty liver.

Signs
- may happen to several ewes at once like an epidemic
- total lack of appetite, normal body temperature 38.9 °C (102°F)
- listlessness, wandering about, apparent blindness
- grinding of teeth as though in pain, staggering, loud breathing
- sometimes there are convulsions, leading to loss of consciousness (coma) and death.

Diagnosis
- positive ketone test in urine, blood test shows low sugar
- a post mortem exam shows fatty liver and a set of twins in advanced state of development
- only silage, hay, and straw are being fed (energy shortage).

Treatment
- unsatisfactory
- glucose intravenous gives only temporary results, not very effective
- glycerol or propylene glycol by mouth four times per day
- induce lambing, or have a veterinarian do a Caesarian.

Prevention
- keep ewes in good condition, not too fat, nor too thin
- increase grain intake gradually over final six weeks of pregnancy, from no grain to 0.7 kg (1.5 lb) grain per day at lambing.
- avoid sudden changes during this final period, viz. changes in feed, shipping or trailing ewes over long distances
- avoid stress, such as excessive handling, deworming, vaccinations, overcrowding, excitement during final four weeks of pregnancy.

Abortions

Cause
- can be caused by microorganisms or by a variety of other stress factors. The infectious abortions of sheep are:
  - Vibriosis
  - Enzootic Abortion of Ewes
  - Brucellosis *(Brucella ovis)*
  - Salmonella
  - Listeriosis.

Signs
- most sheep abortions are similar in appearance
- later stages of pregnancy, usually (last four weeks)
- fetus enclosed in its membranes, stillborn lamb or very weak lambs at birth (die shortly after birth)
- there may be retained afterbirth or uterus infections
- ewes may be ill for a few days before or after the abortion.

Transmission
- most abortion diseases are spread from sheep to sheep through feed and water, contaminated with infected discharges. Brucellosis is an exception to the rule. It may be spread by the ram during the breeding act, through infected semen from infected testicles.

Diagnosis
- very difficult by looking at fetus, most aborted fetuses look the same regardless of cause.
- special techniques are required which can be done in

the laboratory only. The cause of many abortions cannot be identified by any known laboratory detection method. Good, namely fresh, preferably clean specimens are necessary for good results. It is important that the whole fetus, its membranes (placenta or afterbirth) be submitted in all cases, or whenever possible. If only the fetus is found but the ewe shows a retained afterbirth, a piece of the latter should be removed and sent in with the fetus.

If the laboratory cannot detect, isolate or identify infectious abortive agents after a number of suitable submissions, one should look for noninfectious causes of abortions such as:
- nutritional deficiencies - vitamin A, iodine
- rough handling, accidents
- exhaustion after stress, long drives, transport over long distance, dog attacks with stampeding
- any disease accompanied by high fever
- hormonal disturbances, (estrogens, or progesterones).

Treatment
- antibiotics are generally not too effective in preventing abortions
- antibiotics may be required to treat possible uterine infections in the ewe
- uterine pills to clean and contract the uterus
- injectable penicillin may be helpful.

Control
- isolate aborting and discharging ewes from the flock
- after an adequate number of fetuses have been sent to the laboratory for diagnosis, aborted lambs and their membranes should be destroyed, buried, burned.

Don't leave aborted fetuses in the corral, or allow the dog to drag them all over the corral or yard.

- prevent contamination of feed and water with discharges via boots and hands
- be careful about feeding silage to ewes in late pregnancy after Listeriosis abortions have been diagnosed
- maintain high standards of sanitation and hygiene while lambing; wash and disinfect hands frequently.

Immunity against abortions

Vibriosis
- a bacterin is available in Alberta
- a flock is expected to be immune for several years after an outbreak of vibrio abortion has taken place
- the clean home flock should be vaccinated if replacement ewes are purchased from other flocks. Clean replacements should be vaccinated when brought into a flock of vibrio carriers
- vaccinate just before flushing or breeding or at weaning time.

Salmonellosis
- recovered ewes are immune but may be carriers for up to four months after recovery
- no vaccine or bacterin is available for replacement ewes, which can become infected by Salmonella carriers, which usually are already aborted immune ewes.

Enzootic Abortions
- recovered ewes are usually resistant for two to three years
- a number of abortions (5%) will recur year after year in ewe lambs and brought in replacement ewes
- an effective British vaccine can be made available should the need arise. This disease would now appear to be a widespread problem in Alberta, especially in new flocks assembled from various sources, auction markets, etc.

Listeriosis
- no vaccine available
- no immunity is formed.

Prolapsed Vagina

The vagina and cervix bulge out as a "red ball"

Occurrence
- fat ewes more susceptible than thin ones
- three year olds and older
- ewes get very little exercise
- ewes get a lot of roughage.

Cause
- a lot of internal pressure and lack of room, e.g., full rumen, perhaps twin lambs, lying on sloped ground, towards the wind (irritation)
- perhaps genetic predispositions, e.g., weak supports

Signs
- vagina protruded from vulva, red glistening or dry brown, burned, frozen, torn and bruised
- may or may not go back in after ewe gets up
- it may interfere with bladder emptying
- excessive straining, contamination, injury will lead to infection, urine poisoning and death, if condition is not corrected immediately.

Treatment
- needs immediate attention
- work with a detergent and disinfect gently
- if found in early stages the prolapse is replaced quite easily.

- more difficult or almost impossible if found caked with manure, sunburned or frozen
- sometimes a topical application of 0.5 kg (1 lb) of sugar is useful in reducing swelling and facilitating repair
- several methods can be used to keep the vagina where it belongs, despite some straining by the ewe

Examples of repair
- a single vaginal suture
- a shoe lace type of suture
- vaginal retainer, attached to wool
- truss and harness

A veterinarian should be consulted for details of various surgical techniques.

Prevention
- remove causes of vaginal prolapse through sensible feeding and management practices
- cull all ewes which have had a prolapse
- don't use offspring from such ewes as replacement breeding stock
- genetic predisposition to vaginal prolapse should be weighed carefully against other factors before any drastic culling measures are undertaken.

Lambing

Most lambings under good management are without serious complications. However, ewes having enjoyed the best husbandry, nutrition, and disease prevention techniques are still prone to complications (dystocia) such as:

- too large a lamb or lambs, especially for ewes lambing for the first time
- incorrect position or presentation of lambs
- twisted womb (uterine torsion) closing off exit for lambs
- failure to dilate cervix, often called ringwomb
- ruptured uterus.

Fortunately, the latter three are relatively rare. Most lambing problems can be handled quite well by a conscientious sheep person with a level head and common sense. Instructions for correcting some cases of dystocia can be found on page 18 of this manual.

It is very important to clean hands and arms with plenty of hot water and soap. One should then use a liberal quantity of an antiseptic lubricant on hands and arms before going into a ewe to examine her or to try to correct a delivery problem. Nothing damages and hurts a ewe as much as dirty, manure caked, filthy, dry or water wetted hands.

Be very gentle while trying to straighten up a lamb inside the uterus. It can be very frustrating sometimes, but gentleness and patience really pay off. Carelessness and roughness cause bleeding. Laceration of the birth canal or a ruptured uterus are more serious and even fatal complications. Women and teenagers are usually more succesful in correcting abnormal presentations, since their hands tend to be smaller.

Ewes which have been assisted in lambing, especially after a long hard labor should be injected with oxytocin. This drug causes rapid contraction of an empty uterus and helps to expel the afterbirth.

- penicillin injected into a muscle may be useful as an infection preventative
- a couple of sheep uterine boluses can be inserted as well, to prevent infection of a possibly damaged uterus and vagina

A veterinarian should be consulted in difficult cases. The decision to obtain his assistance should be made early, preferably before the lambs are dead or the ewe is almost ready to expire.

Milk Fever

Also called lambing sickness because it usually occurs shortly before or after lambing.

Causes
- excessive handling, e.g., forced exercise, shearing, feeding stresses, deprivation of feed
- grazing on lush green cereal crops
- high calcium and low phosphorus in feed, e.g., lots of good alfalfa but no grains or minerals
- grazing sheep in late pregnancy on beet tops (high in oxalate contents) which lowers calcium level of the ewe's blood.

Signs
- stiffness, stilted gait, trembling, staggering
- sheep may go down after an hour or two
- hind legs stretched backwards, head may be turned toward the flank
- there is no fever, temperature is usually decreased to 36.0 to 36.7°C (97-98°F)
- ewes often look bloated (stomach stops working and gases accumulate)
- most ewes will die if not treated promptly.

Diagnosis
- usually more than one ewe is affected at the same time
- signs and circumstances are highly suggestive
- liver is not fatty, as is usually seen with pregnancy toxemia.

Other diseases which may sometimes look like milk fever are:

- pregnancy toxemia, grain overload, septicemia (blood poisoning), or shock (ruptured uterus for example)
- infection of uterus, mastitis, acute septicemia, pneumonia, acute comatose listeriosis, malignant edema
- brain abscess, some poisonous substance causing unconsciousness.

Treatment
- an injection of 80 mL of calcium borogluconate under the skin will get most ewes up within an hour.

Prevention
- avoid rough handling or long drives during late pregnancy (avoid stress)
- good quality Ca-P minerals should be available at all times. Watch copper levels if fed free choice.
- avoid sudden changes in feed or interruption in feeding routine
- green leafy sugarbeet tops are dangerous for sheep (oxalates).

Prolapsed Uterus

The entire womb turns inside out after lambing.

Cause
- flaccid, atonic (tired) relaxed uterus which just falls out after prolonged difficult labor
- excessive straining due to rough or incompetent lambing assistance, constipation, retained afterbirth
- concurrent milk fever, low calcium in blood prevents proper contraction of a flaccid uterus
- fat ewes have a hard time lambing and are more likely to prolapse.

Signs
- uterus looks red, usually bloody and is studded with cotyledonae (knobs)
- it's found hanging out from the vagina
- if the ewe appears to be very weak, feels cold, and shows very pale eyelids, she is probably dying of internal bleeding and not much can be done.

Treatment
- is best handled by a veterinarian who will wash the prolapsed part very gently with a very mild disinfectant detergent solution.
- places the ewe upside down and lifting her by the hind quarters, returns the uterus to its original position and sutures the vulva to prevent recurrence
- for the do-it-yourselfer, gentleness, patience and a lot of antiseptic lubricant are necessary to do a good job
- one should make sure the eversion is completely corrected before withdrawing one's arm. An incompletely replaced womb will quickly fall out again because of straining by the ewe.
- an injection of oxytocin should be given as well as a few uterine pills. A penicillin injection serves as a precaution against infection
- the vagina should be sutured as under vaginal prolapse
- ewes commonly die within half an hour after the prolapse has been corrected, as a result of massive internal bleeding caused by a ruptured uterine blood vessel
- don't let that be a deterrent to repairing future uterine prolapses.

Prevention
- don't allow a ewe to remain in labor too long. If the water bag appears, breaks, but there is no further progress, the ewe should be examined via the vagina, the problem corrected and the lamb removed before the ewe becomes exhausted and the uterus ready for prolapse.
- get competent help for difficult lambing cases
- inject a ewe with oxytocin into muscle after having helped her, just a safeguard against a prolapse.

Malignant Edema

A deadly clostridial disease which is commonly seen at lambing time. Can kill a ewe very very rapidly.

Cause
- failure to properly clean soiled, dirty hands before assisting a lambing ewe
- unsanitary lambing facilities
- bruising, laceration of vagina during lambing
- infected afterbirth membranes
- bacteria *Clostridium septicum* and *chauvei*

Signs
- hot, puffy, painful swelling in the region of vulva
- ewe depressed, off feed, quite ill, could be quite lame on one leg in early stages
- death usually follows in 24 hours

Diagnosis
- gassy, malodorous, gangrenous swelling
- greenish discoloration.

Treatment
- nil, too late!!

Prevention
- vaccinate with a clostridial toxoid as described on page 61 of this guide

Mastitis

Infection of the udder causing "blue bag"

Causes
- damage to udder, bruising, wire cuts, sore mouth
- bacteria such as *Staphylococcus* sp. or *Pasteurella* sp.

Signs
- mastitis can come up rapidly
- udder becomes hard and painful
- ewe carries one leg away from udder
- bag may turn blue-green and one half may slough off
- if infection spreads through the body, the ewe becomes feverish, quite ill and may die in a day or two
- if ewe recovers, the affected half or the entire udder no longer produces milk
- lamb can go hungry and die as well.

Treatment
- frequent stripping of milk out of udder (at least twice per day)
- hot packs applied to udder using hot water and liniments
- intravenous or intramuscular tetracycline injections may be useful
- sulfa pills might work as well, early treatment is essential.

Prevention
- unless lumps and abscesses are very small, the affected and recovered ewe should be culled from breeding flock.

Agalactia (Lack of Milk)

An udder condition of ewes in Alberta, resulting in inability to produce milk.

Cause
- not known, producers are familiar with the condition, but little or no veterinary research has been done on this problem
- possible influencing factors could be
  - chilling of udders
  - excessive barley feeding
  - mastitis infection not culled
  - mycoplasma infection
  - early lambing (December - January).

Signs
- no fever, no illness, no pain
- no edema of udder
- there is a hard fibrotic lump within the parenchyma of the udder
- sometimes there is an extension from this fibrous mass descending down into the teat canal, causing an interruption of milk flow
- there is a shelf like flattening on the top of this mass
- lambs are sucking but don't fill up. Ewe cannot feed her lambs
- milk appears normal in color and consistency, simply not enough of it
- occurs among first time lambing ewe lambs as well as older ewes.

Treatment
- not known as yet

Prevention
- not known as yet
- cull affected ewes.

Johne's Disease

Wasting disease of older ewes commonly seen after the stress of lambing and nursing.

Cause
- a bacterial organism *(Mycobacterium paratuberculosis)* which causes intestinal damage, which leads to inability of intestines to absorb food properly.

Signs
- there is a slowly progressing loss of body weight, despite good appetite
- stools may be softer than usual, hence rear end is often soiled with fecal material
- affected sheep always die after some period of illness
- may be confused with old age and a run-down condition.

Diagnosis
- laboratory examination
- post mortem findings
- marked emaciation (skinniness).

Treatment
- none

Control
- have suspected cases taken to slaughter OR
- live with the disease and cull ewes as soon as they seem to develop signs of Johne's disease OR
- depopulate for at least two years OR
- have veterinarian or laboratory do routine autopsies on all sheep that die, to determine extent to which flock is infested and act accordingly.

Prevention
- buy clean healthy replacement sheep
- no vaccine available
- no reliable blood test available to detect carriers.

Caseous Lymphadenitis

A very serious disease occurring quite commonly in Alberta. It is most often seen in older animals.

Cause
- bacteria *Corynebacterium pseudo tuberculosis*
- cuts, bruises, wounds, breaks in the skin
- transmission takes place from sheep to sheep through contaminated shearing equipment

Signs
- enlarged lymph nodes of neck, under jaw, side of the face, at shoulder
- chronic and persistent coughing is seen with lung abscesses due to this disease
- some sheep may just waste away without showing abscesses anywhere on the body.

Diagnosis
- greenish yellow cheesy looking pus in abscesses, under skin or in lymph nodes of lungs, intestines, kidneys (seen on post mortem)

Treatment
- not advisable

Prevention
- slaughter all sheep showing abscesses
- sanitary docking, castration, shearing procedures, disinfect hands and equipment between each sheep
- avoid cutting the skin of sheep when shearing
- try to shear young animals first
- no effective vaccine available.

Diseases of Rams

Epididymitis

A bacterial disease affecting the testicles of rams, causing low fertility and poor semen quality.

Cause
- Ram testicles are very vulnerable to injury and infection owing to their large size and close proximity to the ground.
- many types of bacteria can cause abnormalities in one or both testicles.

Signs
- vary with the cause
- some acute infections cause the ram to walk with an abnormal gait due to tender painfully enlarged testicles
- chronic infections can cause pus filled abscesses in the testicles and epididymus
- some chronic infections (*Brucella ovis*) cause no obvious signs of discomfort
- palpation of the scrotum may show lumpy enlargements of epididymus and a change in size and feel of the testicle
- there could be low conception rates in the ewe flock.

NOTE: Brucellosis can be transmitted to a susceptible ewe via the semen of an infected ram. Pregnant ewes may abort.

Treatment
There is none.
- slaughter all rams showing abnormal testicles.

Prevention
- examine and feel scrotum and testicles of all breeding rams at shearing time and shortly before they are turned out with the ewes
- slaughter all abnormal rams.

Sheath Rot (Pizzle Rot)

A bacterial infection of the sheath and prepuce of rams and wethers on a high protein ration or good pastures.

Signs
- irritation from urine, ammonia caused infection, swelling and obstruction of the prepuce.

Treatment
- clean scabs, urine and pus from the infected areas and apply antibiotic ointments, vaseline and copper sulfate.

Miscellaneous Diseases of Sheep

Blue Tongue

A viral disease transmitted by a tiny biting insect *Culicoides* sp. or "no-see-ums".

The federal government is doing all it can to keep the disease out of Canada, and Canada is considered to be free of blue tongue.

Signs
- swollen and inflamed muzzle, lips, tongue, and throat
- excessive salivation and nasal discharge
- lameness, inability to walk, starvation, emaciation
- muscle weakness.

Treatment and Prevention
- a local or federal veterinarian should be notified immediately, since this is a reportable disease by law.

Scrapie

A deadly, slowly developing brain disease of sheep characterized by a long incubation period and intense itchiness, progressive weakness and impaired gait.

Cause
- a virus which will not produce signs of disease before a sheep is about two years old.

Signs
- the fleece loses its bloom

- intense itchiness develops gradually
- extensive loss of wool due to rubbing
- some sheep can die quickly without much wool being lost
- nervous signs, muscle tremor, twitching, grinding of teeth, convulsions
- all affected sheep die in an average of two to six months

Diagnosis
- microscopic examination of the brain.

Prevention
- again this disease is a reportable disease by law. A local or federal veterinarian should be notified immediately when a sheep shows signs suspiciously similar to those of scrapie.

Rabies

Sheep, like all other domesticated farm animals, are susceptible to rabies.

Cause
- a viral brain disease transmitted through a bite of a rabid animal. A sheep bitten by a rabid dog can develop rabies.

Signs
- restlessness, twitching of lips, salivation
- sexual excitement appears to be common
- aggressiveness as shown by butting against a fence or wall
- disease usually kills a sheep within six days.

Diagnosis
- inform a local or a federal veterinarian to have brain sent to a federal rabies laboratory.

Prevention
- none for sheep
- have the farm dogs vaccinated against rabies by a local veterinarian
- wear GLOVES when examining the mouth of a sheep that appears to be drooling saliva and is acting unusually strange
- keep the population of coyotes, foxes and skunks under control
- rabies among sheep is rare in Alberta.

Maedi

A slowly progressing infectious and contagious lung disease of sheep resulting in gradually increasing respiratory distress, loss of body weight and death.

Cause
- a virus spread from sheep to sheep by direct contact.

Signs
- usually seen in sheep from three to five years old
- early stages show faster than normal breathing after exercise
- later stages shows definite expiratory distress, after very mild exercise
- there is gradual loss of body condition
- the animal eventually dies in six to eighteen months of sheer inability to breathe (anoxia).

Diagnosis
- signs of disease and typical appearance and texture of lungs
- they are often called "lungers" by shepherds and culled.

Treatment
- none.

Prevention
- send to slaughter all sheep showing signs of progressive respiratory disease.
- lambs can contract the virus from older ewes, and start to show signs when they are three to four years of age.
- be very careful when buying replacement stock. Check the entire flock of origin for signs of maedi among older ewes.

Sarcosporidiosis

A commonly seen condition of mature sheep. It is only seen in the slaughter house, and is a cause of condemnation of carcasses.

Cause
- a protozoal parasite *Sarcocystis tenella*
- the infectious spores are eaten together with infected manure contaminated feed.

Signs
- rarely seen in living sheep
- the meat inspectors at the packing house find cysts varying in size from microscopic to 1 cm (0.4 in.).
- these cysts occur in the:
    - lower esophagus
    - abdominal muscles
    - diaphragm
    - cheek muscles.

Treatment
- none.

Prevention
- prevent fecal contamination of feed
- avoid wet marshy pastures
- avoid overcrowding and overstocking of pastures.

PRODUCTION COSTS AND RETURNS

Costs of production are as important in the production of sheep as in other agricultural enterprises. Attention to them is expected of any operator. Sometimes it is difficult to ascertain the exact costs when several enterprises share the resources of land, labor and capital on the same farm. However, it is safe to assume that most sheep operators want to make some profit, and do individually assess costs of production in some manner.

Returns are not likely to reach a profitable level unless sheep raising is undertaken as a business. For those who maintain flocks of commercial size from year to year whether on the range, in the feed lot, in confinement or otherwise, a system of records is essential. Information on costs and prices of breeding, weaning, medical treatment, etc. from year to year can be useful references in succeeding production periods.

Components of Costs and Returns

Sheep flock costs and returns should be carefully interpreted, especially if it is only one of a number of enterprises on the farm. Expenses which are incurred only because of the sheep enterprise should be deducted first. Resources which are shared with several other enterprises have to be proportionally allocated to the sheep enterprise.

Value of the annual production: calculations require more than just lamb sales. It should include all the sales: cull ewes, rams, fleeces, etc. Adjustment must also be made for inventory build up or decline in the sheep flock, that is, all purchases and sales of the stock should be reflected in the total value of production. In most cases, the number of lambs produced per ewe per year, commonly called productivity, is an important factor in generating the total revenue. Some commercial sheep operators consider productivity to be a matter over which they have little control, however, a sound program of sheep husbandry undoubtedly will influence the productivity.

Variable costs and services are the costs of goods that you bought because you needed them for your product. The greatest proportion of these expenses in sheep farming goes toward feed. Consequently, an optimum feeding program is important and can increase your returns. Sheep have a better feed conversion ratio and produce higher gross income per each dollar of feed spent than the majority of other livestock enterprises. In order to determine the true cost of feed for a sheep enterprise, it is necessary to value the feed at either market value or alternative opportunity value, if it is a home grown crop. The other expenses under this category are items such as veterinary, repairs, supplies, marketing and transportation fees.

Operator's labor cost is a significant item in calculating the return for a sheep enterprise. Labor use is usually measured in numbers of hours per ewe per year. Under Alberta conditions this varies from 4 to 5 hours per ewe.

Lower labor requirements are often associated with:

- modernized watering
- modern means of litter removal
- good lambing facilities and fences
- organized weighing and loading operations

Depreciation and interest on investment: The expenses associated with the capital (depreciation, interest) have to be covered regardless of whether you produce anything or not. Therefore, the greater the production value per dollar invested, the lower the fixed costs for depreciation and interest per unit of output. Operating at full capacity reduces overhead costs per unit and increases net return of the farm. It should be pointed out that the interest consists of two items:

- Interest actually paid on borrowed capital
- Interest on the operator's equity, the level of which has to be appropriately estimated.

Usually the combination of current lending and borrowing interest rates is used. The interest rate used on land is usually lower than on other capital (machinery, buildings, basic herd) because it has in the past appreciated in value. For the farm with several enterprises, the capital investment has to be proportionally allocated to each enterprise according to use. For instance, the crop land value is allocated to the crops while the pasture value is allocated to sheep or other livestock enterprises.

Return to management is the residual after all expenses are paid by the value of production. The success of the enterprise is measured by the return to management. This amount can be negative in some cases, however, we have to keep in mind that this residual covers the estimated operator's labor at the going rate, depreciation and the return to capital at the current rate. The feed is considered if purchased and thus separates the sheep production from the crop enterprise.

Analyzing the ewe-lamb operation: The first step in such an analysis is to calculate costs and returns to the

ewe-lamb operation over the past year. This means that the farm operator's yearly accounts must be summarized so that information can be easily extracted.

Two important calculations in the analysis are:

1. Gross ewe-lamb returns (value of the year's production)
2. Feed used by the flock

Calculations for gross returns require more than just sales. Adjustments must also be made for inventory buildup or decline in the flock. Purchases must also be deducted as they are not part of production. Feed makes up a large proportion of the flock costs on most farms. Much of it is also home grown and therefore appraisal of feed quantities used can be difficult.

Two summary sheets are therefore useful when completed before ewe-lamb costs and returns are calculated. These are:

1. Feed Summary Balance Sheet - Table 11
2. Livestock Summary Balance Sheet - Table 12

These two statements can assist in balancing off sheep numbers and tonnes of feed to make sure that none has been overlooked, lost or stolen.

Once these summary statements have been completed, calculations of costs and income are simply a matter of collecting and transferring information. This can be obtained from the two summary sheets and portions of the total farm accounts which deal with the ewe-lamb operation. (A ewe-lamb costs and returns summary is attached as Table 13).

A ewe-lamb costs and returns analysis should be carefully interpreted, especially if it is only one of a number of enterprises on the farm. Large expenses which are incurred only because the ewe-lamb enterprise is there, should be deducted first. Feed and labor are the most important, accounting for two thirds of total costs. Direct cash costs on repairs, veterinary, trucking, etc., are not usually large items on a per ewe basis, but are real and must be paid as a direct result of having the ewe lamb operation. Overhead is a large item but difficult to appraise, so it is often deducted last, or simply left as a residual. It is up to the farmer to decide whether return to the overhead investment is adequate.

Break even analysis: The price of lambs determines, to a great extent, the amount of profit that your sheep enterprise will make. However, the major management factors such as per cent weaning, production costs and lamb crops per year must also be considered.

Table 10 shows the average price, per kilogram for finished market lambs, that would be required to break even at various per cent weaning levels and at five different levels of Total Costs/Ewe. **The calculations are based on the assumption that all gross return is from the sale of fattened lambs.** The purpose of this Table is to demonstrate the effect Management and the use of new technology has on per cent lambs marketed and Total Costs per ewe.

To illustrate the use of these tables, consider in Table 10 that your Total Cost per Ewe is $80.00. You expect to market 150 lambs from a 100 ewe flock. In Table 10 look down the column from the $80.00 Total Cost/Ewe until you come to the 150 per cent marketed line. Observe that your break even price is $1.07 per kilogram or 49¢ per pound.

Table 10. Lamb Price Required per Kilogram to Break Even (i.e., 50 kg lambs)

Percent Marketed	Total Cost/Ewe $				
	70	**80**	**90**	**110**	**120**
100	1.40	1.60	1.80	2.20	2.40
110	1.27	1.46	1.64	2.00	2.18
120	1.17	1.33	1.50	1.83	2.00
130	1.08	1.23	1.38	1.69	1.85
140	1.00	1.14	1.29	1.57	1.71
150	0.93	1.07	1.20	1.47	1.60
160	0.88	1.00	1.13	1.38	1.50
170	0.82	0.94	1.05	1.29	1.41
180	0.78	0.89	1.00	1.22	1.33
190	0.74	0.84	0.95	1.16	1.26
200	0.70	0.80	0.90	1.10	1.20

A Word of Warning

All input items should be priced at their alternative opportunity value. In other words they should be charged to the ewe-lamb operation only at what they would earn in another feasible use, if any. Coulee pasture for example, may have no alternative use and thus there should be no charge against the ewe-lamb operation. Idle winter labor on a grain farm falls in the same class, although the farmer may put a reservation price on idle hours simply because he/she values leisure, curling, etc. and doesn't want to be bothered with sheep. Farmers with a supplementary ewe-lamb operation will only be kidding themselves if they enter these cost items at inflated prices which cannot be realized in other practical alternatives. If this is done the ewe-lamb enterprise may appear to have lost money, thus leading to the false conclusion that the farm would be better off without it.

Disposal of the sheep flock in many cases means that the farmer now has no market for waste resources. The result is a lower total farm profit. The costs-returns analysis thus does the farmer a disfavor, instead of helping in management decisions.

TABLE 11

Annual Feeding Schedule - Ewes

1. Flushing	- pasture _____	days _____ to _____
	- feed _____	days _____ to _____
	- grain _____	kg/day; total _____
	- hay _____	kg/day; total _____
2. Breeding	- pasture _____	days _____ to _____
	- feed _____	days _____ to _____
	- grain _____	kg/day; total _____
	-hay _____	kg/day; total _____
3. Maintenance - (Fall)	- pasture _____	days _____ to _____
	- feed _____	days _____ to _____
	- grain _____	kg/day; total _____
	- hay _____	kg/day; total _____
4. Maintenance - (Winter)	- feed _____	days _____ to _____
	- grain _____	kg/day; total _____
	- hay _____	kg/day; total _____
5. Gestation 6 - 4 weeks pre-	lambing _____	days _____ to _____
	- grain _____	kg/day; total _____
	- hay _____	kg/day; total _____
	_____	kg/day; total _____
6. Gestation 4 weeks pre-	lambing _____	days _____ to _____
	- grain _____	kg/day; total _____
	- hay _____	kg/day; total _____
	_____	kg/day; total _____
7. Lactation	_____	days _____ to _____
	- grain _____	kg/day; total _____
	- hay _____	kg/day; total _____
	_____	kg/day; total _____

8. Maintenance (spring & summer) - pasture _____ days _____ to _____

- feed _____ days _____ to _____
- grain _____ days _____ to _____
- hay _____ days _____ to _____
- straw _____ days _____ to _____

Annual Feeding Schedule - Lambs

1. Creep feeding _____ days _____ to _____

- grain _____ kg/day; total _____
- protein supplement _____ kg/day; total _____

2. Finishing ration _____ days _____ to _____

- grain _____ kg/day; total _____
- protein supplement _____ kg/day; total _____
- hay _____ kg/day; total _____

Annual Feeding Schedule - Replacement Ewe Lambs

1. Creep feeding _____ days _____ to _____

- grain _____ kg/day; total _____
- protein supplement _____ kg/day; total _____

2. Growing ration _____ days _____ to _____

- grain _____ kg/day _____ to _____
- protein supplement _____ kg/day; total _____
- hay _____ kg/day _____ to

Annual Feeding Schedule - Rams

1. Flushing & Breeding _____ days _____ to _____

- grain _____ kg/day; total _____
- hay _____ kg/day; total _____
- ( )_____ kg/day; total _____

2. Maintenance - feed _____ days _____ to _____

- grain _____ kg/day; total _____
- hay _____ kg/day; total _____
- straw _____ kg/day; total _____
- pasture _____ days _____ to _____

Table 12. Sheep Flock Balance Summary _____ 19___ to _____ 19_____

	A			B	C			D			E	F		
	Opening Inventory			Born	Bought or Transferred In			Sold Or Transferred Out			Died	Closing Inventory		
Item	No.	Wt.	Value	No.	No.	Wt.	Value	No.	Wt.	Value	No.	No.	Wt.	Value
Ewes Exposed														
Yearling Ewes Exposed														
Yearling Rams														
Lambs														
Rams														
TOTAL SHEEP														
Feeder Lambs														
Feeder Lambs														
Feeder Lambs														
TOTAL FEEDER LAMBS														
Other Livestock														
TOTAL OTHER														
TOTAL LIVESTOCK														

For Sheep Enterprise: A + B + C must equal D + E + F

NOTE: If this does not check, some sheep have been overlooked, stolen, lost, died, sold, etc.

Table 13. Estimated Returns and Costs of Sheep Production in Alberta 1983.

TYPE OF ENTERPRISE: EWE-LAMB			FOR: TOTAL PROVINCE	TOTAL	PER EWE	PER LB. LIVE
RECEIPTS:						
123 *FINISHED LAMBS	124.4	CWT	$ 66.44/CWT	8264.47	55.65	0.50
16 EWES	23.7	CWT	$ 22.23/CWT	527.15	3.55	0.03
1 RAMS	1.7	CWT	$ 36.99/CWT	64.33	0.43	
1 *BR. RAMS/RAM LAMBS	0.7	HEAD	$204.52/HEAD	145.52	0.98	0.01
14 *FEEDER LAMBS	13.6	HEAD	$ 44.11/HEAD	599.66	4.04	0.04
8 *BR. EWES/EWE LAMBS	8.3	HEAD	$ 83.53/HEAD	695.55	4.68	0.04
GOVERNMENT SUPPORT PAYMENTS				1683.25	11.33	0.10
INV. CHANGE (FORS, ETC.)				1683.48	11.34	0.10
OTHER RECEIPTS				1219.04	8.21	0.07
A.GROSS INCOME				14882.46	100.21	0.89
VARIABLE COST:						
BARLEY	14.4	TONNES	$101.27/TONNE	1461.26	9.84	0.09
OATS	5.5	TONNES	$101.38/TONNE	555.64	3.74	0.03
OTHER GRAINS	0.1	TONNES	$105.27/TONNE	6.32	0.04	
SCREENINGS	3.8	TONNES	$ 44.12/TONNE	168.76	1.14	0.01
SILAGE	1.3	TONNES	$ 31.65/TONNE	39.78	0.27	
HAY	52.4	TONNES	$ 63.23/TONNE	3316.14	22.33	0.20
STRAW FED	2.0	TONNES	$ 24.30/TONNE	48.69	0.33	
GREENFEED	3.7	TONNES	$ 42.51/TONNE	158.41	1.07	0.01
19 %/%CREEP RATION	1.7	TONNES	$207.78/TONNE	352.55	2.37	0.02
16 %/%GROWER RATION	3.3	TONNES	$185.60/TONNE	609.23	4.10	0.04
18 %/%FINISH RATION	1.0	TONNES	$160.43/TONNE	155.82	1.05	0.01
%/%RAPESEED MEAL		TONNES	$ /TONNE			
54 %/%SOYBEAN MEAL	0.1	TONNES	$514.84/TONNE	51.88	0.35	
VIT.+MINERALS+SALT+RUMEN.	0.5	TONNES	$*******/TONNE	244.96	1.65	0.01
FEED PROCESSING		TONNES	$ /TONNE	2.28	0.02	
FEED TRUCKING COSTS	0.2	TONNES	$236.35/TONNE	49.44	0.33	
OTHER FEED ITEMS	1.1	TONNES	$ /TONNE	245.33	1.65	0.01
PASTURE	141.2	AUM	$ 8.65/AUM	1221.41	8.22	0.07
TOTAL FEED COSTS				8687.90	58.50	0.52
FEEDER LAMBS	1.2	HEAD	$ 30.34/HEAD	35.59	0.24	
EWES/EWE LAMBS		HEAD	$213.75/HEAD	2.74	0.02	
RAMS/RAM LAMBS	0.1	HEAD	$409.33/HEAD	34.11	0.23	
SHEARING	84.0	HEAD	$ 1.64/HEAD	138.04	0.93	0.01
BEDDING	10.3	TONNES	$ 22.52/TONNE	231.29	1.56	0.01
VET.+MED.,CHEM.+DISINFECT.				342.49	2.31	0.02
MANURE DISPOSAL (IF HIRED)				19.19	0.13	
LIVESTOCK TRUCKING COSTS				112.68	0.76	0.01
MARKETING & ASSEMBLY CHARG.				138.98	0.94	0.01
UTILITIES				406.46	2.74	0.02
MACH.BLDG.EQP. OPERTNG.+REP				1595.79	10.74	0.10
ACCTNG,PROF.DUES + MISC.				313.92	2.11	0.02
INTEREST-OPR. LOANS				481.96	3.25	0.03
HIRED LABOUR	36.1	HOURS	$ 5.56/HOUR	200.46	1.35	0.01
OPERATOR'S LABOUR	861.3	HOURS	$ 6.85/HOUR	5910.16	39.79	0.36
FAMILY LABOUR	345.8	HOURS	$ 3.60/HOUR	1245.19	8.38	0.07
B.TOTAL VARIABLE COSTS				19896.94	133.97	1.20
CAPITAL COSTS:						
INSURANCE & TAXES				250.42	1.69	0.02
DEPRECIATION (BLDG.+EQUIP.)				1777.12	11.97	0.11
INTEREST-CAPITAL LOANS				1068.32	7.19	0.06
C.TOTAL CAPITAL COSTS				3095.86	20.84	0.19
D.TOTAL PRODUCTION COSTS(B+C)				22992.80	154.81	1.38
GROSS RETURN (A-B)				-5014.48	-33.76	-0.30
NET RETURN (A-D)				-8110.34	-54.61	-0.49

HEAD HANDLED	217.9	DEATHLOSS o/o	15.7	CWT.LIVE WGHT.	166.3	LB.WT/SHEEP	100.8
NO.SHEEP EQU.	165.0	LB.FD/SHEEP EQ	1212.3	HOME FEED o/o	67.0	SHP RECPT.o/o	59.1
EWES	149.5	EWES/RAM	26.0	EWE LAMBS	16.1	LAMBS WND/EWE	1.2
WNG AGE(DAYS)	133.3						

GRS.RETURN/LB	-0.3	NET INCOME/LB.	-0.1	EQUITY INTERES	-7.6	TOTL.INV.INT.	-6.6

PROCESSING LAMB FOR HOME CONSUMPTION

Introduction

The ease with which lamb can be dressed and prepared at home makes it a convenient source of meat for family use.

The fact that a 50 kg (110 lb) live finished lamb yields about 24 kg (53 lb) of carcass and approximately 20 kg (44 lb) of eating meat makes it small enough so that it can be properly chilled and cured with average home refrigeration. The larger cuts and roasts can be consumed in the fresh state before spoilage occurs and smaller cuts (e.g., chops and stew meat) can be easily frozen in the freezer compartment of the average kitchen refrigerator.

Top quality lamb for home consumption depends basically on four factors.

- The breeding of the animal - Lambs of the so called mutton breeds finish more readily and have thicker muscling in the areas of desirable cuts.

- The way the lamb has been fed - a high degree of finish is not necessary. A lamb that has moderate finish, resulting from being fed grain 3-4 weeks will produce a lamb of excellent quality in terms of eating pleasure. Even grass fat lambs can be used, but they will lack that full delicate flavor.

- The age at which it is slaughtered - meat from sheep which are generally less than a year of age is known as lamb and will produce the most desirable carcass. Over one year of age the product is known as mutton which can be acceptable too, if proper methods of cooking are utilized.

- Methods of slaughter and handling carcass - while plenty of fresh water is important right up to slaughter time, feed is not. A 24 hour fast prior to slaughter is more essential with sheep than any other livestock. An empty gut makes it easier to remove the pelt and improves the color of the carcass. Lambs should be penned up during this time to prevent excessive exercise, and to get over the excitement and stress of being chased. Another important point is to allow the fleece to dry thoroughly, as the dryer the fleece, the cleaner the carcass will be.

Lambs should not be shoved or grabbed by the fleece as this will leave blood bruises on the carcass, which will be the area where spoilage starts first. Because of its age, a lamb carcass chills quickly and does not need to be hung any longer than 24 hours.

Tools and Equipment Required for Slaughter

Curved skinning knife
Sharp pointed boning knife
Hammer for stunning
Hook and rope for hanging (front end loader is good)
Pail and lots of water
Table and/or V-shape trough about 51 cm (20 in.) high

Stunning and Sticking

A sharp blow on the top of the head with the hammer will stun the lamb. Place the lamb on table with head hanging over the edge. Insert knife close to the neck bone just behind the angle of the jaw and below the base of the ear. Cut out at right angles to the neck. Allow sufficient time for lamb to bleed, hold the head so blood will not run through the fleece.

Skinning and Fisting

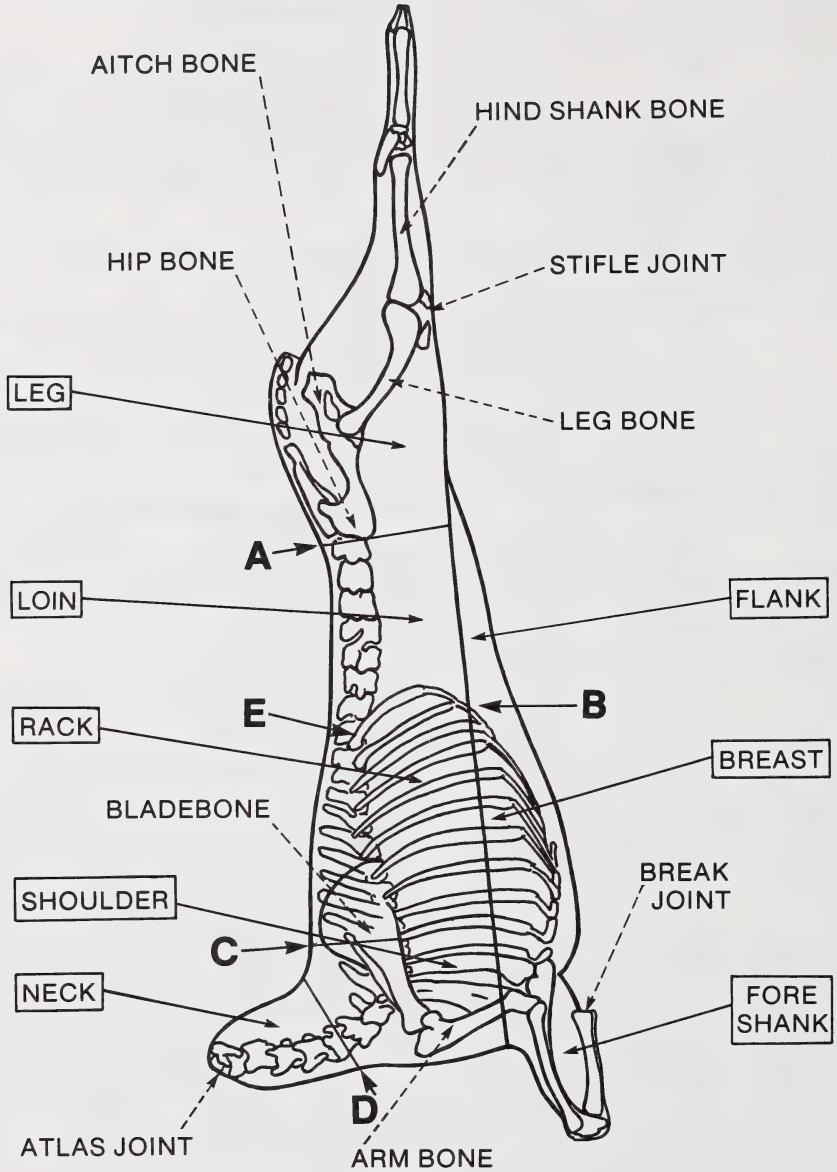
After lamb is well bled the removal of the pelt can begin. It is best not to let the wool or exterior of the pelt touch the skinned surface, if for no other reason than cleanliness.

Stand at the side of the lamb, which is still on the table, hold the front leg between your knees and straighten lamb's leg by leaning away. Cut through skin with cutting edge facing outwards rather than towards meat. This is called choking the knife and if done carefully will avoid cutting the fell, which is a paper thin membrane just under the pelt. Extend cut from below knee up to a point well below the brisket. Do the same for the other front leg. With the knife, skin off pelt from around the legs. Grasp the point or head end of the V-shaped strip over the brisket and pull it up over the brisket.

Now hold the hind leg between the knees and make cut from hoof to a point just in front of the anus. Skin out the hock and leg, being careful not to cut into choice leg muscle. Do the same for the other leg. Now grasp the pointed strip of pelt and pull over the cod or udder as far as it will go without tearing the flesh.

Begin fisting on one side of the brisket. Clench the fist with the thumb on top of the first finger, direct the motion and pressure of the fist against the skin. Push and work it away from the meat. If you break through the fell it will make an unattractive carcass but will not ruin the meat. Be sure to use lots of warm water on your hands and arms, this not only keeps things clean but provides a medium to keep the flesh from becoming tacky. Loosen

Figure 16. How to cut a lamb carcass



the pelt as far down on the brisket as possible, then do the same on the other side. The most difficult place to fist is usually over the brisket and along the ribs. The thumb can be used to loosen the real areas. Now go to the rear and fist off the belly until you reach the opening at the brisket.

Now that this part has been completed the lamb can be hung on a gambrel and hook at about the 2 m (7 ft) level.

Cut the pelt down the belly laying open the hide on both sides. Fist up around the hind legs and stifle area and down past the shoulder. This leaves the pelt attached only along the back and rump. Begin at the rump and pull gently until pelt comes loose, carefully fist and pull pelt down until it is left draped over the head. With knife, remove head at the atlas joint and pelt and head will fall off.

Opening the Carcass

Cut down the middle of the carcass starting at the cod or udder and continue down through the cartilage of the breastbone or sternum. The clenched fist grasping the knife is put on the inside with the blade protruding outwards, in this fashion the knife can be forced right on down through the center of the sternum opening the carcass right down to the neck. Using the longer boning knife, cut around the anus and sever muscles holding the large intestine. Using string, tie off intestine to prevent spillage of contents into body cavity.

As the paunch and intestines fall out and hang loosely, get your hand in behind the viscera and loosen it where it is attached near the kidney. In this fashion, making a few cuts where necessary, the viscera will fall completely out.

Use care in removing the liver as this is an edible organ as are the kidneys and heart. Because of their small size and relative thickness, sheep carcasses are not split before cooling. Sheep carcasses should be cooled as quickly as possible and left to hang at least 24 hours before cutting.

Cutting the Carcass

Lamb does not require the long aging period that beef does and can be satisfactorily cut into edible portions 24 hours after slaughter. A cold carcass that has firmed up is most desirable for making square cuts and equal portions.

A good hand saw and knife can do the job satisfactorily, but a meat power saw, or even a carpenters band saw can do a much superior job.

The lamb carcass left whole is first cut by removing both hind legs. This cut is made at point A on Figure 16, first by scoring with a knife, then cutting through the backbone with saw. When the legs have been removed, they can be further split into two separate legs, and if smaller roasts are desired, cut again into four portions to suit your desires. For home use, roasts are more desirable to make, as steaks require hand sawing and individual steaks will often vary in thickness.

Our next cutting operation involves removing the flank and brisket. This is cut B on Figure 16, and is made through both sides. The brisket, shank and flank can be used for stew meat and the ribs for spare ribs much like pork.

The square cut shoulder can be cut, first by cutting the complete carcass along C and removing neck at D. Once this cut has been made, it can be split down the middle making two fairly large square cut shoulder roasts.

This leaves the rack and the loin to be cut into double chops for the entire length if desired, or can be divided into the two wholesale cuts by cutting at point E on the diagram. Once the rack has been separated from the loin, these two wholesale cuts can be further split by cutting down the midline. This may make it easier to cut chops, but chops will only be half the size.

Boneless cuts can be made from the entire carcass by using a little knife skill and removing the individual muscles from the carcass, leaving the bones intact. This gives you straight eating meat and is desirable if a high proportion of "fry" meat is desired, as shoulder and leg can both be made into steaks or chops to suit your preference.

Lamb offers diversity to the Canadian meat menu. There are many recipe books available that can tell you how to prepare and cook lamb.

APPENDIX I

Glossary of Sheep Terms

Inherited Defects

In selection of replacement stock it is important to select only for traits that are economically important in total weight of lamb and wool produced.

Record keeping can be simplified if replacements with production defects are culled and sent to market upon visual appraisal.

Acquired Character - Any character of an animal which is the result of environment and is not inherited or transmitted to the offspring.

Apparel Wool - Wool suitable for manufacture into apparel fabrics.

Black Wool - Fleeces from sheep containing gray, brown or black wool.

Buck Wool - Wool shorn from rams or male sheep.

Bulk Grade - The largest percentage of grade in a lot of original-bagged wool.

Carbonizing - Removal of burrs from wool by immersion in sulphuric acid.

Character - Any feature such as color of face or fleece, horns, length of ear and so on. A character may be due to a single factor or gene or to several. This is one of the reasons why it is difficult to know how a particular character developed.

Core Testing - Sampling grease wool and processing the samples to determine the shrinkage and yield or clean content.

Cotted - The matting together of wool fibres.

Crimp - The wave in the wool fibres.

Crossbred - The offspring obtained by crossing two breeds or types.

Cryptorchidism - When one or both testes of the ram is retained in the abdomen rather than descending into the scrotum. This defect reduces fertility but not growth rate. Cryptorchid rams should be culled and sent to slaughter.

Embryo - The early stages of the development of the fertilized ova in the uterus; in later stages it is called the fetus.

Environment - Any influence that has its origin outside the body. Feed, climate and shelter are parts of environment. This is a continuing influence in contrast with heredity, which is completed at the time of fertilization.

Ewe - Female sheep.

Face covering - A trait that is highly heritable. There is sufficient research work available to show that wooly faced ewes should be culled from the flock. Open faced ewes raise more lambs than do wooly faced ewes.

Fed **lambs** - Those which have been fed a concentrate in contrast to those off pasture or range.

Fertilization - The union of the nucleus of the sperm and the nucleus of the egg to form one cell from which an individual develops.

Fetus - An unborn lamb in its later developmental stages.

Fleece - The wool from a single sheep in the shorn grease state.

Foreign matter - Any material such as hay and burs that appear in the wool and is removed in processing.

Gestation period - From time of conception to the time of delivery.

Grade - The classification system used to describe grease wools by fibre diameter.

Grease wool - Wool as it is shorn from the sheep, before any processing.

Hairiness - A defect in wool is reported to be highly heritable. The reduced uniformity of the fleece makes it less valuable to the manufacturer. The sheep producer must determine the economic importance of wool to his sheep enterprise and apply selection pressure for wool traits accordingly.

Handle - A term referring to the actual feel of wool. Wool with a good "handle" is a wool with great resilience and softness, one most pleasing to the touch.

Hank - A 512 m (560 yd) unit of wool yarn wound on a reel.

Hybrid - The result of mating two unlike or unrelated animals. In this sense the offspring of a Southdown and

Rambouillet is a hybrid, although usually called a crossbred by sheepmen.

Hybrid vigor - When crossbred lambs exceed the average performance such as in growth rate of their parents, or size, this is termed hybrid vigor or heterosis. It is common in sheep.

Inbreeding - Mating related animals.

Jaw defects - When the teeth in the lower jaw extend forward past the dental pad (undershot) or when the teeth hit in back of the dental pad (overshot). These conditions are inherited defects. Some reports indicate weaning weight is lower for lambs with jaw defects. The condition becomes more severe with age and a lower survival rate for yearling rams with such defects is reported.

Keds - The common sheep tick.

Lactation period - The time the ewe is producing milk.

Lamb's wool - Wool of short character taken from a lamb not over seven months old.

Lanolin - Wool grease. This substance, sometimes called "yolk", is a secretion from the sebaceous glands of the sheep. It collects in the wool and serves as a conditioner to prevent excessive drying of the wool.

Line Breeding - A system of mating designed to keep the descendants closely related to an ancestor and regarded as very desirable.

Lock - A small, approximately finger size, bit of wool that tends to stay together when shorn from the sheep.

Noils - The short and sometimes defective wool fibres removed from the card sliver on the comb in the process of manufacture or combing of top. The noils are used in woolens and felts, usually blended with longer-stapled wools.

Pelt - The skin of the sheep with wool still on the skin.

Phenotype - The appearance of an animal with respect to characters it inherited and as affected by environment. The animal may contain other characters in its germ plasm that differ greatly from those which it displays in its own make-up.

Prepotency - Usually used with reference to males and signifies an unusual ability to transmit the characters to his offspring regardless of the kind of females with which he is mated. From a genetic standpoint, it implies the possession of many dominant factors which overshadow the characters in the females.

Progeny - The produce of an ewe; the get of a ram, offspring or descendants.

Pulled wool - When sheep or lambs are slaughtered, most of the pelts removed from the carcasses are sent to "pulleries". The flesh side of the pelt is painted with a caustic depilatory solution, and the wool may easily be pulled from the skin.

Ram - A male sheep.

Range wool - Wool grown on large ranches, distinct from wool grown on small farms.

Sacking - Tied wool fleeces are usually sacked at the shearing plant in large burlap bags varying in length from 1.5-2.0 m (5-7 ft) and in diameter from 50 - 76 cm (20-30 in.). From 90 - 180 kg (200-400 lb) of grease wool are packed in each bag for shipment to mills.

Scouring - The actual washing of dirt, grease and foreign matter from grease wool. This is usually done in a lukewarm, mildly alkaline solution, followed by a rinse.

Shearing - The removal of wool from the sheep by the use of powered clippers or blade shears. The latter practice is almost extinct today.

Short staple length - Lowers the fleece value of wool considerably. It is a product that creates little demand from manufacturers.

Shrinkage - The loss in weight of wool fleeces caused by removal of grease and foreign matter when grease wool is scoured.

Sorting - Virtually all fleeces contain more than one grade of wool. As grading is the classification by fleece, sorting is the classification of wool within a fleece.

Staple length - A highly heritable trait that is a valuable production characteristic.

Top - A continuous strand of partially manufactured wool, which previously has been scoured and combed, resulting in the fibres being of equal length and running parallel.

Tying - After the wool is shorn it is rolled into a neat bundle and tied with paper cord.

Wether - A castrated male sheep.

Woolen - Large amounts of shorter wools, such as noils, wool wastes and reworked wools are used in addition to virgin wool. Woolen yarn is not combed, hence fibres lie in an uneven fashion.

Worsted - Virgin wool or wool that has not been previously processed is generally used. Fibres are parallelized during combing into a product called top, then are spun into a worsted yarn.

Yearling Wool - The first full fleece shorn from a sheep 12 to 16 months old.

Yield - The amount of clean wool that is derived from grease wool in the scouring process.

APPENDIX II

Production Calendar for Alberta Sheep Producers

For the Production of Early Lambs

August
1. Drench the ewes and rams 10 days before flushing.
2. Shear around the dock of ewes.
3. Check all feet, trim carefully.
4. Flush ewes starting August 15.
5. Shear ram during the last week and start giving him extra feed.

September
1. Turn ram with ewes, starting September 1 for January 28 lambs.
2. Stop flushing September 1.
3. Consider turning one ram with ewes each evening - rest second ram for a day.
4. Change color of marking on ram September 17.
5. Keep records of breeding dates.
6. Observe ewes for breeding efficiency of ram.

October
1. Change color of ram mark October 4.
2. If only one ram has been used, turn in another ram.

November
1. Check condition of ewes.
2. Increase nutrition level if pasture is inadequate.
3. Drench all the flock for winter.

December
1. Start winter feeding.
2. Start feeding 0.2 kg (0.5 lb) grain per ewe about December 15.
3. Provide a good mineral mixture.
4. Provide plenty of fresh ice-free water.
5. Order lambing supplies.
6. Enroll flock in Alberta ROP test.

January
1. Trim crotch, udder, and face of each ewe at least 30 days before lambing.
2. Increase feed to ewes about to lamb.
3. Check breeding dates for time of lambing.
4. Prepare lambing facilities, 1.2 x 1.2 m (4 x 4 ft) pens.
5. Sort off group of early-bred ewes.
6. Provide dry, well bedded lambing pens.

February
1. Give extra time to save lambs.
2. Dip navels of newborn lambs in iodine. Ear-tag lambs.
3. Trim and treat feet of ewes when they are taken from lambing pen.
4. Feed ewes good quality hay, 1.8 - 2.7 kg (4 - 6 lb), and 0.7 kg 1.5 lb) grain daily.
5. Dock and castrate lambs at 7 to 10 days of age.
6. Start lambs on creep feeder by 10 days of age. Consider vaccination.
7. Pen all lambs in creep for one hour during a.m. and p.m. feeding period.
8. Feed ewes with twins, 0.9 kg (2 lb) grain.
9. Keep water in the creep area.
10. Identify all twin lambs and early dropped lambs for future breeders.

March
1. Continue creep feeding lambs.
2. Continue feeding ewes with twin lambs for 8 weeks after lambing.
3. Shear ewes.
4. Mark all ewes not lambing.

April
1. Cut all ewe rations back to not over 0.5 kg (1 lb) of grain.
2. Drench ewes 10 days before turning to pasture.
3. Either wean lambs or use in and out system for ewes (lambs stay on creep - ewes on pasture during day).
4. Don't permit ewes not raising lambs to consume grain.
5. Consider weaning all lambs at 90 days and finish all lambs in drylot.

May
1. Turn all ewes to pasture when growth is adequate.

2. Note poor producing ewes from records of lamb weights at weaning time.
3. Arrange for dipping of all sheep and lambs.
4. Market lambs weighing over 27 kg (60 lb) should not go to pasture.

June
1. Top out all choice market lambs weighing 48 - 52 kg (105 - 115 lb).
2. Provide mineral mixture on pasture.
3. Locate breeding rams (a) select on basis of 100 day performance records.

July
1. Feed and finish in drylot all unfinished lambs.
2. Cull unsound and unproductive ewes.
3. Buy meaty, production tested purebred rams.
4. Shear rams during first week.
5. Select or purchase replacement ewes.
6. Start cutting hay for next fall sheep and lamb feeding.

For the Production of Late Lambs

October
1. Drench ewes prior to flushing period, about October 20.
2. Flush ewes by turning on good grass pasture.
3. Trim crotch, around dock, and face of ewes.
4. Trim feet on all ewes.

November
1. Turn ram with ewes November 1 to December 15 (November 7 bred ewes lamb April 6).
2. Keep breeding dates. Start record keeping.
3. Observe ewes for condition.
4. Mark ram to check fertility.

December
1. Remove ram from ewe flock about December 15.
2. Feed good mineral mixture in drylot, and iodized salt.
3. Start feeding hay.
4. Provide fresh, ice-free water.
5. Drench all ewes.

January
1. Feed at least 1.8 kg (4 lb) of good quality feed.
2. Check condition of ewes frequently.

February
1. Start feeding grain to ewes about February 15; 0.2 kg (0.5 lb) per ewe daily.
2. Order lambing supplies.
3. Provide plenty warmed water and minerals free choice.

March
1. Increase grain from 0.2-0.3 kg (½-¾ lb) per ewe during March.
2. Shear ewes before lambing.
3. Prepare lambing facilities.

April
1. Check breeding dates for time of lambing.
2. Check ewes daily and give extra care needed.
3. Feed at least 1.8-2.7 kg (4-6 lb) of hay.
4. Dip navels of newborn lambs in iodine.
5. Hold ewes and lambs in barn or lot at least during nights.
6. Feed ewes 0.7-0.9 kg (1.5-2 lb) of grain after lambing.
7. Castrate and dock lambs 7 to 10 days of age.
8. Identify lambs and ewes with numbers.
9. Supply plenty of water.

May
1. Continue feeding ewes with lambs 0.7-0.9 kg (1.5-2 lb) grain.
2. Provide good mineral mixture on pasture.
3. Drench ewes before going to pasture.
4. Treat sheep for exterior parasites.
5. Bring ewes and lambs in at night.
6. Cull out the ewes not raising lambs.

June
1. Drench ewes.
2. Secure replacement ewes.
3. Locate breeding rams from production tested flocks.
4. Cut out all grain on ewes.

July
1. Wean all lambs by 90 - 120 days of age.
2. Drench lambs July 1; drench ewes.
3. Cull unsound and unproductive ewes.
4. Give lambs the better pasture, ewes sparse pasture.
5. Buy meaty, performance tested, purebred rams.
6. Spray lambs for fly-strikes.
7. Shear rams.

August
1. Drench lambs.
2. Rotate pastures, providing lambs the best pasture available.
3. Watch for maggot infestation. Spray for fly-strikes.

September
1. Vaccinate for enterotoxemia.
2. Drench lambs.
3. Buy replacement ewes.
4. Top out choice market lambs weighing 48 - 52 kg (105-115 lb) plus.

October - December
1. Place all unmarketed lambs on self-feeders of hay and protein.
2. Vaccinate lambs for enterotoxemia 10 days before offering grain feed.

APPENDIX III

Additional Information

The following publications are available from the Print Media Branch of Alberta Agriculture.

Agdex 724-3 *High Tensile Smooth Wire Fencing Manual for Alberta.* 1985.
Agdex 724-4 *High Tensile Smooth Wire Electric Fencing.* 1985.

The Farm Building Plan Service provides plans and design information for a wide range of production buildings, storage buildings, and building components and equipment. Most plans are produced by the Canada Plan Service, a cooperative venture of the federal and provincial departments of agriculture. In addition to these, a number of plans have been produced by Alberta Agriculture for specific Alberta requirements.

Each plan is described in a leaflet which outlines the main features of the plan, including a pictorial drawing or floor plan, management information and some construction details. For some items, the leaflet contains all the construction information in which case large plans are not provided. Each extension office has a complete set of these leaflets as well as the popular plans, or they may be ordered from:

Engineering Field Services Branch
Agriculture Centre
Lethbridge, Alberta
T1J 4C7
Phone: (403) 329-5113

Following is a list of the current plans. Those marked (*) are complete plans, the others are for descriptive leaflets only.

The large scale plans are available in limited quantity. Although they may be ordered by mail, it is preferable to obtain them directly from the regional engineering office serving your district. They can offer planning and design assistance, or explain construction details or modifications to a particular plan.

Sheep Housing & Equipment

Number	Plan Title
*4000	Sheep Housing
4111	Pole Frame Sheep Shed
4121	Semi-Confinement Sheep Facilities for 1,000 Ewes
4122	Sheep Drylot Unit
4151	Open-End Pole Sheep Barn, Drive-Through Feeding
4152	Open-End Pole Sheep Barn, Mechanical Feeding
M4154	Slatted Floor Sheep Barn
4311	Lambing Unit
*4391	Stanchion Lambing Pen
*4511	Shearing Facilities
*M4551	Shearing Table
*4552	Shearing Floor and Fleece Sorting Table
*M4553	Fleece Packing Frame
*4611	6-Sided Sheep Feeder
*M4612	Adjustable Feed Bunk Adapted for Sheep
*4613	Fixed Mineral Box
*4614	Portable Mineral Box
*4615	Grain Feeders for Lambs
*4616	Sheep Fenceline Feeder, Steel Posts
*4617	Sheep Fenceline Feeder, Wood Posts
*M4619	Self-Feeder for Concentrate Lamb Rations
*M4621	Hay and Grain Feeder for Sheep
*M4622	Walk Through Sheep Feeder
*M4623	Lamb Creep with Feeder
*4624	Portable Hay Feeding Fence
*4625	Sheep Feed Rack
*M4626	Hanging Self-Feeder
*M4627	Baled Hay Feeder
*4628	Chopped Hay Feeder for Sheep
A4629	Large Round Bale Sheep Feeder
*M4632	Salt and Mineral Feeder
4811	Sheep Corral Unit
*M4812	Working Chute
*4813	Sheep Corral Fencing and Gates
*4814	Weighing Crate and Scale Frame
Q4815	Sheep Spray Chute
*4831	Portable Claiming Pen
*4832	Portable Fence Sections
*M4841	Loading Chute for Double-Decker Truck

CONVERSION FACTORS FOR METRIC SYSTEM

Imperial units	Approximate conversion factor	Results in:	
LINEAR			
inch	x 25	millimetre	(mm)
foot	x 30	centimetre	(cm)
yard	x 0.9	metre	(m)
mile	x 1.6	kilometre	(km)
AREA			
square inch	x 6.5	square centimetre	(cm^2)
square foot	x 0.09	square metre	(m^2)
acre	x 0.40	hectare	(ha)
VOLUME			
cubic inch	x 16	cubic centimetre	(cm^3)
cubic foot	x 28	cubic decimetre	(dm^3)
cubic yard	x 0.8	cubic metre	(m^3)
fluid ounce	x 28	millilitre	(mL)
pint	x 0.57	litre	(L)
quart	x 1.1	litre	(L)
gallon	x 4.5	litre	(L)
WEIGHT			
ounce	x 28	gram	(g)
pound	x 0.45	kilogram	(kg)
short ton (2000 lb)	x 0.9	tonne	(t)
TEMPERATURE			
degrees Fahrenheit	($^oF - 32$) x 0.56 or ($^oF - 32$) x 5/9	degrees Celsius	(^oC)
PRESSURE			
pounds per square inch	x 6.9	kilopascal	(kPa)
POWER			
horsepower	x 746	watt	(W)
	x 0.75	kilowatt	(kW)
SPEED			
feet per second	x 0.30	metres per second	(m/s)
miles per hour	x 1.6	kilometres per hour	(km/h)
AGRICULTURE			
gallons per acre	x 11.23	litres per hectare	(L/ha)
quarts per acre	x 2.8	litres per hectare	(L/ha)
pints per acre	x 1.4	litres per hectare	(L/ha)
fluid ounces per acre	x 70	millilitres per hectare	(mL/ha)
tons per acre	x 2.24	tonnes per hectare	(t/ha)
pounds per acre	x 1.12	kilograms per hectare	(kg/ha)
ounces per acre	x 70	grams per hectare	(g/ha)
plants per acre	x 2.47	plants per hectare	(plants/ha)